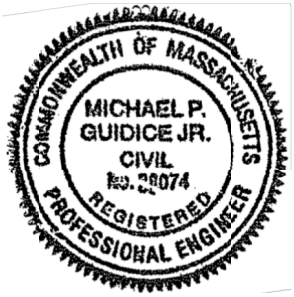
Bid Set

Wastewater Collection and Water Resource Recovery Facilities

Phase 1 – Contract No. 6
Project No. CWSRF-8349/6

Contract Documents and Technical Specifications



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Prepared for:

Town of Yarmouth, MA

Issue Date:

November 2025

CDM Smith

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT 6
PROJECT NO. CWSRF – 8349/6

INVITATION TO BID

Sealed Bids for construction of Wastewater Collection and Water Resource Recovery Facilities, Phase 1 – Contract No. 6 will be received by the Town of Yarmouth, Massachusetts at the Department of Public Works, 74 Town Brook Road, West Yarmouth, MA 02673 until 2:00 PM, December 18, 2025 and at that time bids will be publicly opened and read aloud in the conference room.

The work of this contract includes, but is not limited to, furnishing and installing approximately 10,000 linear feet of 8-inch to 24-inch polyvinyl chloride (PVC) and ductile iron (DI) sewer pipe; 3,000 linear feet of 8-inch and 12-inch PVC force main; two submersible pumping stations; including manholes, sewer service connections and appurtenances; approximately 300 linear feet of 2-inch PVC pressure sewer and appurtenances; approximately 7,000 linear feet of 6-inch to 12-inch Class 52 DI water main; including water service connections, fittings, valves, hydrants, connections to the existing water system, cutting, capping and abandoning existing water mains; earthwork; dewatering and drainage; paving; restoration; and all miscellaneous work and cleanup as specified.

The Contract Time shall be 900 Calendar Days commencing twenty days following the Effective Date of the Agreement.

Contract Documents may be examined and/or obtained online at https://www.yarmouth.ma.us/bids.aspx after 2:00 PM beginning November 19, 2025.

Contract Documents may be examined at, but not removed from, the office of the Town of Yarmouth Department of Public Works (DPW), 74 Town Brook Road, West Yarmouth, MA 02673 and at the office of CDM Smith, 3 Davol Square, Building A, Suite A425, Providence, RI 02903.

Each Bid shall be submitted in accordance with the Instructions to Bidders and shall be accompanied by a Bid Security in the amount of five percent of the Bid.

Bidders may not withdraw their Bids for a period of sixty days, excluding Saturdays, Sundays, and legal holidays after the actual date of the opening of the Bids.

The Successful Bidder must furnish a 100 percent Performance Bond and a 100 percent Payment Bond with a surety company acceptable to the Owner.

Complete instructions for filing Bids are included in the Instructions to Bidders.

Minimum Wage Rates as determined by the Executive Office of Labor and Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Section 26 to 27H, as amended, apply to this project. It is the responsibility of the Contractor, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those tradespeople who may be employed for the proposed work under this Contract. Federal Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

The bidding and award of this Contract will be under the provisions of M.G.L. Chapter 30, Section 39M.

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Massachusetts Department of Transportation (MassDOT) prequalification of contractors with the class of work as, SEWER & WATER, for the project with an estimated value of $23,200,000 will be required.

The Owner reserves the right to waive any informality in or to reject any or all Bids if deemed to be in its best interest.

The work under this Contract is funded in part by the Massachusetts Clean Water Trust (the "Trust").

Procurement Considerations - Six Good Faith Efforts. 40 CFR, Part 33, Subpart C: Pursuant to 40 CFR Section 33.301, the sub-recipient agrees to make good faith efforts whenever procuring construction, equipment, services, and supplies under an EPA financial assistance agreement, and to require that sub-recipients, loan recipients, and prime contractors also comply. Records documenting compliance with the six good faith efforts shall be retained. The specific six good faith efforts can be found at: 40 CFR Section 33.301 (a)-(f).

This Project requires compliance with the Department of Environmental Protection's (DEP) Diesel Retrofit Program by use of after-engine emission controls that are EPA certified, or their equivalent, on all of the off-road (non-registered) diesel vehicles/equipment, and vehicles greater than 50 brake horsepower, which will be used in the performance of the work.

MR. ROBERT WHRITENOUR
TOWN ADMINISTRATOR
TOWN OF YARMOUTH, MASSACHUSETTS

END OF DOCUMENT 001116

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

INSTRUCTIONS TO BIDDERS

ARTICLE 1. QUALIFICATIONS OF BIDDERS

1.1 Bidders may be investigated by OWNER to determine if they are qualified to perform the Work. All Bidders shall be prepared to submit within five days of OWNER's or ENGINEER's request, written evidence of such information and data necessary to make this determination.

1.2 The investigation of a Bidder will seek to determine whether the organization is adequate in size, is authorized to do business in the jurisdiction where the project is located, has had previous experience and whether available equipment and financial resources are adequate to assure OWNER that the Work will be completed in accordance with the terms of the Agreement. The amount of other work to which the Bidder is committed may also be considered.

1.3 In evaluating Bids, OWNER will consider the qualifications of only those Bidders whose Bids are in compliance with the prescribed requirements.

1.4 OWNER reserves the right to reject any Bid if the evidence submitted by, or the investigation of, such Bidder fails to satisfy OWNER that such Bidder is properly qualified to carry out the obligations of the Contract Documents and to complete the Work contemplated therein.

ARTICLE 2. COPIES OF CONTRACT DOCUMENTS

2.1 Complete sets of Contract Documents shall be used in preparing Bids; neither OWNER nor ENGINEER assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Contract Documents.

2.2 OWNER and ENGINEER in making copies of Contract Documents available do so only for the purpose of obtaining Bids on the Work and do not confer a license or grant for any other use.

ARTICLE 3. EXAMINATION OF CONTRACT DOCUMENTS AND SITE

3.1 Before submitting a Bid, each Bidder must (a) examine the Contract Documents thoroughly, (b) visit the site to become familiar with local conditions that may in any manner affect cost, progress or performance of the Work, (c) become familiar with Federal, State and local laws, ordinances, rules and regulations that may in any manner affect cost, progress or performance of the Work; and (d) study and carefully correlate Bidder's observations with the requirements of the Contract Documents.

3.2 Boring locations are indicated in Plan and Profile views on the Drawings. The boring logs are included in the Appendix to the Project Manual.

3.3 Before submitting a Bid, Bidders may, at their own expense, make such additional investigations and tests as they may deem necessary to determine their Bid for performance of the Work in accordance with the time, price and other terms and conditions of the Contract Documents.

3.4 On request, OWNER will provide each Bidder access to the site to conduct such investigations and tests as each Bidder deems necessary for the submission of a Bid.

3.5 The lands upon which the Work is to be performed, rights-of-way for access thereto and other lands designated for use by CONTRACTOR in performing the Work are identified in the Supplementary Conditions, General Requirements or on the Drawings.

3.6 The submission of a Bid will constitute an incontrovertible representation that the Bidder has complied with every requirement of this Article 3 and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.

ARTICLE 4. INTERPRETATIONS

4.1 All questions about the meaning or intent of the Contract Documents shall be received in writing by CDM Smith, 3 Davol Square, Building A, Suite A425, Providence, RI 02903 Attn: Mike Guidice (GuidiceMP@cdmsmith.com), at least ten days before the date set herein for the opening of bids.

4.2 Written clarifications or interpretations will be issued by Addenda not later than five days before the bid opening date. Only questions answered by formal written Addenda will be binding. Oral and other clarifications or interpretations will be without legal effect. Addenda will be posted to the Town website at https://www.yarmouth.ma.us/bids.aspx and be available to all parties recorded as having received the Contract Documents.

4.3 Bidders are responsible for determining that they have received all Addenda issued.

ARTICLE 5. PRE-BID CONFERENCE

5.1 A non-mandatory pre-bid conference may be held between prospective bidders, ENGINEER and OWNER to review the proposed methods of complying with the requirements of the Contract Documents. Prospective bidders will be notified by addendum of the time, date and place if the pre-bid conference will be held.

ARTICLE 6. BID SECURITY

6.1 Each Bid must be accompanied by cash, bid bond, or a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to OWNER. The Bid Security shall be in the amount stated in the Invitation to Bid. Bid Security shall be sealed in a separate envelope from the Bid and then attached to the envelope containing the Bid. All Bid Securities except those of the three lowest responsible and eligible Bidders will be returned within five days, Saturdays, Sundays, and legal holidays excluded, after opening of the Bids. All Bid Securities will be returned on the execution of the Agreement or if no award is made, within sixty days, excluding Saturdays, Sundays and legal holidays after the actual date of opening of the Bids, unless forfeited under the conditions herein stipulated.

6.2 In case a party to whom a Contract is awarded shall fail or neglect to execute the Agreement and furnish the satisfactory bonds within the time specified, OWNER may determine that the Bidder has abandoned the Contract, and thereupon the Bid Forms and acceptance shall be null and void and the Bid Security accompanying the Bid Form shall be forfeited to OWNER as liquidated damages for such failure or neglect and to indemnify said OWNER for any loss which may be sustained by failure of the Bidder to execute the Agreement and furnish the bonds as aforesaid, provided that the amount forfeited to OWNER shall not exceed the difference between the Bid Price of said Bidder and that of the next lowest responsible and eligible bidder and provided further that, in case of death, disability, or other unforeseen

circumstances affecting the Bidder, such Bid Security may be returned to the Bidder. After execution of the Agreement and acceptance of the bonds by OWNER, the Bid Security accompanying the Bid Form of the Successful Bidder will be returned.

ARTICLE 7. PERFORMANCE, PAYMENT AND OTHER BONDS

7.1 Performance, Payment and other Bonds shall be provided in accordance with Article 6 of the Conditions of the Contract.

7.2 All Bonds required as Contract Security shall be furnished with the executed Agreement.

ARTICLE 8. BID FORM

8.1 Each Bid shall be submitted on the Bid Form. All blank spaces for Bid prices must be filled in with the unit price for the item or the lump sum for which the Bid is made.

8.2 Bid Forms shall be completed in ink or by typewriter. The Bid price of each item on the form shall be stated in words, and figures. If unit prices are required on the Bid Form, discrepancies between unit prices and their respective total amounts will be resolved in favor of the unit prices. Discrepancies between words and figures will be resolved in favor of words. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

8.3 Bids by corporations shall be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown below the signature.

8.4 Bids by Limited Liability Companies shall be executed in the Limited Liability name by the Manager (or other Limited Liability Company officer/representative accompanied by evidence of authority to sign.) The Limited Liability Company address and state where the Limited Liability Company was formed shall be shown below the signature.

8.5 Bids by partnerships shall be executed in the partnership name and signed by a partner, whose title shall appear under the signature. The official address of the partnership shall be shown below the signature.

8.6 All names shall be typed or printed below the signature.

8.7 The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which shall be filled in on the Bid Form).

8.8 The address to which communications regarding the Bid are to be directed shall be shown.

8.9 One copy of each Bid shall be submitted in a sealed opaque envelope bearing on the outside the Bidder's name, address, and the Project Title for which the Bid is submitted. (If forwarded by mail, Bid and sealed envelope marked as described above shall be enclosed in another envelope with the notation "BID ENCLOSED" on the face and addressed as indicated in the Invitation to Bid.) The Bid Security shall be submitted in a separate envelope from the Bid and attached to the envelope containing the Bid.

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ARTICLE 9. RECEIPT OF BIDS

9.1 Sealed Bids for the work of this Contract will be received at the time and place indicated in the Invitation to Bid.

9.2 OWNER may consider informal any Bid not prepared and submitted in accordance with the provisions hereof.

9.3 Bidders are cautioned that it is the responsibility of each individual bidder to assure that their bid is in the possession of the responsible official or the designated alternate prior to the stated time and at the place of the Bid Opening. Owner is not responsible for bids delayed by mail and/or delivery services, of any nature.

ARTICLE 10. MODIFICATION AND WITHDRAWAL OF BIDS

10.1 Bids may be modified only by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the opening of Bids.

10.2 Bids may be withdrawn prior to the scheduled time (or authorized postponement thereof) for the opening of Bids.

10.3 Any Bid received after the time and date specified shall not be considered. No Bid may be withdrawn for a period of sixty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids.

ARTICLE 11. AWARD OF CONTRACT

11.1 The Contract will be awarded to the lowest responsible and eligible Bidder (Successful Bidder). Such a Bidder shall possess the skill, ability, and integrity necessary for the faithful performance of the work. The term "lowest responsible and eligible Bidder" as used herein shall mean the Bidder whose Bid is the lowest of those Bidders possessing the skill, ability and integrity necessary to the faithful performance of the Work.

11.2 The Owner may elect to increase the scope of work by selecting, in order, any of the add alternates listed in the Bid Form, such that no single alternate will be considered unless every alternate preceding it on the list has been added to the Base Bid.

11.3 Bidders to be considered responsive shall submit bids on all add alternates listed in the Bid Form. The low bidder will be determined by comparison of the Base Bid and any alternates selected by the Owner.

11.4 Owner reserves the right to reject any and all Bids, to waive any and all informalities if it is in Owner's best interest to do so, and the right to disregard all nonconforming, non-responsive or conditional Bids.

11.5 A Bid which includes for any item a Bid Price that is abnormally low or high may be rejected as unbalanced.

11.6 OWNER also reserves the right to reject the Bid of any Bidder that OWNER considers to be unqualified relative to Article 1 above.

11.7 If the Contract is to be awarded, OWNER will give the Successful Bidder a Notice of Award within sixty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids. All bids shall remain open for sixty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids but OWNER may, at OWNER's sole discretion, release any Bid and return the Bid Security prior to that date.

ARTICLE 12. EXECUTION OF AGREEMENT

12.1 When OWNER gives a Notice of Award to the Successful Bidder, it will be accompanied by at least six unsigned copies of the Agreement and all other applicable Contract Documents. Within five days, excluding Saturdays, Sundays and legal holidays, after the date of receipt of such notification CONTRACTOR shall execute and return all copies of the Agreement and all other applicable Contract Documents to OWNER. Within ten days thereafter OWNER will deliver one fully signed copy to CONTRACTOR.

ARTICLE 13. SAFETY AND HEALTH REGULATIONS

13.1 This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in Title 29 CFR, Part 1926 and to all subsequent amendments, and to any applicable Massachusetts regulations. Contractors shall be familiar with the requirements of these regulations.

13.2 The Successful Bidder shall comply with the Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 (PL-91-596) and under Section 107 of the Contract Work Hours and Safety Standards Act (PL-91-54).

13.3 The Successful Bidder shall have a competent person or persons, as required under the Occupational Safety and Health Act, on the Site to inspect the Work and to supervise the conformance of the Work with the regulations of the Act.

ARTICLE 14. FEDERAL WAGE RATES

14.1 Davis Bacon (DB) Prevailing Wage Requirements

14.1.1 The following clauses shall apply to any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2012 Appropriations Act, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1 (b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(l)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanic's performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein, provided that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(l)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii)(A) The Owner(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known) or their representatives, and the Owner(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the Owner(s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the Owner(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(l)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The Owner(s) shall, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, their correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section l(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(l)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section l(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the Owner, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the Owner shall provide written confirmation in a form

satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(l) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at http://www.dol.gov/esa/whd/forms/wh347instr.htm or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker and shall provide them upon request to the Owner(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the Owner(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or their agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in their first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(l) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3 and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Owner(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither the contractor nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(l).

(11) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(l).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

14.1.2 Contract Provision for Contracts in Excess of $100,000.

(a) Contract Work Hours and Safety Standards Act. The following clauses set forth in paragraphs (a)(l), (2), (3), and (4) of this section in full shall apply to any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall apply in addition to the clauses required by Item 1, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which the contractor is employed on such work to work in

excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(l) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(l) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(l) of this section.

(3) Withholding for unpaid wages and liquidated damages. The Owner, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(l) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(l) through (4) of this section.

(b) In addition to the clauses contained in Item 1, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Owner shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Owner shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

14.1.3 Compliance Verification

(a). The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c). The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d). The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at http://www.dol.gov/esa/contacts/whd/america2.htm.

14.2 It is the responsibility of the Contractor before the bid opening to request, if necessary, any additional information on Federal Wage Rates for those tradespeople who are not covered by the applicable Federal Wage Determination, but who may be employed for the proposed work under this Contract.

14.3 All construction associated with this contract will be governed by Heavy and Highway Rates.

ARTICLE 15. MANUFACTURER'S EXPERIENCE

15.1 Whenever it is written that an equipment manufacturer must have a specified period of experience with its product, equipment which does not meet the specified experience period can be considered if the equipment supplier or manufacturer is willing to provide an Efficiency Guarantee Bond or cash deposit for the duration of the specified time period which will guarantee replacement of that equipment in the event of failure.

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ARTICLE 16. ACCESS TO WORK

16.1 Representatives of the Commonwealth and any local agencies having a direct interest in the Work shall have access to the Work under this contract wherever it is in preparation or progress and the Contractor shall provide proper facilities for such access and inspection.

ARTICLE 17. CHANGE ORDERS

17.1 Change orders will be processed in accordance with the "Change Order Forms" which are included in Part II of the Supplementary Conditions.

ARTICLE 18. SALES TAX

18.1 The material and supplies to be used in the Work will be subject to the requirements of Paragraph 7.09 of the Conditions of the Contract.

ARTICLE 19. UTILITY UNDERGROUND PLANT DAMAGE PREVENTION SYSTEM

19.1 All excavations within public or private ways are subject to the requirements of Massachusetts General Law, Chapter 82, Section 40 included in Part II of the Supplementary Conditions.

ARTICLE 20. WAGE RATES

20.1 Minimum Wage Rates as determined by the Executive Office of Labor and Workforce Development under the provision of the Massachusetts General Laws, Chapter 149, Sections 26 to 27H, as amended, apply to this project. It is the responsibility of the Contractor, before bid opening, to request if necessary, any additional information on Minimum Wage Rates for those trades people who may be employed for the proposed work under this Contract. Federal Minimum Wage Rates as determined by the United States Department of Labor under the Davis-Bacon Act also apply to this project.

20.2 Both Federal and State schedules of minimum wage rates are included in Part II of the Supplementary Conditions. Where rates differ, the higher rate shall be considered as the minimum rate.

ARTICLE 21. COMPETITIVE BIDDING

21.1 The bidding and award of the Contract shall be in full compliance with Section 39 M inclusive of Chapter 30 of the General Laws of the Commonwealth of Massachusetts as last revised.

ARTICLE 22. PRICE ADJUSTMENTS

22.1 Due to the uncertainty of prices for certain materials (liquid asphalt, Portland cement, diesel fuel and gasoline, structural steel and reinforcing steel) price adjustments will be in accordance with Appendix H, which is included in Part 2 of the Supplementary Conditions. The base price for each material shall be the period price in effect at the time the project is advertised. The price adjustment clause shall provide for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 per cent. Period prices can be found at the Massachusetts Department of Transportation (MassDOT) website at
http://www.massdot.state.ma.us/highway/DoingBusinessWithUs/Construction/PriceAdjustments.aspx

ARTICLE 23. GUARANTEE

23.1 The Contractor guarantees that the Work and Services to be performed under the Contract, and all workmanship, materials and equipment performed, furnished, used or installed in the construction of the same shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, Specifications, and other Contract Documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified, and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of completion and acceptance of the Work as stated in the final estimate. If part of the Work is accepted in accordance with that subsection of the AGREEMENT titled "Partial Acceptance," the guarantee for that part of the Work shall be for a period of one year from the date fixed for such acceptance.

23.2 If at any time within the said period of guarantee any part of the Work requires repairing, correction or replacement, the Owner may notify the Contractor in writing to make the required repairs, corrections, or replacements. If the Contractor neglects to commence making such repairs, corrections or replacements to the satisfaction of the Owner within seven days from the date of receipt of such notice or having commenced fails to prosecute such Work with diligence, the Owner may employ other persons to make said repairs, corrections or replacements, and charge the costs, including compensation for additional professional services, to the Contractor.

ARTICLE 24. DEPARTMENT OF ENVIRONMENTAL PROTECTION'S (DEP) DIESEL RETROFIT PROGRAM

24.1 This project is subject to the requirements of the Department of Environmental Protection's Diesel Retrofit Program. Bidders must submit a signed and dated Statement of Intent to Comply form as part of their bid proposal documents. Additional requirements are included in Part II of the Supplementary Conditions.

ARTICLE 25. SUSPENSE AND DEBARMENT

25.1 Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at www.usgovxml.com/dataservice.aspx?ds=EPLS are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

ARTICLE 26. MASSACHUSETTS GENERAL LAWS AND REGULATIONS

26.1 Applicable provisions of Massachusetts General Laws and Regulations and/or the United States Code and Code of Federal Regulations govern this Contract and any provision in violation of the foregoing shall be deemed null, void and of no effect. Where conflict between Code of Federal Regulations and State Laws and Regulations exists, the more stringent requirement shall apply.

ARTICLE 27. AMERICAN IRON AND STEEL REQUIREMENT

27.1 This project is subject to the American Iron and Steel Requirements of P.L. 113-76, the Consolidated Appropriations Act of 2014.

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ARTICLE 28. BUILD AMERICA, BUY AMERICA (BABA) REQUIREMENTS

28.1 BABA implementation is not required for this project as the project is not receiving federal assistance based on EPA's Build America, Buy America Act Implementation Procedures for EPA Office of Water Federal Financial Assistance Programs Memorandum issued November 3, 2022.

MR. ROBERT WHRITENOUR
TOWN ADMINISTRATOR
TOWN OF YARMOUTH, MASSACHUSETTS

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BID FORM
TO
TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF-8349/6

The undersigned declares that the only persons or parties interested in this Bid as principals are as stated; that the Bid is made without any collusion with other persons, firms, or corporations; that all the Contract Documents as prepared by CDM Smith, 3 Davol Square, Building A, Suite A425, Providence, RI 02903 and dated November 2025 have been carefully examined; that the undersigned is fully informed in regard to all conditions pertaining to the Work and the place where it is to be done, and from them the undersigned makes this Bid. These prices shall cover all expenses incurred in performing the Work required under the Contract Documents, of which this Bid Form is a part.

The Contract will be awarded to the lowest responsible and eligible bidder (Successful Bidder) based on the Total Base Bid or the Total Base Bid plus Bid Alternate No. 1 or the Total Base Bid plus Bid Alternate No. 1 and Bid Alternate No. 2; whose Bid, conforming to the solicitation, will be most advantageous to the OWNER, considering only price, and any price related factors specified in this solicitation.

The time period for holding bids, where Federal approval is not required is 60 days, Saturdays, Sundays and legal holidays excluded, after the opening of bids and where Federal approved is required, the time period for holding bids is 60 days, Saturdays, Sundays and holidays excluded after Federal approval.

The Bid Security accompanying this Bid shall be in the amount of five percent of the Bid.

If a Notice of Award accompanied by at least six unsigned copies of the Agreement and all other applicable Contract Documents is delivered to the undersigned within sixty days, excluding Saturdays, Sundays, and legal holidays, after the actual date of the opening of the Bids, the undersigned will within five days, excluding Saturdays, Sundays, and legal holidays, after the date of receipt of such notification, execute and return all copies of the Agreement and all other applicable Contract Documents to Owner. The premiums for all Bonds required shall be paid by Contractor and shall be included in the Contract Price. The undersigned Bidder further agrees that the Bid Security accompanying this Bid shall become the property of Owner if the Bidder fails to execute the Agreement as stated above.

The Bid Security shall be sealed in a separate envelope from the Bid and then attached to the envelope containing the Bid.

The undersigned hereby agrees that the Contract Time shall commence twenty days following the Effective Date of the Agreement and to fully complete the Work within 900 Calendar Days and in accordance with the terms as stated in the Agreement. The undersigned further agrees to pay OWNER, as liquidated damages, $2,000 per day for each calendar day beyond the Contract Time Limit or extension thereof that the Work remains incomplete, in accordance with the terms of the Agreement.

The undersigned acknowledges receipt of addenda numbered: _____

In accordance with the above understanding, the undersigned proposes to perform the Work, furnish all materials and complete the Work in its entirety in the manner and under the conditions required at the prices listed as follows:

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
1a	60 lin. ft.	Furnish and install 24-in PVC sewer pipe including excavation and backfill, all depths _____ per linear foot	$_____	$_____
1b	310 lin. ft.	Furnish and install 12-in PVC sewer pipe including excavation and backfill, all depths _____ per linear foot	$_____	$_____
1c	160 lin. ft.	Furnish and install 10-in PVC sewer pipe including excavation and backfill, at depths up to 16-ft deep _____ per linear foot	$_____	$_____
1d	450 lin. ft.	Furnish and install 10-in PVC sewer pipe including excavation and backfill, at depths greater than 16-ft _____ per linear foot	$_____	$_____
1e	1,500 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, 0 to 12-ft depth _____ per linear foot	$_____	$_____
1f	740 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, at depths greater than 12-ft up to 16-ft deep _____ per linear foot	$_____	$_____

Subtotal Page 004113-2 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
1g	90 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, at depths greater than 16-ft _____ per linear foot	$_____	$_____
1h	2,970 lin. ft.	Furnish and install 12-in PVC force main pipe including excavation and backfill, all depths _____ per linear foot	$_____	$_____
1i	680 lin. ft.	Furnish and install 6-in PVC and/or DI sewer service pipe including excavation and backfill, all depths _____ per linear foot	$_____	$_____
1j	35 each	Furnish and install 6-in PVC wye branches and/or 6-in DI tees _____ per each	$_____	$_____
1k	5 vert. ft.	Furnish and install PVC drop connections including fittings, all types and sizes _____ per vertical foot	$_____	$_____
1l	50 vert. ft.	Furnish and install 6-in DI chimneys including fittings _____ per vertical foot	$_____	$_____

Subtotal Page 004113-3 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
2a	240 vert. ft.	Furnish and install 4-ft diameter precast concrete sewer manholes _____ per vertical foot	$_____	$_____
2b	55 vert. ft.	Furnish and install 5-ft diameter precast concrete sewer manholes _____ per vertical foot	$_____	$_____
2c	1 each	Furnish and install automatic air release valve precast concrete manhole including valve and fittings _____ per each	$_____	$_____
2d	1 each	Furnish and install precast concrete force main cleanout manhole including fittings _____ each	$_____	$_____
3a	50 lin. ft.	Miscellaneous drain pipe replacements, all sizes and depths _____ per linear foot	$_____	$_____
3b	50 lin. ft.	Miscellaneous water main replacements, all sizes and depths Fifty Dollars per linear foot	$ 50.00	$ 2,500.00

Subtotal Page 004113-4 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
3c	50 lin. ft.	Additional payment for miscellaneous water main replacements over the established price, all sizes and depths _____ per linear foot	$_____	$_____
3d	100 lin. ft.	Furnish, install and remove 2-in and 4-in temporary water pipe _____ per linear foot	$_____	$_____
4a	L.S	Furnish and install Pumping Station No. 2 (PS2) with on-site generator _____ lump sum		$_____
4b	Allowance	Allowance for installation of electric and gas service at PS2 by utility companies Twenty Thousand Dollars allowance		$ 20,000.00
5	25 cu. yds.	Test Pits _____ per cubic yard	$_____	$_____
6a	25 cu. yds.	Rock and Boulder Excavation Sixty-Five Dollars per cubic yard	$ 65.00	$ 1,625.00
6b	25 cu. yds.	Additional payment for rock and boulder excavation over the established price _____ per cubic yard	$_____	$_____

Subtotal Page 004113-5 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
7a	2,100 cu. yds.	Bank run gravel/gravel borrow _____ per cubic yard	$_____	$_____
7b	50 cu. yds.	Screened gravel for utility crossings and miscellaneous purposes _____ per cubic yard	$_____	$_____
7c	50 cu. yds.	Common Fill _____ per cubic yard	$_____	$_____
7d	560 cu. yds.	Dense graded crushed stone for pavement base (Route 28) _____ per cubic yard	$_____	$_____
7e	15 cu. yds.	Earth excavation and refill below normal grade _____ per cubic yard	$_____	$_____
8a	300 Tons	Management and disposal of excavated material at <RCS-1 disposal facility _____ per cubic yard	$_____	$_____
8b	2,000 Tons	Management and disposal of excavated material at in-state unlined landfill _____ per cubic yard	$_____	$_____

Subtotal Page 004113-6 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
8c	150 Tons	Management and disposal of excavated material at in-state lined landfill _____ per cubic yard	$_____	$_____
8d	150 Tons	Management and disposal of excavated material at an out-of-state facility _____ per cubic yard	$_____	$_____
8e	500 Tons	Management and disposal of excavated material at RCRA hazardous waste disposal facility _____ per cubic yard	$_____	$_____
9a	800 sq. yds.	Furnish and install initial trench width HMA Binder Course, 4-in thick (Town roads) _____ per square yard	$_____	$_____
9b	3,900 sq. yds.	Furnish and install initial trench width plus 1-foot HMA, 3-in thick (Route 28) _____ per square yard	$_____	$_____
9c	4,470 sq. yds.	Furnish and install permanent trench width plus 2-feet HMA, 10-in thick (Route 28) _____ per square yard	$_____	$_____
10	L.S.	Traffic Management _____ Lump sum		$_____

Subtotal Page 004113-7 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
11	L.S.	Sedimentation and Erosion Control _____ Lump sum		$_____
12	L.S.	Dewatering and Drainage _____ Lump sum		$_____
13	25 cu. yds.	Miscellaneous concrete _____ per cubic yard	$_____	$_____
14a	20 hours	Street sweeper _____ per hour	$_____	$_____
14b	30 months	Furnish, maintain and remove two (2) trailer-mounted message boards _____ per month	$_____	$_____
15	30 months	Engineer's field office _____ per month	$_____	$_____
16	L.S.	Miscellaneous Work and Cleanup _____ Lump sum		$_____

Subtotal Page 004113-8 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 2
PROJECT NO. CWSRF – 8349/2

BASE BID ELIGIBLE WORK (PART A - SEWER)

SUBTOTAL PAGE 004113-8	$_____
SUBTOTAL PAGE 004113-7	$_____
SUBTOTAL PAGE 004113-6	$_____
SUBTOTAL PAGE 004113-5	$_____
SUBTOTAL PAGE 004113-4	$_____
SUBTOTAL PAGE 004113-3	$_____
SUBTOTAL PAGE 004113-2	$_____

SUBTOTAL ELIGIBLE (PART A) BASE BID PRICE $_____

17	L.S.	Mobilization - not to exceed 5% of Subtotal Eligible Base Bid Price above _____ Lump sum	$_____

TOTAL ELIGIBLE (PART A) BASE BID PRICE $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
18a	2,700 lin. ft	Furnish and install 12-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____	$_____
18b	280 lin. ft	Furnish and install 8-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____	$_____
18c	120 lin. ft	Furnish and install 6-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____	$_____
19a	4,600 lbs.	Furnish and install compact ductile iron pipe fittings, all sizes _____ per pound	$_____	$_____
19b	1 each	Furnish and install 16-in couplings _____ each	$_____	$_____
19c	1 each	Furnish and install 12-in couplings _____ each	$_____	$_____
19d	5 each	Furnish and install 8-in couplings _____ each	$_____	$_____

Subtotal Page 004113-10 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
19e	6 each	Furnish and install 6-in couplings _____ each	$_____	$_____
20a	11 each	Furnish and install 12-in gate valves and boxes _____ each	$_____	$_____
20b	8 each	Furnish and install 8-in gate valves and boxes _____ each	$_____	$_____
20c	4 each	Furnish and install 6-in gate valves and boxes _____ each	$_____	$_____
21a	5 each	Furnish and install 12” x 8” tapping sleeves and valves _____ each	$_____	$_____
21b	1 each	Furnish and install 12” x 6” tapping sleeves and valves _____ each	$_____	$_____
21c	2 each	Furnish and install 6” and 8” insertion valves _____ each	$_____	$_____

Subtotal Page 004113-11 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
21d	2 each	Furnish and install 12" and 16" insertion valves _____ each	$_____	$_____
22a	4 each	Furnish and install new hydrant assemblies including all associated fittings, connecting pipe, gate valves, thrust restraint and joint restraint as necessary _____ each	$_____	$_____
22b	L.S.	Remove, deliver and stack existing hydrants at the Town of Yarmouth's Water Department yard _____ Lump sum		$_____
23a	130 lin. ft	Furnish and install 2-in PVC service tubing including earth excavation and backfill _____ per linear foot	$_____	$_____
23b	500 lin. ft	Furnish and install 1-in PVC service tubing including earth excavation and backfill _____ per linear foot	$_____	$_____
24a	3 ea. set	Furnish and install 2-in corporation cocks and curb stops with boxes, including excavation and backfill (includes testing taps) _____ each set	$_____	$_____

Subtotal Page 004113-12 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
24b	20 ea. set	Furnish and install 1-in corporation cocks and curb stops with boxes, including excavation and backfill (includes testing taps)		
		_____ each set	$_____	$_____
25a	860 cu. yds.	Bank-run gravel/gravel borrow for pavement, driveway and sidewalk base		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7a)	$_____
25b	20 cu. yds.	Screened gravel		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7b)	$_____
25c	40 cu. yds.	Common fill		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7c)	$_____
25d	280 cu. yds.	Dense graded crushed stone for pavement base (Route 28)		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7d)	$_____
25e	20 cu. yds	Excavation below normal grade including gravel refill		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7e)	$_____

Subtotal Page 004113-13 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
26a	200 sq. yds.	Furnish and install initial trench width HMA Binder Course, 4-in thick (Town Roads)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9a)	$_____
26b	2,500 sq. yds.	Furnish and install initial trench width plus 1-foot HMA, 3-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9b)	$_____
26c	3,200 sq. yds.	Furnish and install permanent trench width plus 2-feet HMA, 10-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9c)	$_____
27	10 cu. yds	Miscellaneous concrete		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 13)	$_____
28	5 cu. yds	Test pits		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 5)	$_____

Subtotal Page 004113-14 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BASE BID INELIGIBLE WORK (PART B - WATER)

SUBTOTAL PAGE 004113-14	$_____
SUBTOTAL PAGE 004113-13	$_____
SUBTOTAL PAGE 004113-12	$_____
SUBTOTAL PAGE 004113-11	$_____
SUBTOTAL PAGE 004113-10	$_____
TOTAL INELIGIBLE (PART B) BASE BID PRICE	$_____
TOTAL ELIGIBLE (PART A) BASE BID PRICE	$_____
TOTAL BASE BID PRICE	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
29a	1,320 lin. ft.	Furnish and install 18-in PVC sewer pipe including excavation and backfill, at depths up to 12-ft deep _____ per linear foot	$_____	$_____
29b	730 lin. ft.	Furnish and install 18-in PVC sewer pipe including excavation and backfill, at depths greater than 12-ft _____ per linear foot	$_____	$_____
29c	290 lin. ft.	Furnish and install 15-in PVC sewer pipe including excavation and backfill, at depths up to 16-ft deep _____ per linear foot	$_____	$_____
29d	120 lin. ft.	Furnish and install 15-in PVC sewer pipe including excavation and backfill, at depths greater than 16-ft _____ per linear foot	$_____	$_____
29e	500 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, 0 to 12-ft depth _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 1e)	$_____

Subtotal Page 004113-16 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
29f	100 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, at depths greater than 12-ft up to 16-ft depth _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 1f)	$_____
29g	520 lin. ft.	Furnish and install 6-in PVC and/or DI sewer service pipe including excavation and backfill, all depths _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 1i)	$_____
29h	18 each	Furnish and install 6-in PVC wye branches and/or 6-in DI tees _____ each	$_____ (Transfer Unit Bid Price from Item 1j)	$_____
29i	20 vert. ft.	Furnish and install PVC internal drop connections including fittings, all types and sizes _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 1k)	$_____
29j	10 vert. ft.	Furnish and install 6-in DI chimneys including fittings _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 1l)	$_____

Subtotal Page 004113-17 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
30a	200 vert. ft.	Furnish and install 4-ft diameter precast concrete sewer manholes _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 2a)	$_____
30b	35 vert. ft.	Furnish and install 5-ft diameter precast concrete sewer manholes _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 2b)	$_____
31a	25 lin. ft.	Miscellaneous drain pipe replacements, all sizes and depths _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 3a)	$_____
31b	25 lin. ft.	Miscellaneous water main replacements, all sizes and depths Fifty Dollars per linear foot	$ 50.00	$ 1,250.00
31c	25 lin. ft.	Additional payment for miscellaneous water main replacements over the established price, all sizes and depths _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 3c)	$_____

Subtotal Page 004113-18 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
32	25 cu. yds.	Test Pits _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 5)	$_____
33a	10 cu. yds.	Rock and Boulder Excavation Sixty-Five Dollars per cubic yard	$ 65.00	$ 650.00
33b	10 cu. yds.	Additional payment for rock and boulder excavation over the established price _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 6b)	$_____
34a	1,900 cu. yds.	Bank run gravel/gravel borrow _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7a)	$_____
34b	25 cu. yds.	Screened gravel for utility crossings and miscellaneous purposes _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7b)	$_____
34c	25 cu. yds.	Common Fill _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7c)	$_____

Subtotal Page 004113-19 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
34d	470 cu. yds.	Dense graded crushed stone for pavement base (Route 28)		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7d)	$_____
35	10 cu. yds.	Earth excavation and refill below normal grade		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7e)	$_____
36a	710 sq. yds.	Furnish and install initial trench width HMA Binder Course, 4-in thick (Town Roads)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9a)	$_____
36b	3,900 sq. yds.	Furnish and install initial trench width plus 1-foot HMA, 3-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9b)	$_____
36c	4,200 sq. yds.	Furnish and install permanent trench width plus 2-feet HMA, 10-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9c)	$_____
37	L.S.	Traffic Management		
		_____ Lump sum		$_____

Subtotal Page 004113-20 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
38	L.S.	Sedimentation and Erosion Control _____ Lump sum		$_____
39	L.S.	Dewatering and Drainage _____ Lump sum		$_____
40	10 cu. yds.	Miscellaneous concrete _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 13)	$_____
41	8 hours	Street sweeper _____ per hour	$_____ (Transfer Unit Bid Price from Item 14a)	$_____
42	L.S.	Miscellaneous Work and Cleanup _____ Lump sum		$_____

Subtotal Page 004113-21 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 2
PROJECT NO. CWSRF – 8349/2

ADD ALTERNATE NO. 1 ELIGIBLE WORK (PART A - SEWER)

SUBTOTAL PAGE 004113-21	$_____
SUBTOTAL PAGE 004113-20	$_____
SUBTOTAL PAGE 004113-19	$_____
SUBTOTAL PAGE 004113-18	$_____
SUBTOTAL PAGE 004113-17	$_____
SUBTOTAL PAGE 004113-16	$_____
TOTAL ELIGIBLE (PART A) ALTERNATE NO. 1 BID PRICE	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
43a	2,310 lin. ft	Furnish and install 12-inch cement lined ductile iron water main Class 52, including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 18a)	$_____
43b	360 lin. ft	Furnish and install 8-inch cement lined ductile iron water main Class 52, including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 18b)	$_____
43c	90 lin. ft	Furnish and install 6-inch cement lined ductile iron water main Class 52, including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 18c)	$_____
44a	6,700 lbs.	Furnish and install compact ductile iron pipe fittings, all sizes		
		_____ per pound	$_____ (Transfer Unit Bid Price from Item 19a)	$_____
44b	5 each	Furnish and install 8-in couplings		
		_____ each	$_____ (Transfer Unit Bid Price from Item 19d)	$_____
44c	6 each	Furnish and install 6-in couplings		
		_____ each	$_____ (Transfer Unit Bid Price from Item 19e)	$_____

Subtotal Page 004113-23 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
45a	9 each	Furnish and install 12-in gate valves and boxes		
		_____ each	$_____ (Transfer Unit Bid Price from Item 20a)	$_____
45b	8 each	Furnish and install 8-in gate valves and boxes		
		_____ each	$_____ (Transfer Unit Bid Price from Item 20b)	$_____
45c	4 each	Furnish and install 6-in gate valves and boxes		
		_____ each	$_____ (Transfer Unit Bid Price from Item 20c)	$_____
46a	3 each	Furnish and install 12” x 8” tapping sleeves and valves		
		_____ each	$_____ (Transfer Unit Bid Price from Item 21a)	$_____
46b	1 each	Furnish and install 12” x 6” tapping sleeves and valves		
		_____ each	$_____ (Transfer Unit Bid Price from Item 21b)	$_____

Subtotal Page 004113-24 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
47	7 each	Furnish and install new hydrant assemblies including all associated fittings, connecting pipe, gate valves, thrust restraint and joint restraint as necessary		
		_____ each	$_____ (Transfer Unit Bid Price from Item 22a)	$_____
48a	110 lin. ft	Furnish and install 2-in PVC service tubing including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 23a)	$_____
48b	460 lin. ft	Furnish and install 1-in PVC service tubing including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 23b)	$_____
49a	3 ea. set	Furnish and install 2-in corporation cocks and curb stops with boxes, including excavation and backfill (includes testing taps)		
		_____ each set	$_____ (Transfer Unit Bid Price from Item 24a)	$_____
49b	21 ea. set	Furnish and install 1-in corporation cocks and curb stops with boxes, including excavation and backfill (includes testing taps)		
		_____ each set	$_____ (Transfer Unit Bid Price from Item 24b)	$_____

Subtotal Page 004113-25 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
50a	850 cu. yds.	Bank-run gravel/gravel borrow for pavement, driveway and sidewalk base		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7a)	$_____
50b	50 cu. yds.	Screened gravel		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7b)	$_____
50c	40 cu. yds.	Common fill		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7c)	$_____
50d	270 cu. yds.	Dense graded crushed stone for pavement base (Route 28)		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7d)	$_____
50e	20 cu. yds	Excavation below normal grade including gravel refill		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7e)	$_____
51a	100 sq. yds.	Furnish and install initial trench width HMA Binder Course, 4-in thick (Town Roads)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9a)	$_____

Subtotal Page 004113-26 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 1 INELIGIBLE WORK (PART B - WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
51b	2,350 sq. yds.	Furnish and install initial trench width plus 1-foot HMA, 3-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9b)	$_____
51c	2,950 sq. yds.	Furnish and install permanent trench width plus 2-feet HMA, 10-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9c)	$_____
52	10 cu. yds	Miscellaneous concrete		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 13)	$_____
53	10 cu. yds	Test pits		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 5)	$_____

Subtotal Page 004113-27 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 2
PROJECT NO. CWSRF – 8349/2

ADD ALTERNATE NO. 1 INELIGIBLE WORK (PART B - WATER)

SUBTOTAL PAGE 004113-27	$_____
SUBTOTAL PAGE 004113-26	$_____
SUBTOTAL PAGE 004113-25	$_____
SUBTOTAL PAGE 004113-24	$_____
SUBTOTAL PAGE 004113-23	$_____
TOTAL INELIGIBLE (PART B) ALTERNATE NO. 1 BID PRICE	$_____
TOTAL ELIGIBLE (PART A) ALTERNATE NO. 1 BID PRICE	$_____
TOTAL ALTERNATE NO. 1 BID PRICE	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
54a	1,000 lin. ft.	Furnish and install 15-in PVC sewer pipe including excavation and backfill, at depths up to 12-ft deep _____ per linear foot	$_____	$_____
54b	750 lin. ft.	Furnish and install 15-in PVC sewer pipe including excavation and backfill, at depths greater than 12-ft up to 16-ft deep _____ per linear foot	$_____	$_____
54c	620 lin. ft.	Furnish and install 15-in PVC sewer pipe including excavation and backfill, at depths greater than 16-ft _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 29d)	$_____
54d	990 lin. ft.	Furnish and install 12-in PVC sewer pipe including excavation and backfill, all depths _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 1b)	$_____
54e	680 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, 0 to 12-ft depth _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 1e)	$_____

Subtotal Page 004113-29 $_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
54f	50 lin. ft.	Furnish and install 8-in PVC sewer pipe including excavation and backfill, at depths greater than 12-ft _____ per linear foot	$_____	$_____
54g	370 lin. ft.	Furnish and install 8-in PVC force main pipe including excavation and backfill, all depths _____ per linear foot	$_____	$_____
54h	860 lin. ft.	Furnish and install 6-in PVC and/or DI sewer service pipe including excavation and backfill, all depths _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 1i)	$_____
54i	33 each	Furnish and install 6-in PVC wye branches and/or 6-in DI tees _____ each	$_____ (Transfer Unit Bid Price from Item 1j)	$_____
54j	10 vert. ft.	Furnish and install PVC internal drop connections including fittings, all types and sizes _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 1k)	$_____

Subtotal Page 004113-30 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
54k	60 vert. ft.	Furnish and install 6-in DI chimneys including fittings _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 1l)	$_____
54l	350 lin. ft.	Furnish and install 2-in PVC pressure sewer pipe including excavation and backfill, all depths _____ per linear foot	$_____	$_____
54m	50 lin. ft.	Furnish and install 1.5-in PVC pressure sewer service pipe including excavation and backfill and valves, all depths _____ per linear foot	$_____	$_____
54n	2 each	Furnish and install pressure sewer cleanout/flushing structures including valves and fittings, all types and sizes _____ each	$_____	$_____
54o	1 each	Furnish and install 2-in PVC pressure sewer ball valves _____ each	$_____	$_____
55a	200 vert. ft.	Furnish and install 4-ft diameter precast concrete sewer manholes _____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 2a)	$_____

Subtotal Page 004113-31 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
55b	35 vert. ft.	Furnish and install 5-ft diameter precast concrete sewer manholes		
		_____ per vertical foot	$_____ (Transfer Unit Bid Price from Item 2b)	$_____
56a	20 lin. ft.	Miscellaneous drain pipe replacements, all sizes and depths		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 3a)	$_____
56b	50 lin. ft.	Miscellaneous water main replacements, all sizes and depths		
		Fifty Dollars per linear foot	$ 50.00	$ 2,500.00
56c	50 lin. ft.	Additional payment for miscellaneous water main replacements over the established price, all sizes and depths		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 3c)	$_____
57a	L.S	Furnish and install Pumping Station No. 1 (PS1) with on-site generator		
		_____ lump sum		$_____
57b	Allowance	Allowance for installation of electric and gas service at PS1 by utility companies		
		Twenty Thousand Dollars allowance		$ 20,000

Subtotal Page 004113-32 $_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
58	10 cu. yds.	Test Pits _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 5)	$_____
59a	10 cu. yds.	Rock and Boulder Excavation Sixty-Five Dollars per cubic yard	$ 65.00	$ 650.00
59b	10 cu. yds.	Additional payment for rock and boulder excavation over the established price _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 6b)	$_____
60a	2,900 cu. yds.	Bank run gravel/gravel borrow _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7a)	$_____
60b	25 cu. yds.	Screened gravel for utility crossings and miscellaneous purposes _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7b)	$_____
60c	25 cu. yds.	Common fill _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7c)	$_____

Subtotal Page 004113-33 $_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
60d	720 cu. yds.	Dense graded crushed stone for pavement base (Route 28) _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7d)	$_____
60e	10 cu. yds.	Earth excavation and refill below normal grade _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7e)	$_____
61a	750 sq. yds.	Furnish and install initial trench width HMA Binder Course, 4-in thick (Town Roads) _____ per square yard	$_____ (Transfer Unit Bid Price from Item 9a)	$_____
61b	5,400 sq. yds.	Furnish and install initial trench width plus 1-foot HMA, 3-in thick (Route 28) _____ per square yard	$_____ (Transfer Unit Bid Price from Item 9b)	$_____
61c	6,400 sq. yds.	Furnish and install permanent trench width plus 2-feet HMA, 10-in thick (Route 28) _____ per square yard	$_____ (Transfer Unit Bid Price from Item 9c)	$_____
62	L.S.	Traffic Management _____ Lump sum		$_____

Subtotal Page 004113-34 $_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
63	L.S.	Sedimentation and Erosion Control _____ Lump sum		$_____
64	L.S.	Dewatering and Drainage _____ Lump sum		$_____
65	10 cu. yds.	Miscellaneous concrete _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 13)	$_____
66	8 hours	Street sweeper _____ per hour	$_____ (Transfer Unit Bid Price from Item 14a)	$_____
67	L.S.	Miscellaneous Work and Cleanup _____ Lump sum		$_____

Subtotal Page 004113-35 $_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 ELIGIBLE WORK (PART A - SEWER)

SUBTOTAL PAGE 004113-35	$_____
SUBTOTAL PAGE 004113-34	$_____
SUBTOTAL PAGE 004113-33	$_____
SUBTOTAL PAGE 004113-32	$_____
SUBTOTAL PAGE 004113-31	$_____
SUBTOTAL PAGE 004113-30	$_____
SUBTOTAL PAGE 004113-29	$_____
TOTAL ELIGIBLE (PART A) ALTERNATE NO. 2 BID PRICE	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 INELIGIBLE WORK (PART B – WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
68a	750 lin. ft	Furnish and install 16-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____	$_____
68b	50 lin. ft	Furnish and install 12-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 18a)	$_____
68c	250 lin. ft	Furnish and install 8-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 18b)	$_____
68d	90 lin. ft	Furnish and install 6-inch cement lined ductile iron water main Class 52, including earth excavation and backfill _____ per linear foot	$_____ (Transfer Unit Bid Price from Item 18c)	$_____
69a	6,500 lbs.	Furnish and install compact ductile iron pipe fittings, all sizes _____ per pound	$_____ (Transfer Unit Bid Price from Item 19a)	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 INELIGIBLE WORK (PART B – WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
69b	3 each	Furnish and install 16-in couplings _____ each	$_____ (Transfer Unit Bid Price from Item 19b)	$_____
69c	4 each	Furnish and install 12-in couplings _____ each	$_____ (Transfer Unit Bid Price from Item 19c)	$_____
69d	3 each	Furnish and install 8-in couplings _____ each	$_____ (Transfer Unit Bid Price from Item 19d)	$_____
69e	2 each	Furnish and install 6-in couplings _____ each	$_____ (Transfer Unit Bid Price from Item 19e)	$_____
70a	5 each	Furnish and install 16-in gate valves and boxes _____ each	$_____	$_____
70b	1 each	Furnish and install 12-in gate valves and boxes _____ each	$_____ (Transfer Unit Bid Price from Item 20a)	$_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 INELIGIBLE WORK (PART B – WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
70c	4 each	Furnish and install 8-in gate valves and boxes		
		_____ each	$_____ (Transfer Unit Bid Price from Item 20b)	$_____
70d	1 each	Furnish and install 6-in gate valves and boxes		
		_____ each	$_____ (Transfer Unit Bid Price from Item 20c)	$_____
71a	1 each	Furnish and install 16” x 6” tapping sleeves and valves		
		_____ each	$_____	$_____
71b	1 each	Furnish and install 12” x 8” tapping sleeves and valves		
		_____ each	$_____ (Transfer Unit Bid Price from Item 21a)	$_____
71c	1 each	Furnish and install 12” and 16” insertion valve		
		_____ each	$_____ (Transfer Unit Bid Price from Item 21d)	$_____
72	5 each	Furnish and install new hydrant assemblies including all associated fittings, connecting pipe, gate valves, thrust restraint and joint restraint as necessary		
		_____ each	$_____ (Transfer Unit Bid Price from Item 22a)	$_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 INELIGIBLE WORK (PART B – WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
73a	80 lin. ft	Furnish and install 2-in PVC service tubing including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 23a)	$_____
73b	1,150 lin. ft	Furnish and install 1-in PVC service tubing including earth excavation and backfill		
		_____ per linear foot	$_____ (Transfer Unit Bid Price from Item 23b)	$_____
74a	4 ea. set	Furnish and install 2-in corporation cocks and curb stops with boxes, including excavation and backfill (includes testing taps)		
		_____ each set	$_____ (Transfer Unit Bid Price from Item 24a)	$_____
74b	35 ea. set	Furnish and install 1-in corporation cocks and curb stops with boxes, including excavation and backfill (includes testing taps)		
		_____ each set	$_____ (Transfer Unit Bid Price from Item 24b)	$_____
75a	2,100 cu. yds.	Bank-run gravel/gravel borrow for pavement, driveway and sidewalk base		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7a)	$_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 INELIGIBLE WORK (PART B – WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
75b	30 cu. yds.	Screened gravel _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7b)	$_____
75c	20 cu. yds.	Common fill _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7c)	$_____
75d	670 cu. yds.	Dense graded crushed stone for pavement base (Route 28) _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7d)	$_____
75e	10 cu. yds	Excavation below normal grade including gravel refill _____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 7e)	$_____
76a	40 sq. yds.	Furnish and install initial trench width HMA Binder Course, 4-in thick (Town Roads) _____ per square yard	$_____ (Transfer Unit Bid Price from Item 9a)	$_____
76b	1,350 sq. yds.	Furnish and install initial trench width plus 1-foot HMA, 3-in thick (Route 28) _____ per square yard	$_____ (Transfer Unit Bid Price from Item 9b)	$_____

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WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

ADD ALTERNATE NO. 2 INELIGIBLE WORK (PART B – WATER)

Item No.	Estimated Quantity	Brief Description of Items With Unit Price Bid in Words	Unit Bid Price in Figures	Amount in Figures
76c	1,600 sq. yds.	Furnish and install permanent trench width plus 2-feet HMA, 10-in thick (Route 28)		
		_____ per square yard	$_____ (Transfer Unit Bid Price from Item 9c)	$_____
77	10 cu. yds	Miscellaneous concrete		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 13)	$_____
78	10 cu. yds	Test pits		
		_____ per cubic yard	$_____ (Transfer Unit Bid Price from Item 5)	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BID SUMMARY

SUBTOTAL PAGE 004113-42	$_____
SUBTOTAL PAGE 004113-41	$_____
SUBTOTAL PAGE 004113-40	$_____
SUBTOTAL PAGE 004113-39	$_____
SUBTOTAL PAGE 004113-38	$_____
SUBTOTAL PAGE 004113-37	$_____
TOTAL INELIGIBLE (PART B) ALTERNATE NO. 2 BID PRICE	$_____
TOTAL ELIGIBLE (PART A) ALTERNATE NO. 2 BID PRICE	$_____
TOTAL ALTERNATE NO. 2 BID PRICE	$_____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

BID SUMMARY

TOTAL BASE BID

TOTAL BASE BID PRICE	$_____

TOTAL BASE BID + ALTERNATE NO. 1

TOTAL BASE BID PRICE	$_____
+ Alternate No. 1 Bid Price	$_____
TOTAL BID PRICE (Total Base Bid plus Alternate No. 1 Bid Price)	$_____

TOTAL BASE BID + ALTERNATE NO. 1 & 2

TOTAL BASE BID PRICE	$_____
+ Alternate No. 1 Bid Price	$_____
+ Alternate No. 2 Bid Price	$_____
TOTAL BID PRICE (Total Base Bid plus Alternate No. 1 & Alternate No. 2 Bid Price)	$_____

NOTE: Award will be based on the Total Base Bid; Total Base Bid plus Alternate No. 1; or Total Base Bid plus Alternate No. 1 and Alternate No. 2 as selected by the OWNER after receipt of Bids.

`

The undersigned agrees that extra work, if any, will be performed and will be paid for in accordance with Article 11 of the Conditions of the Contract.

The bidding and award of this Contract will be in accordance with M.G.L. Chapter 30, Section 39M.

The undersigned must furnish a 100 percent Performance Bond and a 100 percent Payment Bond with a surety company acceptable to Owner.

Amounts shall be shown in both words and figures, where indicated. In case of discrepancy, the amount shown in words will govern.

The above prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance and incidentals required to complete the Work.

The names and residences of all persons and parties interested in the foregoing Bid as principals are as follows:

(Give first and last names in full. In the case of a corporation, see Article 8.3 of the Instructions to Bidders, in the case of a limited liability company (LLC), see Article 8.4 of the Instructions to Bidders, in the case of a partnership, see Article 8.5 of the Instructions to Bidders.)

_____

_____

_____

The attached Department of Environmental Protection Diesel Retrofit Program Form must be completed and submitted as part of the Bid Proposal.

Pursuant to M.G.L. Ch. 62C, sec. 49A, I certify under the penalties of perjury that I, to my best knowledge and belief, have filed all state tax returns and paid all state taxes required under law.

The undersigned hereby certifies that he/she is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed on the work; that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee.

The undersigned bidder hereby certifies he/she will comply with the (a) the Civil Rights Act of 1964, 42 USC s.2000(1) et seq., as amended, Section 13 of the Federal Water Pollution Control Act (FWPCA) of 1972; Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act of 1975, and (b) shall make a good faith efforts to comply with 40 CFR Part 33. The undersigned bidder shall also comply with Executive Order 592 and Mass General Laws c 151B, §4.1.

Bidders must fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled responsibilities of Participants Regarding transactions (Doing Business with Other Persons). Contractors, subcontractors, or suppliers that appear on the Excluded Parties List System at

www.usgovxml.com/dataservice.aspx?ds=EPLS are not eligible for award of any contracts funded by the Massachusetts State Revolving Fund.

The undersigned hereby certifies under the penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this section, the word "person" shall mean any natural person, joint venture, partnership, corporation, limited liability company, or other business or legal entity. The undersigned further certifies under penalty of perjury that the said undersigned is not presently debarred from doing public construction work in the Commonwealth under the provisions of Section Twenty-nine F of Chapter Twenty-nine, or any other applicable debarment provisions of any other chapter of the General Laws or any rule or regulation promulgated thereunder; and is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

_____ _____

Social Security Number or Federal Identification Number

Signature of Individual or Corporate Name

By: _____
Corporate Officer (if applicable)

Notice of acceptance should be mailed, faxed, or delivered to the following:

_____
(Name)

By: _____
(Title)

_____
(Business Address)

_____
(City and State)

Date:_____

If the Bidder is a corporation, indicate State of incorporation under signature, and affix corporate seal; if a partnership, give full names and residential addresses, if different from business address.

END OF DOCUMENT 004113

APPENDIX B
DIESEL RETROFIT PROGRAM

The Department of Environmental Protection ("DEP") has developed the Diesel Retrofit Program in response to increasing public health concerns with the emissions from diesel engines and vehicles.

Diesel Construction Equipment Standard

All diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") must have the following pollution control device installed unless exempt as provided below:

1. Emission control technology verified by U.S. Environmental Protection Agency ("EPA") or the California Air Resources Board ("CARB") for use with non-road engines;
2. Emission control technology verified by EPA or CARB for use with on-road engines provided that such equipment is operated with diesel fuel that has no more than 15 parts per million sulfur content (i.e. Ultra Low Sulfur Diesel fuel); or
3. Emission control technology certified by the manufacturer that such technology meets or exceeds the emission reductions provided by on-road or off-road emission control technology verified by EPA or CARB, i.e. that a Diesel Oxidation Catalyst is achieving the following minimum emission reductions: particulate matter 20%; carbon monoxide 40%; volatile organic compounds 50%; or a Diesel Particulate Filter is achieving a minimum of 85% emission reductions for particulate matter.

Emission control devices, such as oxidation catalysts or particulate filters, shall be installed on the exhaust system side of the Diesel Construction Equipment. The Contractor shall be responsible to insure that the emissions control technology is operated, maintained, and serviced as recommended by the manufacturer.

For the latest up-to-date list of EPA verified-technologies, see:
https://www.epa.gov/verified-diesel-tech
For the latest up-to-date list of CARB verified technologies, see:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Exemptions

The following Diesel Construction Equipment shall be exempt from the standard above. The Contractor shall include such Diesel Construction Equipment in the required recordkeeping:

1. Diesel Construction Equipment not owned by the Contractor and used in the performance of the work under this Contract for 30 calendar days (cumulative days but not necessarily consecutive) or less;
2. Unless otherwise exempt, additional Diesel Construction Equipment originally not anticipated to be used under the Contract or used as permanent replacement after the work under the Contract has commenced, for 15 calendars days from the date such Diesel Construction Equipment is brought on site;

3. Diesel Construction Equipment with an engine that meets the EPA particulate matter (PM) Tier emission standards in effect at the start of the Contract for non-road diesel engines for the applicable engine power group (e.g., as of January 1, 2009, a piece of Diesel Construction Equipment with a Tier 3 engine is exempt from meeting the standard until the piece of Diesel Construction Equipment is available with a Tier 4 engine) provided that if such emissions standards are superseded during the Contract then such Diesel Construction Equipment must be retrofitted in accordance with the standards above prior to the end of the Contract;
4. A large crane (e.g. a sky crane or link belt crane which is responsible for critical lift operations) if such device would adversely affect the operation of the crane provided the Contractor submits to the municipality's project engineer written technical justification documenting the adverse impact on operation; and
5. Diesel Construction Equipment that the project engineer has determined is necessary to control a compelling emergency including but not limited to, the need for rescue vehicles or other equipment to prevent harm to human beings or additional equipment required to address a catastrophic emergency such as structure collapse or imminent collapse. After the compelling emergency is controlled, such non-compliant equipment must be removed from the Contract site and may not be used in further performance of the work under this Contract. Meeting Contract deadlines is not a compelling emergency.

Contractor Certification

Each bidder shall submit as part of its bid, the Statement of Intent to Comply. Within 10 days of being notified that it has been awarded a contract, the bidder and each of its Contractors and Subcontractors shall submit a Diesel Retrofit Program Contractor Certification. Each such Certification shall contain the following information for each piece of Diesel Construction Equipment:

1. Contractor or Subcontractor name;
2. Equipment type, make, model;
3. Vehicle Identification Number or VIN;
4. Engine model and year of manufacture;
5. Engine HP rating;
6. Emission Control Device (ECD) type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
7. ECD make, model, and manufacturer;
8. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
9. ECD installation date;
10. Type of fuel to be used; and
11. Whether the equipment is owned or rented.

Recordkeeping

Each Contractor and Subcontractor shall maintain detailed records of all Diesel Construction Equipment used under the Contract, including the dates and duration times the Diesel Construction Equipment is

used at the Contract site. Records shall be available for inspection by DEP. Each Contractor and Subcontractor shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site.

For Diesel Construction Equipment that has an emissions control device with a manufacturer's certification, the Contractor shall maintain records of all supporting emissions test data and test procedures. If upon review the emissions reductions are not supported by the test data and test procedures, then the emissions control device may need to be replaced with a compliant retrofit device.

Project Regulatory Agreement

The following language shall be included section 4 (Covenants of the Borrower) of the municipality's Project Regulatory Agreement if it receives funds from the State Revolving Fund:

> The Borrower shall require each Contractor and Subcontractor to submit the Diesel Retrofit Program Contractor Certification to DEP and the Borrower prior to commencing work on the Project. The Borrower shall not allow any Contractor or Subcontractor to commence work at the Project site prior to submitting such Certification.

STATEMENT OF INTENT TO COMPLY

This form must be signed and submitted by the bidder as part of the bid.

Local Governmental Unit _____ **SRF Project No.** _____

Contract No. _____ **Contact Title** _____

Bidder _____

The undersigned, on behalf of the above-named Bidder, agrees that, if awarded the Contract:

1. **the Bidder shall comply with the Massachusetts Department of Environmental Protection's ("MassDEP") Diesel Retrofit Program by ensuring that all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard;**
2. **the Bidder shall require all Subcontractors to comply with MassDEP's Diesel Retrofit Program by ensuring all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard; and**

3. **The Bidder shall submit and shall require each Subcontractor to submit a Diesel Retrofit Program Contractor Certification (form attached) with a Diesel Retrofit List to MassDEP Municipal Services and the Bidder within 10 days of the bidder being notified that it has been awarded the Contract. The Bidder shall require each Subcontractor to update such Certification and List within 2 days of using additional Diesel Construction Equipment on the project under the Contract.**

_____

(Signature of Bidder's Authorized Representative) **(Date)**

APPENDIX B (cont.)

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

Each Contractor and its Subcontractor(s) must sign and email this form to the DEP DMS project engineer, within 10 days after the contractor is awarded.

Local Governmental Unit _____ **SRF Project No.** _____

Contract No. _____ **Contact Title** _____

Contractor _____

I, _____, an authorized signatory for _____, whose principal place of business is at _____ do hereby certify that any and all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") have pollution control devices, such as oxidation catalysts or particulate filters, installed on the exhaust system side of the diesel combustion engine equipment in accordance with the Diesel Retrofit Program Standard.

I am submitting on behalf of _____ a list of all said Diesel Construction Equipment, labeled "Diesel Retrofit List," that will be used in connection with this Contract by _____. I hereby certify that the information on the attached Diesel Retrofit List is correct and accurate as of the date of signature. The List includes the following information for each piece of Diesel Construction Equipment:

1. Equipment type, make, model;
2. Vehicle Identification Number or VIN;
3. Engine model and year of manufacture;
4. Engine HP rating;
5. Emission Control Device ("ECD") type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
6. ECD make, model, and manufacturer;
7. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
8. ECD installation date;
9. Type of fuel to be used; and
10. Whether the equipment is owned or rented.

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

_____shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site. _____shall maintain detailed records of all Diesel Construction Equipment used at the Contract site, including the dates and duration times the Diesel Construction Equipment is used at the Contract site. _____ shall make such records available for inspection by DEP. _____shall ensure that the emissions control technology for each piece of Diesel Construction Equipment is operated, maintained, and serviced as recommended by the manufacturer. _____ shall retrofit prior to the end of the Contract any Diesel Construction Equipment no longer exempt from meeting the Diesel Construction Equipment Standard under exemption 3 (because it had an engine that met the EPA particulate matter (PM) Tier emission standards currently in effect at the start of the Contract for non-road diesel engines for the applicable engine power group and such emissions standards were superseded during the Contract).

I acknowledge that this certificate is being furnished as a requirement under this Contract and is subject to applicable State and federal laws, both criminal and civil. Signed under pains and penalty of perjury on this date _____.

Signature_____

Name: _____

Title: _____

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TOWN OF YARMOUTH, MASSACHUSETTS
WASTEWATER COLLECTION AND WATER RESOURCE RECOVERY FACILITIES
PHASE 1 – CONTRACT NO. 6
PROJECT NO. CWSRF – 8349/6

AGREEMENT

THIS AGREEMENT made as of the _____ day of _____ in the year 2025 by and between the Town of Yarmouth, Massachusetts acting through its Board of Selectmen hereinafter called OWNER and _____
with legal address and principal place of business at _____
_____ hereinafter called CONTRACTOR. OWNER and CONTRACTOR in consideration of the mutual covenants hereinafter set forth, agree as follows:

ARTICLE 1. WORK.

1.1 CONTRACTOR shall perform the Work as specified or indicated in the Contract Documents. The Work is as described in SECTION 01010.

ARTICLE 2. ENGINEER.

2.1 The Project has been designed by CDM Smith, 3 Davol Square, Building A, Suite A425, Providence, RI 02903 who will act as ENGINEER in connection with completion of the Work in accordance with the Contract Documents.

ARTICLE 3. CONTRACT TIME.

3.1 The Contract Time shall be 900 Calendar Days commencing twenty days following the Effective Date of this Agreement.

3.2 CONTRACTOR agrees that the Work shall be prosecuted regularly, diligently and uninterruptedly and at such rate of progress as will insure full completion thereof within the Contract Time stated above. It is expressly understood and agreed, by and between CONTRACTOR and OWNER that the Contract Time is reasonable for the completion of the Work, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.

ARTICLE 4. CONTRACT PRICE.

4.1 OWNER will pay CONTRACTOR for performance of the Work in accordance with the Contract Documents in current funds at the Contract Price agreed upon in the CONTRACTOR's Bid Form attached to this Agreement.

4.2 As per MassDEP’s Policy Memorandum No.10 - the agreed upon DIRECT LABOR MARKUP (percentage) for Change Orders on this project shall be ___ percent.

4.3 All contracts for water and sewer projects awarded as a result of a proposal or invitation for bids under MGL Chapter 30 section 39M shall include a price adjustment clause for fuel, both diesel and gasoline; liquid asphalt; and portland cement contained in cast-in-place concrete. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provide for a contract

adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus five percent.

4.4 Notwithstanding anything in the Contract Documents to the contrary, any and all payments which the Town is required to make under this Contract shall be subject to appropriation or other availability of funds as certified by the Town Accountant. In the absence of appropriation or availability as certified herein, this Contract shall be immediately terminated without liability for damages, penalties or other charges to the Town. In the event this is a multi-year contract, this Contract shall be subject to annual appropriation and in the event funds are not so appropriated, this Contract shall terminate immediately without liability for damages, penalties or charges to the Town.

ARTICLE 5. APPLICATIONS FOR PAYMENT

5.1 CONTRACTOR shall submit Applications for Payment in accordance with Article 15 of the Conditions of the Contract. Applications for Payment will be processed by ENGINEER as provided in the Conditions of the Contract.

ARTICLE 6. PROGRESS AND FINAL PAYMENTS

6.1 OWNER will make progress payments on account of the Contract Price on the basis of CONTRACTOR's Applications for Payment as recommended by ENGINEER, monthly during construction as provided below. All progress payments will be on the basis of the progress of the Work measured by the schedule of values provided for in Paragraph 15.01 of the Conditions of the Contract.

6.2 OWNER will make progress and final payments as provided in Article 15 of the Conditions of the Contract and in accordance with the applicable Massachusetts General Law.

ARTICLE 7. LIQUIDATED DAMAGES

7.1 OWNER and CONTRACTOR recognize that time is of the essence of this Agreement and that OWNER will suffer financial loss if the Work is not completed within the Contract Time specified in Article 3 above, plus any extensions thereof allowed in accordance with Article 11 of the General Conditions. They also recognize the delays, expense and difficulties involved in proving, in a legal or arbitration proceeding, the actual loss suffered by OWNER if the Work is not completed on time. Accordingly, instead of requiring any such proof OWNER and CONTRACTOR agree that as liquidated damages for delay (but not as a penalty) CONTRACTOR shall pay OWNER $2,000 per day for each calendar day of delay until the Work is complete.

7.2 Provided, that CONTRACTOR shall not be charged with liquidated damages or any excess cost when the delay in completion of the Work is for reasons included in Paragraph 4.05 of the General Conditions.

7.3 Provided, further, that CONTRACTOR shall furnish OWNER the required notification of such delays in accordance with Paragraph 11.06 of the General Conditions.

ARTICLE 8. ASSURANCE

8.1 CONTRACTOR has familiarized himself with the nature and extent of the Contract Documents, Work, locality, and with all local conditions and Federal, State and local laws, ordinances, rules and regulations that in any manner may affect cost, progress or performance of the Work.

8.2 CONTRACTOR has studied carefully all reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the Work which were relied upon by ENGINEER in the preparation of the Drawings and Specifications and which have been identified in Article 5 of the Supplementary Conditions.

8.3 CONTRACTOR has made or caused to be made examinations, investigations and tests and studies of such reports and related data [in addition to those referred to in the above paragraph] as CONTRACTOR deems necessary for the performance of the Work at the Contract Price within the Contract Time and in accordance with the other terms and conditions of the Contract Documents; and no additional examinations, investigations, tests, reports or similar data are or will be required for such purposes.

8.4 CONTRACTOR has correlated the results of all such observations, examinations, investigations, tests, reports and data with the terms and conditions of the Contract Documents.

8.5 CONTRACTOR has given ENGINEER written notice of any conflict, error or discrepancy that CONTRACTOR has discovered in the Contract Documents and the written resolution thereof by ENGINEER is acceptable to CONTRACTOR.

8.6 CONTRACTOR agrees that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the Work.

ARTICLE 9. CONTRACT DOCUMENTS.

9.1 The Contract Documents which comprise the Contract between OWNER and CONTRACTOR are attached hereto and made a part hereof and consist of the following:

9.1.1 Invitation To Bid.

9.1.2 Instructions To Bidders.

9.1.3 Bid Form.

9.1.4 This Agreement.

9.1.5 Performance Bond, EJCDC Document C-610, 2013 edition, Payment Bond, EJCDC Document C-615, 2013 edition, and other required Bonds.

9.1.6 General Conditions, EJCDC Document No. C-700, 2013 edition.

9.1.7 Supplementary Conditions Parts I and II.

9.1.8 Specifications (as listed in Table of Contents).

9.1.9 Drawings as listed in the List of Drawings and dated November 2025.

9.1.10 Addenda numbers _____ to _____, inclusive.

9.1.11 Any modification, including Change Orders, duly delivered after execution of Agreement.

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ARTICLE 10. MISCELLANEOUS

10.1 Terms used in this Agreement which are defined in Article 1 of the Conditions of the Contract shall have the meanings assigned in the Conditions of the Contract.

10.2 Neither OWNER nor CONTRACTOR shall, without the prior written consent of the other, assign or sublet in whole or in part any interest under any of the Contract Documents; and, specifically but without limitation, CONTRACTOR shall not assign any monies due or to become due without the prior written consent of OWNER. In case CONTRACTOR assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to CONTRACTOR shall be subject to prior claims of all persons, firms and corporations for services rendered or materials supplied for the performance of the Work called for in this Contract.

10.3 OWNER and CONTRACTOR each bind themselves, their partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.

10.4 The Contract Documents constitute the entire agreement between OWNER and CONTRACTOR and may only be altered, amended or repealed by a Modification.

ARTICLE 11. MASSACHUSETTS EQUAL OPPORTUNITY REQUIREMENTS

11.1 Procurement Considerations - Six Good Faith Efforts. 40 CFR, Part 33, Subpart C: Pursuant to 40 CFR Section 33.301, the sub-recipient agrees to make good faith efforts whenever procuring construction, equipment, services, and supplies under an EPA financial assistance agreement, and to require that sub-recipients, loan recipients, and prime contractors also comply. Records documenting compliance with the six good faith efforts shall be retained. The specific six good faith efforts can be found at: 40 CFR Section 33.301 (a)-(f).

11.2 Anti-Discrimination Requirements

During the performance of this Contract, the Contractor agrees as follows:

1. The contractor will comply with the (a) the Civil Rights Act of 1964, 42 USC s.2000(1) et seq., as amended, Section 13 of the Federal Water Pollution Control Act (FWPCA) of 1972; Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act of 1975, and (b) will also comply with Executive Order 592 and the Mass General Laws c 151B, §4.1.
2. The contractor will, in all solicitations or advancements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive consideration for employment consistent with Executive Order 592 and the Mass General Laws c 151B, §4.1.
3. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the agency contracting officer, advising the labor union or workers' representative of the contractor's commitments under Massachusetts Executive Order No. 592 and Mass General Laws c 151B, §4.1, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. The contractor will comply with all provisions of Massachusetts Executive Order No. 592 and Mass General Laws c 151B, §4.1 and of the rules, regulations, and relevant orders.
5. The contractor will furnish all information and reports required by Massachusetts Executive Order No. 592 and Mass General Laws c 151B, §4.1, and by the rules, regulations, and orders,

pursuant thereto, and will permit access to his books, records, and accounts by the contracting agency for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

6. In the event of the contractor's noncompliance with the nondiscrimination clauses of this contract or with any of such rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 592 and Mass General Laws c 151B, §4.1 and such other sanctions may be imposed and remedies invoked as by rule, regulation, or as otherwise provided by law.
7. The contractor will include the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules or regulations, so that such provisions will be binding upon each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as a means of enforcing such provisions.

11.3 The CONTRACTOR shall not participate in or cooperate with an international boycott, as defined in Section 999(b)(3) and (4) of the Internal Revenue Code of 1986, as amended, or engage in conduct declared to be unlawful by Section 2 of Chapter 151E of the Massachusetts General Laws.

ARTICLE 12. AMERICAN IRON AND STEEL (AIS) REQUIREMENTS

12.1 The Contractor acknowledges to and for the benefit of the City/Town of Yarmouth ("Purchaser") and the Commonwealth of Massachusetts (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

12.2 The Contractor acknowledges to and for the benefit of the City/Town of Yarmouth ("Purchaser") and the Commonwealth of Massachusetts (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "Build America, Buy America Act;"; that requires starting on May 14, 2022, all steel, iron, manufactured products, non-ferrous metals, plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables), glass (including optic glass), lumber, and

drywall used in infrastructure projects for federal financial assistance programs must be produced in the United States. MassDEP will conduct field verifications to ensure project compliance.

This project is subject to the Build American, Buy America (BABA) requirements. BABA implementation is not required for this project as the project is not receiving federal assistance based on EPA's Build America, Buy America Act Implementation Procedures for EPA Office of Water Federal Financial Assistance Programs Memorandum issued November 3, 2022.

OWNER is a Subrecipient for funding purposes, and as such, required contract provisions are incorporated throughout the Agreement.

The Contractor agrees that it will fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled Responsibilities of Participants Regarding Transactions (Doing Business with Other Persons). The Contractor shall not award any subcontracts or purchase any materials from suppliers that appear on the Excluded Parties List System. The Contractor shall include this requirement in each subcontract and require it to be included in all subcontracts regardless of tier. The Contractor shall maintain reasonable records to demonstrate compliance with these requirements.

This Project is subject to the Davis Bacon wage rate requirements. Attention is directed to Appendix G, included in PART II of the Supplementary Conditions for specific terms and conditions.

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IN WITNESS WHEREOF, the parties hereto have signed this Agreement in sextuple. Four copies each have been delivered to OWNER and one copy each to CONTRACTOR and ENGINEER. All portions of the Contract Documents have been signed or identified by OWNER and CONTRACTOR or by ENGINEER on their behalf.

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FOR THE TOWN OF YARMOUTH

Acknowledged:

_____
Department/Division Head Date

Approved as to Procurement:

_____
Chief Procurement Officer Date

Approved as to Availability of Funds:

_____
Town Accountant Date

Contract Approval:

_____
Town Administrator Date

FOR THE CONTRACTOR

_____
Name of Company

_____
Authorized Signature Date

_____
Print Name & Title

Note: If CONTRACTOR is a corporation, an affidavit giving the principal the right to sign the Agreement must accompany the executed Agreement.

END OF DOCUMENT 005214

EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PERFORMANCE BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT
Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND
Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than

the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

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EJCDC
ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

CONSTRUCTION CONTRACT

Effective Date of the Agreement:
Amount:
Description *(name and location)*:

BOND

Bond Number:
Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*:
Amount:
Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL	**SURETY**
_____ *(seal)*	_____ *(seal)*
Contractor's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	**By:** _____
Signature	Signature *(attach power of attorney)*
_____	_____
Print Name	Print Name
_____	_____
Title	Title
Attest: _____	**Attest:** _____
Signature	Signature
_____	_____
Title	Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.

2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.

4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.

5. The Surety's obligations to a Claimant under this Bond shall arise after the following:

    5.1 Claimants who do not have a direct contract with the Contractor,

        5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and

        5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).

    5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).

6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.

7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:

    7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and

    7.2 Pay or arrange for payment of any undisputed amounts.

    7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.

8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.

9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.

10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.

11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.

14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.

16. **Definitions**

16.1 **Claim:** A written statement by the Claimant including at a minimum:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
4. A brief description of the labor, materials, or equipment furnished;
5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.

16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.

16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.

16.4 **Owner Default**: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.

17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

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This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum, or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

To prepare supplementary conditions that are coordinated with the General Conditions, use EJCDC's Guide to the Preparation of Supplementary Conditions (EJCDC® C-800, 2013 Edition). The full EJCDC Construction series of documents is discussed in the Commentary on the 2013 EJCDC Construction Documents (EJCDC® C-001, 2013 Edition).

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

5. *Bidder*—An individual or entity that submits a Bid to Owner.

6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.

7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.

8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.

9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.

10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer

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concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. ("CERCLA"); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5101 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. ("RCRA"); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.

12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.

13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.

14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .

15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.

16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.

17. *Cost of the Work*—See Paragraph 13.01 for definition.

18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.

19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.

20. *Engineer*—The individual or entity named as such in the Agreement.

21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.

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22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.

25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.

26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.

27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.

28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.

29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.

31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.

32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.

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33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.

34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.

35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.

38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.

39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.

40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.

42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.

43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.

44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to

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conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.

45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

46. *Unit Price Work*—Work to be paid for on the basis of unit prices.

47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 *Terminology*

A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives*:

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.

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C. *Day*:

1. The word "day" means a calendar day of 24 hours measured from midnight to the next midnight.

D. *Defective*:

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).

E. *Furnish, Install, Perform, Provide*:

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words "furnish," "install," "perform," or "provide," then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

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B. *Evidence of Contractor's Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.

C. *Evidence of Owner's Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.

B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;

2. a preliminary Schedule of Submittals; and

3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.

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B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.

C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

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ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.

C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.

D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.

E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

A. *Standards Specifications, Codes, Laws and Regulations:*

1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*:

1. *Contractor's Verification of Figures and Field Measurements*: Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check

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and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

2. *Contractor's Review of Contract Documents*: If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies*:

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:

a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or

b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.

B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and

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binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

A. Contractor and its Subcontractors and Suppliers shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or

2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the

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Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.

B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.

C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:

1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;

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2. abnormal weather conditions;

3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and

4. acts of war or terrorism.

D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.

F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

A. *Limitation on Use of Site and Other Areas*:

1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site,

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adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.

2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

B. *Removal of Debris During Performance of the Work*: During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.

C. *Cleaning*: Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

D. *Loading of Structures*: Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

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5.03 *Subsurface and Physical Conditions*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and

3. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

A. *Notice by Contractor*: If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:

1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or

2. is of such a nature as to require a change in the Drawings or Specifications; or

3. differs materially from that shown or indicated in the Contract Documents; or

4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection

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therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

B. *Engineer's Review*: After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.

C. *Owner's Statement to Contractor Regarding Site Condition*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.

D. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

    a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;

    b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

    c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:

    a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or

    b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study

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of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or

c. Contractor failed to give the written notice as required by Paragraph 5.04.A.

3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

A. *Contractor's Responsibilities*: The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:

1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;

b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;

c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.

B. *Notice by Contractor*: If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.

C. *Engineer's Review*: Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents,

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or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.

D. *Owner's Statement to Contractor Regarding Underground Facility*: After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.

E. *Possible Price and Times Adjustments*:

1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

    a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;

    b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;

    c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and

    d. Contractor gave the notice required in Paragraph 5.05.B.

2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

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5.06 *Hazardous Environmental Conditions at Site*

A. *Reports and Drawings*: The Supplementary Conditions identify:

1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and

2. Technical Data contained in such reports and drawings.

B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.

D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.

E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such

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actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.

G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.

H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.

I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.I shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

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K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.

B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.

C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.

D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.

E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.

F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.

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B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.

F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.

G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.

H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.

I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.

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J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.

2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).

3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).

B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:

1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.

2. claims for damages insured by reasonably available personal injury liability coverage.

3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.

C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:

1. Products and completed operations coverage:

a. Such insurance shall be maintained for three years after final payment.

b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.

2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.

3. Broad form property damage coverage.

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4. Severability of interest.

5. Underground, explosion, and collapse coverage.

6. Personal injury coverage.

7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.

D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.

E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.

F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.

G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.

H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may

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be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:

1. include at least the specific coverages provided in this Article.

2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.

3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.

5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.

J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

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1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."

2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.

4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).

6. extend to cover damage or loss to insured property while in transit.

7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

8. allow for the waiver of the insurer's subrogation rights, as set forth below.

9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.

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10. not include a co-insurance clause.

11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.

12. include performance/hot testing and start-up.

13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.

B. *Notice of Cancellation or Change*: All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.

C. *Deductibles*: The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.

D. *Partial Occupancy or Use by Owner*: If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.

F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and

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damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.

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B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.

C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.

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B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *"Or Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.

1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

3) it has a proven record of performance and availability of responsive service; and

4) it is not objectionable to Owner.

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

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B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.

C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.

E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.

1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.

2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.

3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

a. shall certify that the proposed substitute item will:

1) perform adequately the functions and achieve the results called for by the general design,

2) be similar in substance to that specified, and

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3) be suited to the same use as that specified.

b. will state:

1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,

2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.

c. will identify:

1) all variations of the proposed substitute item from that specified, and

2) available engineering, sales, maintenance, repair, and replacement services.

d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.

B. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.

C. *Special Guarantee*: Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

D. *Reimbursement of Engineer's Cost*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

E. *Contractor's Expense*: Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

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F. *Effect of Engineer's Determination*: If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.

B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.

C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.

D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.

F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.

G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.

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H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.

I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.

J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.

K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.

L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.

N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.

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B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals

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and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them

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in the protection, removal, relocation, and replacement of their property or work in progress.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a

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change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements*:

1. Before submitting a Shop Drawing or Sample, Contractor shall have:

a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

B. *Submittal Procedures for Shop Drawings and Samples*: Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.

1. *Shop Drawings*:

a. Contractor shall submit the number of copies required in the Specifications.

b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.

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2. *Samples*:

    a. Contractor shall submit the number of Samples required in the Specifications.

    b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.

3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.

C. *Other Submittals*: Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.

D. *Engineer's Review*:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.

5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.

6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

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7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.

E. *Resubmittal Procedures*:

1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.

2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.

3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

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3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal;

6. the issuance of a notice of acceptability by Engineer;

7. any inspection, test, or approval by others; or

8. any correction of defective Work by Owner.

D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

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2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.

B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding

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the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.

C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.

D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:

1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;

2. an itemization of the specific matters to be covered by such authority and responsibility; and

3. the extent of such authority and responsibilities.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying,

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disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.

C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

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9.02 *Replacement of Engineer*

A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

9.03 *Furnish Data*

A. Owner shall promptly furnish the data required of Owner under the Contract Documents.

9.04 *Pay When Due*

A. Owner shall make payments to Contractor when they are due as provided in the Agreement.

9.05 *Lands and Easements; Reports, Tests, and Drawings*

A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.

B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.

C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.

9.07 *Change Orders*

A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.

9.08 *Inspections, Tests, and Approvals*

A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.

9.09 *Limitations on Owner's Responsibilities*

A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

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9.10 *Undisclosed Hazardous Environmental Condition*

A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.

9.11 *Evidence of Financial Arrangements*

A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).

9.12 *Safety Programs*

A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

A. Engineer will be Owner's representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner's representative during construction are set forth in the Contract.

10.02 *Visits to Site*

A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

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10.03 *Project Representative*

A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.

C. Engineer's authority as to Change Orders is set forth in Article 11.

D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any

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Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders*:

a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.

b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

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2. *Work Change Directives*: A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

3. *Field Orders*: Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

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11.04 *Change of Contract Price*

A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.

B. An adjustment in the Contract Price will be determined as follows:

1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or

2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or

3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).

C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:

1. a mutually acceptable fixed fee; or

2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:

a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;

b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;

c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.04.C.2.a and 11.04.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;

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e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.

B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.

1. *Procedures*: Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.

2. *Engineer's Action*: Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

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3. *Binding Decision*: Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

B. *Resolution of Certain Change Proposals*: If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

A. Owner and Contractor shall execute appropriate Change Orders covering:

1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;

2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;

3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and

4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

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ARTICLE 12 – CLAIMS

12.01 *Claims*

A. *Claims Process*: The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:

1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;

2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and

3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.

B. *Submittal of Claim*: The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.

C. *Review and Resolution*: The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.

D. *Mediation*:

1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.

2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.

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E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.

F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:

1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or

2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.

B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

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thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

    a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

    b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

    c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

    d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

    e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

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f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.

C. *Costs Excluded*: The term Cost of the Work shall not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expediters, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.

2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.

3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.

4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.

5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

D. *Contractor's Fee*: When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.

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E. *Documentation*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 *Allowances*

A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.

B. *Cash Allowances*: Contractor agrees that:

1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and

2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.

B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.

C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.

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E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:

1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;

2. there is no corresponding adjustment with respect to any other item of Work; and

3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.

B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.

C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:

1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;

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2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;

3. by manufacturers of equipment furnished under the Contract Documents;

4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and

5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.

F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

A. *Contractor's Obligation*: It is Contractor's obligation to assure that the Work is not defective.

B. *Engineer's Authority*: Engineer has the authority to determine whether Work is defective, and to reject defective Work.

C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.

D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.

E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective

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Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

A. Engineer has the authority to require additional inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.

C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.

2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

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14.06 *Owner May Stop the Work*

A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.

B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.

C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.

D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

A. *Basis for Progress Payments*: The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.

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B. *Applications for Payments:*

1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.

C. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

    a. the Work has progressed to the point indicated;

    b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

    c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

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3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

    a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or

    b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

    a. to supervise, direct, or control the Work, or

    b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or

    c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or

    d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or

    e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.

5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.

6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:

    a. the Work is defective, requiring correction or replacement;

    b. the Contract Price has been reduced by Change Orders;

    c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

    e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

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D. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:

    a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;

    b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;

    c. Contractor has failed to provide and maintain required bonds or insurance;

    d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;

    e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;

    f. the Work is defective, requiring correction or replacement;

    g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;

    h. the Contract Price has been reduced by Change Orders;

    i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;

    j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;

    k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;

    l. there are other items entitling Owner to a set off against the amount recommended.

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2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.

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D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. At any time, Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.

2. At any time, Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

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15.05 *Final Inspection*

A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

A. *Application for Payment*:

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

a. all documentation called for in the Contract Documents;

b. consent of the surety, if any, to final payment;

c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects or will so pass upon final payment.

d. a list of all disputes that Contractor believes are unsettled; and

e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance*:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and

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accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work*: The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due*: Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.

B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. correct the defective repairs to the Site or such other adjacent areas;

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2. correct such defective Work;

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);

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2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;

3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or

4. Contractor's repeated disregard of the authority of Owner or Engineer.

B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:

1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and

2. enforce the rights available to Owner under any applicable performance bond.

C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.

D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.

E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.

G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

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16.03 *Owner May Terminate for Convenience*

A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):

1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;

2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and

3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.

B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.

B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

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ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

A. *Disputes Subject to Final Resolution*: The following disputed matters are subject to final resolution under the provisions of this Article:

1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and

2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents and arising after final payment has been made.

B. *Final Resolution of Disputes*: For any dispute subject to resolution under this Article, Owner or Contractor may:

1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or

2. agree with the other party to submit the dispute to another dispute resolution process; or

3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be

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construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

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SECTION 007300 SUPPLEMENTARY CONDITIONS

PART I - AMENDMENTS TO GENERAL CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC Document No. C-700, 2013 edition) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented remain in full force and effect.

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

SC-1.01A.38.

Delete paragraph 1.01A.38. of the General Conditions in its entirety and replace with the following:

38. Specifications - Sections included under Division 01 through Division 46 of the Project Manual.

SC-1.01A.40.

Insert the following at the beginning of the definition before the words “The time at…...”

The Work required by the Contract has been completed except for work having a Contract Price of less than one per cent of the then adjusted total contract price, or

ARTICLE 2 - PRELIMINARY MATTERS

SC-2.01C.

Delete Paragraph 2.01C of the General Conditions in its entirety.

ARTICLE 3 - DOCUMENTS: INTENT, REQUIREMENTS, REUSE

SC-3.01E.

Add the following new paragraph immediately after Paragraph 3.01E. of the General Conditions which is to read as follows:

F. Each and every provision of law and clause required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be physically amended to make such insertion.

ARTICLE 4 - COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.01A.

Delete Paragraph 4.01A of the General Conditions in its entirety and replace with the following:

A. The Contract Time will commence to run on the twentieth day following the Effective Date of the Agreement.

SC-4.03A.

Add the following new paragraph immediately after Paragraph 4.03A of the General Conditions which is to read as follows:

B. Engineer may check the lines, elevations, reference marks, batter boards, etc., set by Contractor, and Contractor shall correct any errors disclosed by such check. Such a check shall not be considered as approval of Contractor's work and shall not relieve Contractor of the responsibility for accurate construction of the entire Work. Contractor shall furnish personnel to assist Engineer in checking lines and grades.

ARTICLE 5 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.01A.

Add the following new paragraph immediately after Paragraph 5.01A. of the General Conditions which is to read as follows:

1. If all lands and rights-of-way are not obtained as herein contemplated before construction begins, Contractor shall begin the Work upon such land and rights-of-way as Owner has previously acquired.

SC-5.03A.1.

Delete Paragraph 5.03 A.1 of the General Conditions in its entirety and replace it with the following:

1. Engineer has relied upon the data obtained from subsurface investigations made at the site in the form of test borings. Such data is in the form of boring logs which are included in the Appendix to the Project Manual. The locations of the test borings are indicated on the Drawings. Such logs are not part of the Contract Documents.

SC-5.04.D.

Add the following new paragraph immediately after paragraph 5.04D.4. of the General Conditions which is to read as follows:

E. Adjustments resulting from subsurface or latent physical conditions will be in accordance with Massachusetts General Law Chapter 30, Section 39N included in Part II of the Supplementary Conditions.

SC-5.06

Delete Paragraphs 5.06A and 5.06B in their entirety and insert the following:

A. No reports or drawings related to Hazardous Environmental Conditions at the Site, are known to Owner.

ARTICLE 6 - BONDS AND INSURANCE

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SC-6.01A.

Add the following sentence to Paragraph 6.01A of the General Conditions:

Contractor shall furnish Efficiency Guarantee Bonds in accordance with Article entitled MANUFACTURER'S EXPERIENCE in the Instructions to Bidders and executed on forms approved by the Owner.

SC-6.02C

Add the following paragraphs immediately after Paragraph 6.02C of the General Conditions which are to read as follows:

Contractor shall provide evidence of its insurance coverage on the ACORD certificate of insurance form and shall include the following statement in its entirety in the section of the form entitled “Description of Operations/Locations/Vehicles/Special Items”.

The Town of Yarmouth, Massachusetts and CDM Smith, and their officers, directors, partners, employees and other consultants and subcontractors are named as additional insureds with respect to the insured’s Commercial General Liability, Automobile Liability and Pollution Liability Insurance Policies. All insurers waive all rights of subrogation against the Town of Yarmouth, Massachusetts and CDM Smith, their officers, directors, partners, employees and other consultants and subcontractors. All insurance is primary for all claims covered thereby. Commercial General Liability Insurance includes contractual liability coverage.

SC-6.03

Add the following new paragraph immediately after Paragraph 6.03.J of the General Conditions:

K. Additional Insureds: The Town of Yarmouth, Massachusetts and CDM Smith, and their officers, directors, partners, employees and other consultants and subcontractors are named as additional insureds. All insurers waive all rights of subrogation against the Town of Yarmouth, Massachusetts and CDM Smith, their officers, directors, partners, employees and other consultants and subcontractors. All insurance is primary for all claims covered thereby. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by law:

1. 6.03.A Workers' Compensation and related coverages

(1)	Worker's Compensation	in accordance with M.G.L. c.149, Sect. 34A, minimum $100,000
(2)	Employer's Liability	$500,000 Each Occurrence $500,000 Disease per employee

2. 6.03B. and 6.03C. Commercial General Liability including Premise/Operations; Explosion, Collapse and Underground Property Damage; Products/Completed Operations, Contractual, Independent Contractors; Property Damage; and Personal Injury liabilities:

(1) Bodily Injury:	$1,000,000	Each Occurrence
	$1,000,000	Annual Aggregate
(2) Property Damage:	$1,000,000	Each Occurrence
	$1,000,000	Annual Aggregate
(3) Personal Injury:	$1,000,000	Annual Aggregate

3. 6.03D. Comprehensive Automobile Liability including all owned (private and others), hired and non-owned vehicles:

(1) Bodily Injury	$1,000,000	Each Person
	$1,000,000	Each Accident
(2) Property Damage: Each accident [or] Combined Single Limit of	$1,000,000	Each Occurrence

4. 6.03E. Umbrella or Excess Liability:

Per Occurrence	$5,000,000
General Aggregate	$5,000,000

5. 6.03F. Contractor's Pollution Liability:

Each Occurrence	$2,000,000
General Aggregate	$2,000,000

☐ If box is checked, Contractor is required to provide Contractor's Pollution Liability insurance under this Contract.

6. 6.03H. Contractor's Professional Liability:

Each Claim	$ 1,000,000
Annual Aggregate	$ 2,000,000

☐ If box is checked, Contractor is required to provide Contractor's Professional Liability insurance under this Contract.

SC-6.04A.

Delete Paragraph 6.04A. of the General Conditions in its entirety and replace with the following:

A. Contractor shall purchase and maintain a separate Owner's Protective Liability policy, issued to Owner at the expense of Contractor, including Owner and Engineer as named insured. This insurance shall provide coverage for not less than the following amounts:

6.04A.1.	Bodily Injury	$1,000,000	Each Occurrence
6.04A.2.	Property Damage	$1,000,000	Each Occurrence
		$1,000,000	Annual Aggregate

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SC-6.04B

Delete Paragraph 6.04B of the General Conditions in its entirety and replace with the following:

B. All policies required by this Paragraph 6.04 shall contain provisions to the effect that the insurer(s) waive all rights of subrogation against the Owner, Engineer and their officers, directors, partners, employees and other consultants and subcontractors of each and any of them.

SC 6.05

Delete Paragraph 6.05 of the General Conditions in its entirety

ARTICLE 7 - CONTRACTOR'S RESPONSIBILITIES

SC-7.02

SC-7.02B.

Add the following new paragraphs immediately after Paragraph 7.02B. of the General Conditions which are to read as follows:

C. Regular working hours are defined as 8 hours per day, Monday through Friday, excluding holidays, between the hours of 7:00 AM and 5:00 PM. Requests to work other than regular working hours shall be submitted to the Engineer not less than 72 hours prior to any proposed weekend work or scheduled extended work weeks. Occasional unscheduled overtime on weekdays may be permitted provided two hours' notice is given to Engineer.

Contractor will be allowed to transport material during non-regular working hours in accordance with all local, state, and federal requirements. Contractor shall notify the Engineer 72 hours in advance of such request to transport material during non-regular working hours. Contractor shall not exceed 8 hours per day of work. Compensate Owner for additional engineering above and beyond 8 hours as specified in SC-7.02D.

D. Contractor shall reimburse the Owner for additional engineering and/or inspection costs incurred as a result of overtime work in excess of the regular working hours stipulated in Paragraph SC-7.02C. At Owner's opinion, overtime costs may either be deducted from the Contractor's monthly payment request or deducted from the Contractor's retention prior to release of final payment. Overtime costs for the Owner's personnel shall be based on the individual's current overtime wage rate. Overtime costs for personnel employed by the Engineer or Owner's independent testing laboratory shall be calculated in accordance with the terms of their respective contracts with the Owner.

E. This Agreement is subject to the applicable provisions of the Contract Work Hours and Safety Standards Act, Public Law 87-581, 87th Congress. No Contractor or Subcontractor contracting for any part of the Work shall require or permit any laborer or mechanic to be employed on the Work in excess of forty hours in any work week unless such laborer or mechanic receives compensation at a rate not less than one and one-half times that person's basic rate of pay for all hours worked in excess of forty hours in such work week.

F. Contractor shall employ only competent persons to do the work and whenever Owner shall notify Contractor, in writing, that any person on the Work appears to be incompetent, disorderly, or otherwise

unsatisfactory, such person shall be removed from the Project and shall not again be employed on it except with the consent of Owner.

G. Contractor and Subcontractors shall, insofar as practicable, give preference in the hiring of workers for the Project to qualified local residents with first preference being given to citizens of the United States who have served in the armed forces of the United States and have been honorably discharged therefrom or released from active duty therein.

H. Contractor and all Subcontractors shall pay to all laborers and mechanics employed for the construction covered by this Contract the minimum rates of pay as determined by the Secretary of Labor in accordance with the Act of March 3, 1931, as amended, known as the Davis-Bacon Act (40 U.S.C. 276a through 276a-7). Furthermore, Contractor and Subcontractors shall adhere to the stipulations and provisions published by the Secretary of Health, Education, and Welfare in "Labor Standards (Federal Water Pollution Control Act)." The Wage Rate Schedule as prepared by the Secretary of Labor and the "Labor Standards" are part of this Contract and are included in PART II of these Supplementary Conditions.

I. Except as may be otherwise required by law, all claims and disputes pertaining to the classification of labor employed on the project under this Contract shall be decided by the governing body having jurisdiction.

J. Contractor and all Subcontractors shall comply with the Regulations of the Secretary of Labor made pursuant to the Anti-Kickback Act of June 30, 1940 (40 U.S.C. 276c) and all amendments or modifications thereto. Contractor and all Subcontractors shall furnish Owner with weekly Statements of Compliance. In case of Subcontracts, Contractor shall cause appropriate provision to be inserted in all subcontracts for the Work which Contractor may let to ensure compliance with said Anti-Kickback Act by all Subcontractors subject thereto, and Contractor shall be responsible for the submission of all Statements of Compliance required of Subcontractors by said Anti-Kickback Act except as the Secretary of Labor may specifically provide for reasonable limitations, variations, and exemptions from the requirements thereof. These Regulations are part of this Contract and are included in PART II of these Supplementary Conditions.

K. Contractor and all subcontractors shall comply with the Massachusetts Prevailing Wage law as contained in M.G.L. chapter 149 sections 26-27 which are included in Part II of these Supplementary Conditions.

SC-7.06I.

Add the following new sentence at the end of Paragraph 7.06I. of the General Conditions to read as follows:

Contractor shall make payments to Subcontractors in accordance with Massachusetts General Law Chapter 30, Section 39F which is included in Part II of these Supplementary Conditions.

SC-7.07B

Delete Paragraph 7.07B of the General Conditions in its entirety.

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SC-7.08A

Delete the first and second sentences of Paragraph 7.08A of the General Conditions in their entirety and replace with the following:

Contractor shall comply with the guidelines established in the Division of Municipal Services (DMS) Policies, Policy Memorandum No. PM-2 (Permits) included in Part II of the Supplementary Conditions.

SC-7.09A

Add the following new sentences at the end of Paragraph 7.09A of the General Conditions to read as follows:

The materials and supplies to be used in the Work of this Contract are exempt from the Sales and Use Tax of the Commonwealth of Massachusetts. Contractor shall obtain the proper certificates, maintain the necessary records and otherwise comply with the requirements of Chapter 14 of the Acts of 1966 and any amendments thereto.

SC-7.15A.

Delete the last sentence in Paragraph 7.15A. of the General Conditions in its entirety and replace with the following:

If Engineer determines that the incident giving rise to the emergency action was not the responsibility of the Contractor and that a change in the Contract Document is required because of the action taken by the Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

SC-7.16D.1.

Add the following new sentence at the end of paragraph 7.16.D.1 of the General Conditions to read as follows:

Approval of Shop Drawings for equipment requiring Efficiency Guarantee Bonds will be withheld until the receipt of such Bonds.

Reimburse Owner (Engineer) for time at the Engineer's standard rate of $150/hour after two submittals in accordance with Section 013300 "Submittal Procedures."

SC-7.17A.

Add the following new paragraph immediately after Paragraph 7.17A. of the General Conditions which is to read as follows:

B. The Contractor guarantees that the Work and Services to be performed under the Contract, and all workmanship, materials and equipment performed, furnished, used or installed in the construction of the same shall be free from defects and flaws, and shall be performed and furnished in strict accordance with the Drawings, Specifications, and other Contract Documents, that the strength of all parts of all manufactured equipment shall be adequate and as specified and that the performance test requirements of the Contract shall be fulfilled. This guarantee shall be for a period of one year from and after the date of substantial completion. If part of the Work is accepted in accordance with Paragraph 15.04 of the General

Conditions, the guarantee for that part of the Work shall be for a period of one year from the date fixed for such acceptance.

1. If at any time within the said period of guarantee any part of the Work requires repairing, correction or replacement, the Owner may notify the Contractor in writing to make the required repairs, correction or replacements. If the Contractor neglects to commence making such repairs, corrections or replacements to the satisfaction of the Owner within seven (7) days from the date of receipt of such notice, or having commenced fails to prosecute such Work with diligence, the Owner may employ other persons to make said repairs, correction or replacements, and charge the costs, including compensation for additional professional services, to the Contractor.

2. The Contractor's guarantee under Paragraphs 7.17A and 7.17B, is in addition to the Contractor's express or implied warranties under this Contract and State law and in no way diminish any other rights that the Owner may have against the Contractor.

SC-7.17B., C. and D.

Renumber Paragraphs 7.17B., 7.17C and 7.17D. of the General Conditions to read 7.17C., 7.17D. and 7.17E.

SC-7.17E.

Add the following new paragraph immediately after Paragraph 7.17E. of the General Conditions which is to read as follows:

F. Manufacturer's Guaranty/Warranty

1. The Contractor shall obtain the following guaranty/warranty from the manufacturer of all major pieces of equipment furnished and installed on this Project. Such guaranty/warranty shall be for the benefit of Owner and be furnished in writing by the manufacturer. The Contractor's and manufacturer's obligations under this provision are in addition to other express or implied warranties under the Contract Documents and under the law and in no way diminish any other right that the Owner may have against the Contractor or manufacturer for faulty material, equipment or work. The warranty period shall not be interpreted as a limitation on the time in which the Owner can enforce such other duties, obligations, rights, or remedies.

2. The manufacturer warrants and guarantees for a period of one year from the date of Substantial Completion, or such longer period that may be specified in the Contract Documents, that all materials and equipment furnished and installed shall be free from flaws, defects in material and workmanship and shall be in conformance with the Contract Documents.

SC-7.18A.

Delete Paragraph 7.18A of the General Conditions in its entirety and replace with the following:

A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall defend, indemnify and hold harmless Owner, Engineer and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including but not limited to all fees and charges of engineers, architects, attorneys and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost or loss or damage:

1. is attributable to bodily injury, sickness, disease or death or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom; and

2. is caused in whole or in part by any act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable, regardless of whether or not caused in part by any negligence or omission of an individual or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such indemnified party unless caused by the sole negligence of a party indemnified hereunder. If through the acts of neglect on the part of Contractor, any other contractor or any Subcontractor shall suffer loss or damage on the Work, Contractor shall settle with such other contractor or Subcontractor by agreement or arbitration if such other contractor or Subcontractor will so settle. If such other contractor or Subcontractor shall assert any claim against Owner and/or Engineer, or the officers, directors, members, partners, employees, agents, consultants and subcontractors of each on account of any damage alleged to have been sustained, Owner shall notify Contractor, who shall defend, indemnify and save harmless Owner, Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each against any such claims.

SC-7.18C.

Delete Paragraphs 7.18C, C.1 and C.2 of the General Conditions in their entirety.

SC-7.19E.

Add the following new paragraph immediately after Paragraph 7.19E. of the General Conditions which is to read as follows:

SC-7.20 Definitions; Contract Provisions; Management and Financial Statements; Enforcement

A. Contractor shall comply with all applicable provisions of Chapter 30, Section 39R of the Massachusetts General Laws regarding Contractor's records which is included in PART II of the Supplementary Conditions.

ARTICLE 8. OTHER WORK AT THE SITE

SC -8.03 A

Delete paragraph 8.03 A of the General Conditions in its entirety and replace with the following.

A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner’s employees, any other contractor working for Owner, or any utility owner for whom the Owner is responsible causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall not institute any action, legal or equitable, against Owner, Engineer, Engineer's Consultants or the Construction Coordinator or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any arbiter which seeks to impose liability on or to recover damages from Owner, Engineer, Engineer's Consultants or the Construction Coordinator on account of any such damage or claim. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of a separate contractor and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto,

Contractor may make a claim for an extension of times in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner, Engineer, Engineer's Consultants and Construction Coordinator for any delay, disruption, interference or hindrance caused by any separate contractor. This paragraph does not prevent recovery from Owner, Engineer, Engineer's Consultant or Construction Coordinator for activities that are their respective responsibilities.

SC-8.03D.

Delete Paragraph 8.03 D of the General Conditions in its entirety and replace with the following.

D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, Engineer's Consultants, the Construction Coordinator or any person then Contractor shall promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, Contractor shall, to the fullest extent permitted by Laws and Regulations defend, indemnify and hold Owner, Engineer, Engineer's Consultants and the Construction Coordinator harmless from and against all claims, damages, losses and expenses (including, but not limited to, fees of engineers, architects, attorneys and other professionals, and court and arbitration or mediation costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any separate contractor against Owner, Engineer, Engineer's Consultants or the Construction Coordinator to the extent based on a claim arising out of Contractor's performance of the Work.

ARTICLE 9. OWNER'S RESPONSIBILITIES

SC-9.06

Delete Paragraph 9.06 of the General Conditions in its entirety.

SC-9.13

Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions which is to read as follows:

SC-9.13 Owner's Site Representative

A. Owner will furnish an "Owner's Site Representative" to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner's Site Representative is not Engineer's consultant, agent, or employee.

ARTICLE 10 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 Project Representative

Add the following new paragraphs immediately after Paragraph 10.03A of the General Conditions which are to read as follows:

B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.

1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.

2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.

4. Liaison:

    a. Serve as Engineer’s liaison with Contractor. Working principally through Contractor’s authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.

    b. Assist Engineer in serving as Owner’s liaison with Contractor when Contractor’s operations affect Owner’s on-site operations.

    c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.

5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

6. Shop Drawings and Samples:

    a. Record date of receipt of Samples and Contractor-approved Shop Drawings.

    b. Receive Samples which are furnished at the Site by Contractor and notify Engineer of availability of Samples for examination.

    c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.

7. Modifications: Consider and evaluate Contractor’s suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR’s recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.

8. Review of Work and Rejection of Defective Work:

    a. Conduct on-site observations of Contractor’s work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.

b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

9. Inspections, Tests, and System Start-ups:

   a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.

   b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

10. Records:

    a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.

    b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.

    c. Maintain records for use in preparing Project documentation.

11. Reports:

    a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.

    b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.

    c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer,

noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:

    a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.

    b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.

    c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

C. The RPR shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).

2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.

3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.

4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.

5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.

6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.

7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.

8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11 - AMENDING THE CONTRACT DOCUMENTS: CHANGES IN THE WORK

Add the following new paragraphs immediately after Paragraph 11.07B of the General Conditions which are to read as follows:

1. Change Orders shall comply with the requirements of DEP-DMS-PM-10, which is included in Part II of these Supplementary Conditions. The following shall apply:

    a. DEP-DMS-PM-10 indicates that the Contractor's fee for overhead and profit shall not exceed 20% for the work done by the Contractor and shall not exceed 7-1/2% for work done by a subcontractor. For this Contract, the Contractor's fee for overhead and profit, as stated in paragraph 11.04.C.2.a of the General Conditions, shall be 15 percent for work done by the Contractor, and as stated in 11.04.C.2.b of the General Conditions, shall be 5 percent for work done by a subcontractor.

SC-11.04B.2

Delete paragraph 11.04B.2. of the General Conditions in its entirety.

SC-11.04C.1.

Delete paragraph 11.04C.1 of the General Conditions in its entirety.

SC-11.04C.2.b.

In paragraph 11.04C.2.b, before the semicolon add the following words "based on subcontractor's Cost of the Work";

ARTICLE 13 - COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

SC-13.01B.1.

Delete the second sentence in paragraph 13.01B.1. of the General Conditions in its entirety and replace with the following:

Such employees shall include foremen at the site.

SC-13.01B.1.

Add the following new paragraph immediately after paragraph 13.01B.1. of the General Conditions which is to read as follows:

a. Following award and prior to execution of a construction contract Contractor shall establish, in the Agreement, the Direct Labor Cost percentage. This percentage, where approved by Owner, will be used in the determination of the Direct Labor Cost listed in the Change Order Form included in PART II of the Supplementary Conditions. The Direct Labor Costs are defined to include social security contributions, unemployment, excise and payroll taxes, workers' and workmen's compensation, health and retirement benefits, sick leave, vacation and holiday pay, and cost of premiums for all additional insurance required because of changes in the Work.

SC-13.02

Delete Paragraph 13.02 of the General Conditions in its entirety.

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ARTICLE 14 - TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

SC-14.06A.

Add the following new paragraph immediately after Paragraph 14.06A. of the General Conditions which is to read as follows:

B. If Owner stops Work under Paragraph 14.06A. Contractor shall not be entitled to any extension of Contract Time or increase in Contract Price.

ARTICLE 15 - PAYMENTS TO CONTRACTOR, SET-OFFS, AND COMPLETION; CORRECTION PERIOD

SC-15.01B.3.

Add the following new paragraph immediately after paragraph 15.01B.3 of the General Conditions which is to read as follows:

4. Contractor shall furnish evidence that payment received on the basis of materials and equipment not incorporated and suitably stored, has in fact been paid to the respective supplier(s) within sixty days of payment by Owner. Failure to provide such evidence of payment may result in the withdrawal of previous approval(s) and removal of the cost of related materials and equipment from the next submitted Application for Payment.

SC-15.01C.1

Delete paragraph 15.01C.1. of the General Condition in its entirety and replace with the following:

1. Progress Payments will be made in accordance with Massachusetts General Law Chapter 30, Section 39G, which is included in PART II of these Supplementary Conditions.

SC-15.02

Add the following new paragraphs immediately after Paragraph 15.02A of the General Conditions which are to read as follows:

B. No materials or supplies for the Work shall be purchased by Contractor or Subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. Contractor warrants that Contractor has good title to all materials and supplies used by Contractor in the Work, free from all liens, claims or encumbrances.

C. Contractor shall defend, indemnify and save Owner and Engineer harmless from all claims growing out of the lawful demands of Subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. Contractor shall at Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then Owner may, after having served written notice on the said Contractor either pay unpaid bills, of which Owner has written notice, direct, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged

whereupon payment to Contractor shall be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon Owner to either Contractor or Contractor's Surety. In paying any unpaid bills of the Contractor, Owner shall be deemed the agent of Contractor and any payment so made by Owner shall be considered as payment made under the Contract by Owner to Contractor and Owner shall not be liable to Contractor for any such payment made in good faith.

SC-15.06B.1.

Delete paragraph 15.06B.1. of the General Conditions in its entirety and replace with the following:

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation - all as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will indicate in writing Engineer's recommendation of payment and present the Application to Owner for payment. Thereupon Engineer will give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of paragraph 15.07. Otherwise, Engineer will return the Application to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. If the Application and accompanying documentation are appropriate as to form and substance, Owner shall in accordance with the applicable Massachusetts General Law, pay Contractor the amount recommended by Engineer.

SC-15.06D.

Add the following new paragraph immediately after Paragraph 15.06D. of the General Conditions which is to read as follows:

E. Final payment will be reduced by the amount of excessive costs of plant inspection of pipe. Excessive costs are defined as the inspection costs incurred by Owner for that amount of pipe which exceeds 125 percent of the aggregate length of each type installed.

ARTICLE 16 - SUSPENSION OF WORK AND TERMINATION

SC-16.01A.

Delete Paragraph 16.01A. of the General Conditions in its entirety and replace with the following:

A. Owner may order, at any time and without cause, suspension of the Work in accordance with Massachusetts General Law Chapter 30, Section 39O, which is included in PART II of the Supplementary Conditions.

SC-16.02A.4.

Add the following new paragraph immediately after paragraph 16.02.A.4 of the General Conditions which is to read as follows:

5. If Contractor abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of Owner, or if the Contract or any claim thereunder shall be assigned by Contractor otherwise than as herein specified;

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ARTICLE 17 - FINAL RESOLUTION OF DISPUTES

SC-17.01B

Delete paragraph 17.01B.1 of the General Conditions in its entirety and replace with the following:

1. Either Owner or Contractor may request mediation of any Claim. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of this Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract.

SC-17.01B.3.

Add a new paragraph immediately after paragraph 17.01B.3. of the General Conditions which is to read as follows:

C. Contractor shall carry on the Work and maintain the progress schedule during the dispute resolution proceedings, unless otherwise agreed by Contractor and Owner in writing.

ARTICLE 18 - MISCELLANEOUS

SC-18.08

Add the following new paragraphs immediately after Paragraph 18.08 of the General Conditions which are to read as follows:

18.09 Addresses

A. Both the address given in the Bid Form upon which this Agreement is founded, and Contractor's office at or near the site of the Work are hereby designated as places to either of which notices, letters, and other communications to Contractor shall be certified, mailed, or delivered. The delivering at the above named place or depositing in a postpaid wrapper directed to the first-named place, in any post office box regularly maintained by the post office department, of any notice, letter or other communication to Contractor shall be deemed sufficient service thereof upon Contractor; and the date of said service shall be the date of such delivery or mailing. The first-named address may be changed at any time by an instrument in writing, executed and acknowledged by Contractor, and delivered to Owner and Engineer. Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter, or other communication upon Contractor personally.

18.10 Wage Rates

A. The requirements and provisions of all applicable laws and any amendments thereof or additions thereto as to the employment of labor, and to the schedule of minimum wage rates established in compliance with laws shall be a part of these Contract Documents. Copies of the wage schedules are included in PART II of these Supplementary Conditions. If, after the Notice of Award, it becomes necessary to employ any person in a trade or occupation not classified in the wage determinations, such person shall be paid at not less than such rates as shall be determined by the officials administrating the laws mentioned above. Such approved minimum rate shall be retroactive to the time of the initial employment of such person in such trade or occupation. Contractor shall notify Owner of Contractor's intention to employ persons in trades or occupations not classified in sufficient time for Owner to obtain approved rates for such trades or occupations.

B. The schedules of wages referred to above are minimum rates only, and Owner will not consider any claims for additional compensation made by Contractor because of payment by Contractor of any wage rate in excess of the applicable rate contained in these Contract Documents. All disputes between Contractor and employees of Contractor in regard to the payment of wages in excess of these specified in the schedules shall be resolved by Contractor.

C. The said schedules of wages shall continue to be the minimum rates to be paid during the life of this Agreement and a legible copy of said schedules shall be kept posted in a conspicuous place at the site of the work.

D. Both Federal and State schedules of minimum wage rates are included in PART II of these Supplementary Conditions. Where rates differ, the higher rates shall apply as a minimum for that trade.

PART II - FEDERAL AND STATE GOVERNMENT PROVISIONS

Federal and State and Government Provisions included herein, have been selected from those to which specific references have been made elsewhere in the Contract Documents. Each and every other provision of law or clause required by law to be inserted in this Contract shall be deemed to be also inserted herein in accordance with Paragraph 3.01F of the Supplementary Conditions.

1.0. FEDERAL GOVERNMENT PROVISIONS

1.1. Davis Bacon Act Requirements (Appendix G)

1.2. Federal Wage Rates

1.3. This project is subject to American Iron and Steel and the Build America, Buy America Act (BABA). The amendments to the Clean Water Act, as part of WRRDA, apply the American Iron and Steel (AIS) requirements to all treatment works projects. Furthermore, BIL extends this procurement requirement to all SRF construction projects going forward with the inclusion of the Build America, Buy America Act (BABA). Starting on May 14, 2022, all steel, iron, manufactured products, non-ferrous metals, plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables), glass (including optic glass), lumber, and drywall used in infrastructure projects for federal financial assistance programs must be produced in the United States. MassDEP ensures that the required procurement language is included in contracts and conducts field verifications of project compliance. BABA implementation is not required for this project as the project is not receiving federal assistance based on EPA's Build America, Buy America Act Implementation Procedures for EPA Office of Water Federal Financial Assistance Programs Memorandum issued November 3, 2022.

1.4. American Iron and Steel Requirements of P. L. 113-76, the Consolidated Appropriations Act of 2014 (Appendix I)

1.5. Project Signage

Project signs or other means of publicizing the project to comply with the "Guidelines for Enhanced Public Awareness of SRF Assistance Agreements" issued by the United States Environmental Protection Agency on June 3, 2015.

2015 guidance: https://www.epa.gov/sites/default/files/2016-07/documents/guidelines_for_enhancing_public_awareness_srf.pdf

1.6 Prohibitions Relating to Violators of the Clean Air Act and the Clean Water Act with Respect to Federal Contracts, Grants, or Loans Executive Order No. 11738 (1973) Section 306 of the Clean Air Act, 42 U.S.C. § 7606, and Section 508 of the Clean Water Act, 33 U.S.C § 1368

1.7 Demonstration Cities and Metropolitan Development Act Pub. L. No. 89-754 (1966), as amended 42 U.S.C. § 3331 et. Seq.

1.8 Uniform Relocation Assistance and Real Property Acquisition Policies Act Pub. L. No. 91-646 (1971), as amended 42 U.S.C. §§ 4601-4655

1.9 Preservation of Open Competition and Government Neutrality Towards Government Contractors' Labor Relations on Federal and Federally Funded Construction Projects Executive Order No. 13202 (2001), as amended by Executive Order No. 13208 (2001)

1.10 The Age Discrimination Act of 1975 42 U.S.C. § 6102

1.11 Section 13 of the Federal Water Pollution Control Act Amendments of 1972 33 U.S.C. § 1251

1.12 Section 504 of the Rehabilitation Act of 1973 29 U.S.C. § 794

1.13 Title VI of the Civil Rights Act of 1964 42 U.S.C. § 2000d

1.14 Prohibitions Relating to Violators of the Clean Air Act and the Clean Water Act with Respect to Federal Contracts, Grants, or Loans Executive Order No. 11738 (1973) Section 306 of the Clean Air Act, 42 U.S.C. § 7606, and Section 508 of the Clean Water Act, 33 U.S.C § 1368

1.15 Prohibition on Certain Telecommunication and Video Surveillance Services or Equipment in the SRF Programs

i. Effective August 13, 2020, recipients and subrecipients of EPA funded assistance agreements, including borrowers under EPA funded revolving loan funds, must comply with regulations at 2 CFR 200.216, Prohibition on certain telecommunication and video surveillance services or equipment, implementing section 889 of Public Law 115-232. The regulation prohibits the use of Federal funds to procure (enter into, extend, or renew contracts) or obtain equipment, systems, or services that use "covered telecommunications equipment or services" identified in the regulation as a substantial or essential component of any system, or as critical technology as part of any system. Prohibitions extend to the use of Federal funds by recipients and subrecipients to enter into a contract with an entity that "uses any equipment, system, or service that uses covered telecommunications equipment or services" as a substantial or essential component of any system, or as critical technology as part of any system. Certain equipment, systems, or services, including equipment, systems, or services produced or provided by entities subject to the prohibition are recorded in the System for Award Management exclusion list.

2.0. COMMONWEALTH OF MASSACHUSETTS PROVISIONS

2.1. Owner and Contractor agree that the following Commonwealth of Massachusetts Provisions apply to the work to be performed under this Contract and that these provisions supersede any conflicting provisions of this Contract.

2.2. Applicable provisions of Massachusetts General Laws and Regulations and/or the United States Code and Code of Federal Regulations govern this Contract and any provision in violation of the foregoing shall be deemed null, void and of no effect. Where conflict between Code of Federal Regulations and State Laws and Regulations exist, the more stringent requirement shall apply.

2.3. Special Provisions for Disadvantaged Business Enterprises - Massachusetts Department of Environmental Protection, Division of Municipal Services. (Appendix E)

2.4. Massachusetts General Laws

2.4.1. Chapter 30, Section 39F (9 Pages)

2.4.2. Chapter 30, Section 39G (6 Pages)

2.4.3. Chapter 30, Section 39I (2 Pages)

2.4.4. Chapter 30, Section 39J (2 Pages)

2.4.5. Chapter 30, Section 39L (2 Pages)

2.4.6. Chapter 30, Section 39M (8 Pages)

2.4.7. Chapter 30, Section 39N (2 Pages)

2.4.8. Chapter 30, Section 39O (3 Pages)

2.4.9. Chapter 30, Section 39P (2 Pages)

2.4.10. Chapter 30, Section 39Q (4 Pages)

2.4.11. Chapter 30, Section 39R (7 Pages)

2.4.12. Chapter 30, Section 39S (3 Pages)

2.4.13. Chapter 82, Sections 40 and 40A through 40E (11 Pages)

2.4.14. Chapter 82A, Section 1 (3 Pages)

2.4.15. Chapter 149, Section 34 (2 Pages)

2.4.16. Chapter 149, Section 44J (4 Pages)

2.5. State Wage Rates

2.6. Price Adjustments for certain materials in Construction Projects. MGL Chapter 30 Section 38A. (Appendix H – 5 Pages).

2.7. Diesel Retrofit Program Requirements (Appendix B)

2.8. Division of Municipal Services Policies (Currently 16 Policy Memoranda) (Appendix F).

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2.9. Department of Environmental Protection Policy for Review of Sewer Line/Water Supply Protection.

END OF SECTION 007300

1.0 FEDERAL GOVERNMENT PROVISIONS

APPENDIX G
Davis Bacon Act Requirements

All construction projects are subject to the Davis Bacon wage rate requirements and must include the appropriate sections of the following document in its entirety in the contract documents.

The vast majority of SRF projects will be bid by Governmental Entities (i.e., Cities, Towns, Authorities, Water Districts, Wastewater Districts). These projects must include the following language in construction contracts:

I.3. Contract and Subcontract Provisions
I.4. Contract Provisions for Contracts in Excess of $100,000 (if applicable)
I.5. Compliance Verification

This language may be found on pages DB-3-DB-11.

In certain cases, SRF projects may be bid by non-Governmental Entities (i.e., private water companies, private PWSs, etc.). These projects must include the following language in construction contracts:

II.3. Contract and Subcontract Provisions
II.4. Contract Provisions for Contracts in Excess of $100,000 (if applicable)
II.5. Compliance Verification

This language my be found on pages DB-11-DB-21

Preamble

With respect to the Clean Water and Safe Drinking Water State revolving Funds, EPA provides capitalization grants to each State which in turn provides subgrants or loans to eligible entities within the State. Typically, the subrecipients are municipal or other local governmental entities that manage the funds. For these types of recipients, the provisions set forth under Roman Numeral I, below, shall apply. Although EPA and the State remain responsible for ensuring subrecipients' compliance with the wage rate requirements set forth herein, those subrecipients shall have the primary responsibility to maintain payroll records as described in Section 3(ii)(A), below and for compliance as described in Section I-5.

Occasionally, the subrecipient may be a private for profit or not for profit entity. For these types of recipients, the provisions set forth in Roman Numeral II, below, shall apply. Although EPA and the State remain responsible for ensuring subrecipients' compliance with the wage rate requirements set forth herein, those subrecipients shall have the primary responsibility to maintain payroll records as described in Section II-3(ii)(A), below and for compliance as described in Section II-5.

I. Requirements For Subrecipients That Are Governmental Entities:

The following terms and conditions specify how recipients will assist EPA in meeting its Davis-Bacon (DB) responsibilities when DB applies to EPA awards of financial assistance with respect to State recipients and subrecipients that are governmental entities. If a subrecipient has

questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient. If a State recipient needs guidance, the recipient may contact Valerie Marshall at EPA Region 1 (617-918-1674) for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at https://www.dol.gov/whd/govcontracts/dbra.htm

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2012 Appropriations Act, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in §5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein:

Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient (s) to the State award official. The State award official will transmit the request, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the
Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at https://www.dol.gov/whd/forms/wh347.pdf or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA , the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29

CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of $100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient**,** upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other

Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its

assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at https://www.dol.gov/whd/whd_district_offices.pdf.

II. Requirements For Subrecipients That Are Not Governmental Entities

The following terms and conditions specify how recipients will assist EPA in meeting its DB responsibilities when DB applies to EPA awards of financial assistance with respect to subrecipients that are not governmental entities. If a subrecipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient for guidance. If a State recipient needs guidance, the recipient may contact Valerie Marshall at EPA Region 1 (617-918-1674) for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at https://www.dol.gov/whd/govcontracts/dbra.htm

Under these terms and conditions, the subrecipient must submit its proposed DB wage determinations to the State recipient for approval prior to including the wage determination in any solicitation, contract task orders, work assignments, or similar instruments to existing contractors.

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients must obtain proposed wage determinations for specific localities at www.wdol.gov. After the Subrecipient obtains its proposed wage determination, it must submit the wage determination to (insert contact information for State recipient DB point of contact for wage determination) for approval prior to inserting the wage determination into a solicitation, contract or issuing task orders, work assignments or similar instruments to existing contractors (ordering instruments unless subsequently directed otherwise by the State recipient Award Official.

(b) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov. on a weekly basis to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(c) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(d) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(e) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of $2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2011 Full-Year Continuing Appropriation, the following clauses:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work, will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in §5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient(s) to the State award official. The State award official will transmit the report, to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the State award official or will notify the State award official within the 30-day period that additional time is necessary.

(C) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request, and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA Regional Coordinator concurrently. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the
Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s) shall upon written request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is

available for this purpose from the Wage and Hour Division Web site at https://www.dol.gov/whd/forms/wh347.pdf or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA , the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of

fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may by appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination: debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29
CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), State, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

(i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

(iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of $100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of $100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

(1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of forty hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of forty hours in such workweek.

(2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of $10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1) of this section.

(3) Withholding for unpaid wages and liquidated damages. The subrecipient shall upon the request of the EPA Award Official or an authorized representative of the Department of Labor, withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (b)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (4) of this section.

(c) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a). The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, the subrecipient should conduct interviews with a representative group of covered employees within two weeks of each contractor or subcontractor's submission of its initial weekly payroll data and two weeks prior to the estimated completion date for the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c). The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB . In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d). The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at https://www.dol.gov/whd/whd_district_offices.pdf.

Federal (Davis Bacon) Wage Rates

"General Decision Number: MA20250008 09/26/2025

Superseded General Decision Number: MA20240008

State: Massachusetts

Construction Types: Heavy (Heavy and Marine)

Counties: Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth and Suffolk Counties in Massachusetts.

HEAVY AND MARINE CONTRUCTION PROJECTS

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. . The contractor must pay all covered workers at least $17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. . The contractor must pay all covered workers at least $13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at http://www.dol.gov/whd/govcontracts.

Modification Number Publication Date

0	01/03/2025
1	03/07/2025
2	03/14/2025
3	03/21/2025
4	07/11/2025
5	07/18/2025
6	08/01/2025
7	09/12/2025
8	09/26/2025

BOIL0029-001 01/01/2025

	Rates	Fringes
BOILERMAKER	$ 50.62	28.82

BRMA0001-011 02/01/2023

FOXBORO CHAPTER

BRISTOL (Attleboro, Berkley, Dighton, Mansfield, North Attleboro, Norton, Raynham, Rehoboth, Seekonk, Taunton); NORFOLK, (Bellingham, Canton, Dedham, Foxboro, Franklin, Norfolk, Norwood, Plainville, Sharon, Walpole, Westrwood, Wrentham); and PLYMOUTH (Lakeville)

	Rates	Fringes
Bricklayer/Cement Mason	$ 60.35	34.40

BRMA0001-012 02/01/2023

LOWELL CHAPTER

MIDDLESEX (Acton, Ashby, Ayer, Bedford, Billerica, Boxboro, Carlisle, Chemsford, Dracut, Dunstabale, Ft Devens, Groton, Littleton, Lowell, North Acton, Pepperell, Shirley, South Acton, Tewksbury, Townsend, Tyngsboro, West Acton, Westford, Wilmington)

	Rates	Fringes
BRICKLAYER	$ 58.21	33.71

BRMA0001-013 08/01/2023

LOWELL CHAPTER
MIDDLESEX (Ashland, Framingham, Holliston, Hopkinton, Hudson, Maynard, Natick, Sherbvorn, Stow); and NORFOLK (Medfield, Medway, Millis)

	Rates	Fringes
BRICKLAYER	$ 62.40	34.40

BRMA0003-001 08/01/2024

	Rates	Fringes
Marble & Tile Finisher	$ 49.32	35.26
Marble, Tile & Terrazzo Workers	$ 64.52	37.51

TERRAZZO FINISHER.....$ 63.44 37.33

BRMA0003-003 08/01/2024

BOSTON CHAPTER
MIDDLESEX (Arlington, Cambridge, Everett, Malden, Medford, Melrose, Somerville); NORFOLK (Brookline, Milton); and SUFFOLK

	Rates	Fringes
BRICKLAYER	$ 64.50	37.54

BRMA0003-011 08/01/2024

LYNN CHAPTER

ESSEX (Amesbury, Andover, Beverly, Boxford, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence, Lynn, Lynnfield, Manchester, Marblehead, Merrimac, Methuen, Middleton, Nahant, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salisbury, Salem, Saugus, Swampscott, Topsfield, Wakefield, Wenham, West Newbury); and MIDDLESEX (North Reading, Reading, Wakefield)

	Rates	Fringes
Bricklayer/Cement Mason	$ 64.50	37.54

BRMA0003-012 08/01/2024

	Rates	Fringes
BRICKLAYER WALTHAM CHAPTER - MIDDLESEX (Belmont, Burlington, Concord, Lexington, Lincoln, Stoneham, Sudbury, Waltham, Watertown, Wayland, Weston, Winchester, Woburn)	$ 64.50	37.54

BRMA0003-014 08/01/2024

QUINCY CHAPTER

PLYMOUTH COUNTY (Abington, Bridgewater, Brockton, Carver, Duxbury, East Bridgewater, Halifax, Hanover, Hanson, Hingham, Hull, Kingston, Marshfield, Middleboro, Norwell, Pembroke, Plymouth, Rockland, Scituate, West Bridgewater, Whitman)

	Rates	Fringes
Bricklayer/Cement Mason	$ 64.50	37.54

BRMA0003-025 08/01/2024

NEW BEDFORD CHAPTER

BARNSTABLE; BRISTOL (Acushnet, Darmouth, Fairhaven, Fall River, Freetown, New Bedford, Somerset, Swansea, Westport); DUKES; NANTUCKET; PLYMOUTH (Marion, Mattapoisett, Rochester, Wareham)

	Rates	Fringes
Bricklayer/Cement Mason	$ 64.50	37.54

BRMA0003-033 08/01/2024

NEWTON CHAPTER
MIDDLESEX (Newton); NORFOLK (Dover, Needham, Wellesley)

	Rates	Fringes
Bricklayer, Plasterer	$ 64.50	37.54

CARP0056-001 08/01/2024

All of SUFFOLK COUNTY; and those areas of BARNSTABLE, BRISTOL, ESSEX, MIDDLESEX, NORFOLK, and PLYMOUTH COUNTIES situated INSIDE Boston Beltway (I-495) and North of Cape Cod Canal. ALL of DUKES and NANTUCKET COUNTIES

	Rates	Fringes
PILEDRIVERMAN	$ 55.79	35.47

CARP0056-002 08/01/2024

The areas of BARNSTABLE, BRISTOL, PLYMOUTH, and NORFOLK COUNTIES situated OUTSIDE Boston Beltway (I-495) and South of Cape Cod Canal

	Rates	Fringes
PILEDRIVERMAN	$ 51.97	35.47

CARP0056-003 08/01/2024

Those areas of ESSEX and MIDDLESEX COUNTIES situated OUTSIDE Boston Beltway (I-495)

	Rates	Fringes
PILEDRIVERMAN	$ 49.19	35.47

CARP0056-004 08/01/2024

	Rates	Fringes
DIVER TENDER	$ 61.70	35.47
DIVER	$ 78.11	35.47

CARP0327-002 03/01/2025

MIDDLESEX (Belmont, Cambridge, Everett, Malden, Medford, Somerville); NORFOLK (Brookline, Dedham, Milton); AND SUFFOLK COUNTIES

	Rates	Fringes

CARPENTER.....$ 59.94 31.30

CARP0339-002 03/01/2025

BRISTOL (Attleborough, North Attleborough); ESSEX; MIDDLESEX (Except Belmont, Cambridge, Everett, Malden, Medford, Somerville); AND NORFOLK (Bellingham, Braintree, Canton, Cohassett, Foxboro, Franklin, Medfield, Medway, Millis, Needham, Norfolk, Norwood, Plainville, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham) COUNTIES

	Rates	Fringes
CARPENTER	$ 49.10	31.20

CARP0346-001 03/01/2025

NORFOLK (Braintree, Quincy, Cohasset, Weymouth, etc.) PLYMOUTH (Duxbury, Hanover, Hull, Hingham, Marshfield, Norwell, Pembroke Rockland, Scituate)

	Rates	Fringes
CARPENTER	$ 49.10	31.20

CARP0624-002 09/01/2017

DUKES; NANTUCKET

	Rates	Fringes
CARPENTER	$ 46.43	28.35

CARP0624-006 09/01/2017

BARNSTABLE; BRISTOL (Except Attleboro & North Attleboro); NORFOLK (Avon, Holbrook, Randolph, Stoughton); PLYMOUTH (Bridgewater, Kingston, Lakeville, Middleboro, Plymouth, S. Hanover, Whitman)

	Rates	Fringes
CARPENTER	$ 39.28	27.90

CARP1121-001 04/21/2025

SUFFOLK COUNTY

	Rates	Fringes
MILLWRIGHT	$ 50.47	33.50

CARP1121-005 04/21/2025

BARNSTABLE, BRISTOL, DUKES, ESSEX, MIDDLESEX, NANTUCKET, NORFOLK and PLYMOUTH COUNTIES

	Rates	Fringes
MILLWRIGHT	$ 45.03	33.25

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* ELEC0096-001 09/07/2025

MIDDLESEX (Ashby, Ashland, Ayer, Ft. Devens, Groton, Hopkinton, Hudson, Marlboro, Pepperell, Shirley, Stow, Townsend)

	Rates	Fringes
ELECTRICIAN	$ 48.16	36.20
Teledata System Installer	$ 36.12	34.51

ELEC0099-001 06/01/2025

BRISTOL (Attleboro, North Attleboro, Seekonk)

	Rates	Fringes
ELECTRICIAN	$ 56.11	44.10%
Teledata System Installer	$ 42.09	10.45%+15.31

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* ELEC0103-002 09/01/2025

ESSEX (Amesbury, Andover, Boxford, Georgetown, Groveland, Haverhill, Lawrence, Merrimac, Methuen, Newbury, Newburyport, North Andover, Rowley, Salisbury, West Newbury); MIDDLESEX (Bedford, Billerica, Boxboro, Burlington, Carlisle, Chelmsford, Dracut, Dunstable littleton, Lowell, North Reading, Tewksbury, Tyngsboro, Westford, Wilmington)

	Rates	Fringes
ELECTRICIAN	$ 66.17	37.08

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* ELEC0103-004 09/01/2025

ESSEX (Beverly, Danvers, Essex, Gloucester, Hamilton, Ipswich, Manchester, Marblehead, Middleton, Peabody, Rockport, Salem, Topsfield, Wenham)

	Rates	Fringes
ELECTRICIAN	$ 66.17	37.08

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* ELEC0103-005 09/01/2025

ESSEX (Lynn, Lynnfield, Nahant, Saugus, Swampscott); MIDDLESEX (Acton, Arlington, Belmont, Cambridge, Concord, Everett, Framingham, Holliston, Lexington, Lincoln, Malden, Maynard, Medford, Melrose, Natick, Newton, Reading, Sherborn, Somerville, Stoneham, Sudbury, Wakefield, Waltham, Watertown, Wayland, Weston, Winchester, Woburn); NORFOLK (Bellingham, Braintree, Brookline, Canton, Cohasset, Dedham, Dover, Foxboro, Frankloin, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham); PLYMOUTH (Hingham and Hull);SUFFOLK

	Rates	Fringes
ELECTRICIAN	$ 66.17	37.08

ELEC0104-001 09/01/2024

	Rates	Fringes
Line Construction:		
Cableman	$ 58.41	30.19+A
Equipment Operator	$ 49.65	26.72+A
Groundman	$ 32.13	12.70+A
Lineman	$ 58.41	30.19+A

A. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Christmas Day and Columbus Day, provided the employee has been employed 5 working days prior to any one of the listed holidays.

ELEC0223-002 09/01/2024

BARNSTABLE, BRISTOL (Except Attleboro, North Attleboro, Seekonk); DUKES; NANTUCKET; PLYMOUTH (Except Hingham and Hull Twps); NORFOLK (Avon, Halbrook, Randolph, Sloughton)

	Rates	Fringes
ELECTRICIAN	$ 50.02	31.09%+15.50

ENGI0004-009 06/01/2025

	Rates	Fringes
Power equipment operators:		
Group 1	$ 57.83	33.70
Group 2	$ 57.18	33.70
Group 3	$ 37.02	33.70
Group 4	$ 46.52	33.70
Group 5	$ 25.02	33.70
Group 6	$ 30.85	33.70

HOURLY PREMIUM FOR BOOM LENGTHS (Including Jib):
Over 150 ft. +2.18
Over 185 ft. +3.84
Over 210 ft. +5.39
Over 250 ft. +8.16
Over 295 ft. +11.29
Over 350 ft. +13.14

FOOTNOTE FOR POWER EQUIPMENT OPERATORS:
A. PAID HOLIDAYS: New Year's Day, Washington,s Birthday, Labor Day, Memorial Day, Independence Day, Patriot's Day, Columbus Day, Veteran's Day, Thanksgiving Day, Christmas Day

POWER EQUIPMENT OPERATORS CLASSIFICATIONS [HEAVY CONSTRUCTION]
GROUP 1: Power shovel; crane; truck crane; derrick; pile driver; trenching machine; mechanical hoist pavement breaker; cement concrete paver; dragline; hoisting engine; three drum machine; pumpcrete machine; loaders; shovel dozer; front end loader; mucking machine; shaft hoist; steam engine; backhoe; gradall; cable way; fork lift; cherry picker; boring machine; rotary drill; post hole hammer; post hole digger; asphalt plant on job site; concrete batching and/or mixing plant on job site; crusher plant on job site; paving concrete mixer; timber jack
GROUP 2: Sonic or vibratory hammer; grader; scraper; tandem scraper; bulldozer; tractor; mechanic - maintenance; York

rake; mulching machine; paving screed machine;stationary steam boiler; paving concrete finishing machine; grout pump; portable steam boiler; portable steam generator; roller; spreader; asphalt paver; locomotives or machines used in place thereof; tamper (self propelled or tractor-draw); cal tracks; ballast regulator;rail anchor machine; switch tamper; tire truck
GROUP 3: Pumps (1-3 grouped); compressor; welding machines (1-3 grouped); generator; sighting plant; heaters (power driven, 1- 5); syphon-pulsometer; concrete mixer; valves controlling permanent plant air steam, conveyor, wellpoint system (operating)
GROUP 4: Assitant engineer (fireman)
GROUP 5: Oiler (other than truck cranes and gradalls)
GROUP 6: Oiler (on truck cranes and gradalls)

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* IRON0007-001 09/16/2025

AREA 1: BRISTOL (Easton); ESSEX (Beverly,Gloucester,Lynn, Lynnfield, Manchester,Marblehead, Nahant, Rockport, Salem, Saugus, Swampscott); MIDDLESEX (Arlington, Bedford, Belmont, Burlington, Cambridge, Carlisle, Concord, Dunstable, Everett, Framingham, Lexington, Lincoln, Malden, Maynard, Medford, Melrose, Natick, Newton, Reading, Sherborn, Somerville, Stoneham, Sudbury, Wakefield, Waltham, Watertown, Wayland, Weston, Winchester, Woburn); NORFOLK (Except Medway); PLYMOUTH (Abington, Bridgewater, Brocton, Duxbury, East Bridgewater, Halifax, Hanover, Hanson, Hingham, Hull, Kingston, Marshfield, Norwell, Pembroke, Plymouth, Plympton, Rockland, Scituate, West Bridgewater, Whitman); SUFFOLK

AREA 2: ESSEX (Amesbury, Andover, Boxford, Danvers, Essex, Georgetown, Hamilton, Haverhill, Ipswich, Lawrence, Merrimac, Methuen, Newbury, Newburyport, North Andover, Rowley, Salisbury, Topsfield, Wenham, West Newbury); MIDDLESEX (Action,Billerica, Chelmsford, Dracut, Groton, Groveland, Littleton, Lowell, Middleton, North Reading, Pepperell, Tewksbury, Tyngsboro, Westford, Wilminton)

	Rates	Fringes
IRONWORKER		
AREA 1	$ 57.87	37.67
AREA 2	$ 53.46	37.67

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* IRON0007-010 09/16/2025

MIDDLESEX (Ashby, Ashland, Ayer, Boxboro, Holliston, Hopkinton, Hudson, Marlboro, Shirley, Stow, Townsend); NORFOLK (Medway)

	Rates	Fringes
IRONWORKER	$ 57.57	37.67

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* IRON0037-002 09/16/2025

BARNSTABLE; BRISTOL (Acushnet, Attleboro, Berkley, Dartmouth, Dighton, Fairhaven, Fall River, Freetown, Mansfield, New Bedford, North Attleboro, Norton, Raynham, Rehoboth, Seekonk, Somerset, Swansea, Taunton, Westport); DUKES; NANTUCKET; NORFOLK (Billingham, Franklin, Plainville, Wrentham); PLYMOUTH (Lakeville, Marion, Mattapoisett, Middleboro, Rochester,

Wareham)

	Rates	Fringes
IRONWORKER	$ 43.03	33.53

LABO0022-006 12/01/2024

SUFFOLK COUNTY (Boston, Chelsea, Revere, Winthrop, Deer & Nut Islands); MIDDLESEX COUNTY (Arlington, Belmont, Burlington, Cambridge, Everett, Malden, Medford, Melrose, Reading, Somerville, Stoneham, Wakefield, Winchester, Winthrop and Woburn only); NORFOLK COUNTY (Brookline, Dedham, and Milton only)

	Rates	Fringes
Laborers:		
GROUP 1	$ 46.20	29.70
GROUP 2	$ 46.20	29.70
GROUP 3	$ 46.20	29.70
GROUP 4	$ 46.20	29.70
GROUP 5	$ 27.01	29.70
GROUP 6	$ 46.20	29.70

LABORERS CLASSIFICATIONS

GROUP 1: Laborers; carpenter tenders; cement finisher tenders

GROUP 2: Asphalt raker; fence and guard rail erector; laser beam operator; mason tender; pipelayer; pneumatic drill operator; pneumatic tool operator; wagon drill operator

GROUP 3: Air track operator; block paver; rammer; curb setter

GROUP 4: Blaster; powderman

GROUP 5: Flagger

GROUP 6: Asbestos Abatement; Toxic and Hazardous Waste Laborers

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LABO0022-012 12/01/2024

Counties of BARNSTABLE; BRISTOL; DUKES; ESSEX; NANTUCKET; PLYMOUTH; MIDDLESEX (With the exception of Arlington, Belmont, Burlington, Cambridge, Everett, Malden, Melrose, Reading, Somerville, Stoneham, Wakefield, Winchester, Winthrop and Woburn); NORFOLK (With the exception of Brookline, Dedham, and Milton)

	Rates	Fringes
Laborers:		
GROUP 1	$ 38.95	29.70
GROUP 2	$ 38.95	29.70
GROUP 3	$ 38.95	29.70
GROUP 4	$ 38.95	29.70
GROUP 5	$ 27.01	29.70

GROUP 6.....$ 46.10 29.70

LABORERS CLASSIFICATIONS

GROUP 1: Laborers; carpenter tenders; cement finisher tenders

GROUP 2: Asphalt raker; fence and guard rail erector; laser beam operator; mason tender; pipelayer; pneumatic drill operator; pneumatic tool operator; wagon drillperator

GROUP 3: Air track operator; block paver; rammer; curb setter; hydraulic & similar self powere drills

GROUP 4: Blaster; powderman

GROUP 5: Flagger

GROUP 6: Asbestos Abatement; Toxic and Hazardous Waste Laborers

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LABO0022-013 12/01/2024

	Rates	Fringes
Laborers:		
(FREE AIR OPERATION):		
SHIELD DRIVEN AND LINER		
PLATE IN FREE AIR)		
GROUP 1	$ 50.50	29.70
GROUP 2	$ 50.50	29.70
(OPEN AIR CASSONS,		
UNDERPINNING AND TEST		
BORING INDUSTRIES):		
TEST BORING & WELL DRILLING		
Driller	$ 50.20	29.70
Laborer	$ 46.20	29.70
(OPEN AIR CASSONS,		
UNDERPINNING AND TEST		
BORING INDUSTRIES):		
OPEN AIR CASSON,		
UNDERPINNING WORK & BORING		
CREW		
Bottom man	$ 47.35	29.70
Laborers; Top man	$ 46.20	29.70
(TUNNELS, CAISSON &		
CYLINDER WORK IN		
COMPRESSED AIR)		
GROUP 1	$ 47.95	29.70
GROUP 2	$ 58.43	29.70
GROUP 3	$ 58.43	29.70
GROUP 4	$ 58.43	29.70
GROUP 5	$ 58.43	29.70
GROUP 6	$ 58.43	29.70
CLEANING CONCRETE AND		
CAULKING TUNNEL (Both New		
& Existing)		
GROUP 1	$ 50.50	29.70
GROUP 2	$ 50.50	29.70
ROCK SHAFT, CONCRETE		
LINING OF SAME AND TUNNEL		
IN FREE AIR		

GROUP 1	$ 47.95	29.70
GROUP 2	$ 50.50	29.70
GROUP 3	$ 50.50	29.70
GROUP 4	$ 50.50	29.70
GROUP 5	$ 52.50	29.70

LABORERS CLASSIFICATIONS for TUNNELS, CAISSON & CYLINDER WORK IN COMPRESSED AIR

GROUP 1: Powder watchman; Top man on iron bolt; change house attendant

GROUP 2: Brakeman; trackman; groutman; tunnel laborer; outside lock tender; lock tender; guage tender

GROUP 3: Motorman, miner

GROUP 4: Blaster

GROUP 5: Mucking machine operator

GROUP 6: Hazardous Waste work within the ""HOT"" zone. (A premium of two dollars $2.00 per hour over the basic wage rate.

LABORERS CLASSIFICATIONS for (FREE AIR OPERATION): SHIELD DRIVEN AND LINER PLATE IN FREE AIR

GROUP 1: Miner; miner welder; conveyor operator; motorman; mucking machine operator; nozzle man; grout man-; pumps, shaft and tunnel steel and rodman; shield and erector arm operators, mole nipper, outside motorman, burner, TBM operator, safety miner; laborer topside; heading motormen; erecting operators; top signal men

GROUP 2: Brakeman; trackman

LABORERS CLASSIFICATIONS FOR CLEANING CONCRETE AND CAULKING TUNNEL (Both New & Existing)

GROUP 1: Concrete workers; strippers and form movers (wood & steel), cement finisher

GROUP 2: Form erector (wood & steel and all accessories)

LABORERS CLASSIFICATIONS for ROCK SHAFT, CONCRETE LINING OF SAME AND TUNNE IN FREE AIR

GROUP 1: Change house attendants

GROUP 2: Laborers, topside, bottom men (when heading is 50 ft. from shaft) and all other laborers

GROUP 3: Brakeman; trackman; tunnel laborers; shaft laborers

GROUP 4: Miner; cage tender; bellman

GROUP 5: Hazardous Waste work within the ""HOT"" zone. (A premium of two dollars $2.00 per hour over the basic wage rate)

FOOTNOTE FOR LABORERS:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Patriot's Day, Memorial Day, Independence Day, Labor Day, Columbus Day, Veteran's Day, Thanksgiving Day, and Christmas Day

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LABO1421-001 12/02/2024

WRECKING LABORERS:

	Rates	Fringes
Laborers: (Wrecking)		
Group 1	$ 46.25	29.70
Group 2	$ 47.00	29.70
Group 3	$ 47.25	29.70
Group 4	$ 42.25	29.70
Group 5	$ 45.35	29.70
Group 6	$ 46.25	29.70

Group 1: Adzeman, Wrecking Laborer.
Group 2: Burners, Jackhammers.
Group 3: Small Backhoes, Loaders on tracks, Bobcat Type Loaders, Hydraulic ""Brock"" Type Hammer Operators, Concrete Cutting Saws.
Group 4: Yardman (Salvage Yard Only).
Group 5: Yardman, Burners, Sawyers.
Group 6: Asbestos, Lead Paint, Toxic and Hazardous Waste.

PAIN0035-001 07/01/2024

BARNSTABLE BRISTOL; DUKES; ESSEX; NANTUCKET; PLYMOUTH
(Remainder of NORFOLK; MIDDLESEX AND SUFFOLK COUNTIES)

	Rates	Fringes
PAINTER		
NEW CONSTRUCTION:		
Bridge	$ 50.36	30.25
Brush, Taper	$ 39.86	30.25
Spray, Sandblast	$ 41.26	30.25
REPAINT:		
Bridge	$ 56.76	36.00
Brush, Taper	$ 37.92	30.25
Spray, Sandblast	$ 39.32	30.25

PAIN0035-015 07/01/2024

MIDDLESEX (Cambridge, Everett, Malden, Medford, Sommerville)
SUFFOLK COUNTY (Boston, Chelsea) NORFOLK COUNTY (Brookline)

	Rates	Fringes
PAINTER		
NEW CONSTRUCTION:		
Brush, Taper	$ 46.26	36.00
Spay, Sandblast	$ 47.66	36.00
Spray, Sandblast	$ 47.05	30.25

REPAINT:
Bridge.....$ 56.76 36.00
Brush, Taper.....$ 44.32 36.00
Spray, Sandblast.....$ 45.72 36.00

PLAS0534-001 07/01/2024

ESSEX; MIDDLESEX; NORFOLK AND SUFFOLK COUNTY

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	$ 49.19	40.86

PLUM0004-001 09/01/2025

MIDDLESEX (Ashby, Ayer-West of Greenville branch of Boston and Maine Railroad, Ft. Devens, Groton, Shirley, Townsend)

	Rates	Fringes
Plumbers and Pipefitters.....	$ 55.00	31.57

PLUM0012-001 03/02/2025

ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence,Manchester, Marblehead, Merrimac, Methuem, Middleton, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Topsfieild, Wenham, West Newbury)

	Rates	Fringes
PLUMBER.....	$ 69.84	36.43

PLUM0012-003 03/02/2025

ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence, Manchester, Marblehead, Merrimac, Methuen, Middleton, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Topsfield, Wenham, West Newbury)

	Rates	Fringes
Plumber, Pipefitter, Steamfitter.....	$ 69.84	36.43

PLUM0012-006 03/02/2025

ESSEX (Lynn, Lynnfield, Nahant, Saugus, and Swampscott); MIDDLESEX (Acton, Arlington, Ashland, Ayer - except W. of Greenville Branch of Boston & Maine RR, Bedford, Belmont, Billerica, Boxboro, Burlington, Cambridge, Carlisle, Chelmsford, Concord, Dracut, Dunstable, Everett, Framingham, Hudson, Holliston, Hopkinton, Lexington, Lincoln, Littleton, Lowell, Malden, Marlboro, Maynard, Medford, Melrose, Natick, Newton, North Reading, Pepperell, Reading, Sherborn, Somerville, Stoneham, Stow, Sudbury, Tewksbury, Tyngsboro, Wakefield, Waltham, Watertown, Wayland, Westford, Wilmington, Winchester, Woburn); NORFOLK (Bellingham, Braintree,

Brookline, Canton, Cohasset, Dedham, Dover,Foxboro, Franklin, Medfield, Medway, Millis, Milton, Needham, Norfolk, Norwood, Plainville, Quincy, Sharon, Walpole, Wellesley, Westwood, Weymouth, Wrentham); PLYMOUTH (Hingham, Hull, Scituate); SUFFOLK

	Rates	Fringes
PLUMBER	$ 69.84	36.43

PLUM0051-005 08/26/2024

BARNSTABLE; BRISTOL; DUKES; NANTUCKET; NORFOLK (Avon, Holbrook, Randolph, Stoughton) PLYMOUTH(Remainder of County)

	Rates	Fringes
Plumbers and Pipefitters	$ 52.49	33.60

PLUM0537-001 03/01/2025

MIDDLESEX (Arlington, Cambridge, Everett, Malden, Medford, Melrose, Reading, Wakefield, Winchester and Woburn); NORFOLK (Bellingham, Braintree, Brookline, Canton Cashasset, Dedham, Foxboro, Franklin, Millis, Milton, Sharon, Walpole, Westwood, and Wrenthan); PLYMOUTH (Hingham, Hull, Scituate); ESSEX (Ames, Andover, Beverly, Boxford, Byfield, Danvers, Essex, Georgetown, Gloucester, Groveland, Hamilton, Haverhill, Ipswich, Lawrence,Lynn, Lynnfield, Manchester, Marblehead, Merrimac, Methuem, Middleton, Nahant, Newbury, Newburyport, North Andover, Peabody, Rockport, Rowley, Salem, Salisbury, Saugus, Swampscott, Topsfieild, Wenham, West Newbury)

	Rates	Fringes
PIPEFITTER	$ 66.58	39.22

TEAM0379-001 06/01/2025

	Rates	Fringes
Truck drivers:		
Group 1	$ 40.78	37.35+a+b
Group 2	$ 40.95	37.35+a+b
Group 3	$ 41.02	37.35+a+b
Group 4	$ 41.14	37.35+a+b
Group 5	$ 41.24	37.35+a+b
Group 6	$ 41.53	37.35+a+b
Group 7	$ 41.82	37.35+a+b

POWER TRUCKS $.25 DIFFERENTIAL BY AXLE
TUNNEL WORK (UNDERGROUND ONLY) $.40 DIFFERENTIAL BY AXLE
HAZARDOUS MATERIALS (IN HOT ZONE ONLY) $2.00 PREMIUM

TRUCK DRIVERS CLASSIFICATIONS

Group 1: Station wagons; panel trucks; and pickup trucks

Group 2: Two axle equipment; & forklift operator

Group 3: Three axle equipment and tireman

Group 4: Four and Five Axle equipment

Group 5: Specialized earth moving equipment under 35 tons other than conventional type trucks; low bed; vachual; mechanics, paving restoration equipment

Group 6: Specialized earth moving equipment over 35 tons

Group 7: Trailers for earth moving equipment (double hookup)

FOOTNOTES:

A. PAID HOLIDAYS: New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Patriot's Day, Columbus Day, Veteran's Day, Thanksgiving Day and Christmas Day

B. PAID VACATION: Employees with 4 months to 1 year of service receive 1/2 day's pay per month; 1 week vacation for 1 - 5 years of service; 2 weeks vacation for 5 - 10 years of service; and 3 weeks vacation for more than 10 years of service

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at https://www.dol.gov/agencies/whd/government-contracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey

rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were

adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

a) a survey underlying a wage determination
b) an existing published wage determination
c) an initial WHD letter setting forth a position on a wage determination matter
d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

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END OF GENERAL DECISION"

APPENDIX I

BUILD AMERICA, BUY AMERICA ACT (BABA)

AMERICAN IRON AND STEEL (AIS)

ATTACHMENTS

1. **Information Checklist for Waiver Request**
2. **HQ Review Checklist for Waiver Request**
3. **Example Loan Agreement Language**
4. **Sample Construction Contract Language**
5. **Sample Certification 1**
   Sample Certification 2

Appendix I
Build America, Buy America (BABA) Requirements

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER

November 3, 2022

MEMORANDUM

SUBJECT: Build America, Buy America Act Implementation Procedures for EPA Office of Water Federal Financial Assistance Programs

FROM: RadhikaFox
Assistant Administrator

TO: EPA Regional Water Division Directors, Regions I - X
EPA Office of Water Office Directors

OVERVIEW

The Biden-Harris Administration recognized the Nation's critical need for infrastructure investment, championing the Bipartisan Infrastructure Law (BIL), which Congress passed on November 15, 2021 (also known as the Infrastructure Investment and Jobs Act (IIJA)). The BIL will provide an unprecedented level of federal investment in water and wastewater infrastructure in communities across America.

In Title IX of the IIJA, Congress passed the Build America, Buy America (BABA) Act, which establishes strong and permanent domestic sourcing requirements across all Federal financial assistance programs for infrastructure. The U.S. Environmental Protection Agency (EPA) Office of Water is honored to help lead the implementation of these provisions and is proud of its near decade of successful implementation of the American Iron and Steel (AIS) provisions for its flagship water infrastructure programs.

This is a transformational opportunity to build a resilient supply chain and manufacturing base for critical products here in the United States that will spur investment in good-paying American manufacturing jobs and businesses. EPA's efforts to implement BABA will help cultivate the domestic manufacturing base for a wide range of products commonly used across the water sector but not currently made domestically. This will take time, and flexibility will be important to ensure that EPA can leverage critical water investments on time and on budget to protect public health and improve water quality.

IMPLEMENTATION

Recognizing the opportunity and need for BABA implementation guidance, the Made in America Office (MIAO) of the Office of Management and Budget (OMB) published Initial Implementation Guidance on Application of Buy America Preference in Federal Financial Assistance Programs for Infrastructure (OMB Guidance M-22-11) on April 18, 2022. The guidance provides government-wide implementation direction for all Federal financial assistance programs for infrastructure. Despite the extensive guidance developed by MIAO, EPA's Office of Water infrastructure investment programs have received many questions that were not addressed in OMB Guidance M-22-11 or that require further clarification for EPA water infrastructure programs. The following questions and answers serve to supplement OMB Guidance M-22-11 with implementation procedures specific to EPA's relevant water infrastructure programs.

Section 70914(a) of the IIJA states when a Buy America preference under BABA applies: "Not later than… [May 14, 2022], the head of each Federal agency shall ensure that none of the funds made available for a Federal financial assistance program for infrastructure…may be obligated for a project unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States." Therefore, Federal financial infrastructure investments obligated on or after May 14, 2022, must comply with the BABA requirements. Absent a waiver, all iron, steel, manufactured products, and construction materials permanently incorporated into an infrastructure project subject to the BABA requirements must be produced in the United States. For many of EPA's Office of Water infrastructure investment programs, the vast majority of products permanently incorporated into construction, maintenance, or repair projects must comply with the BABA requirements, with the exception of select construction materials (cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives), which are specifically excepted by the BABA statute.

EPA's Office of Water implements many infrastructure investment programs subject to BABA requirements, including the following:

- Alaska Native Villages and Rural Communities Water Grant Program (ANV) (and any associated Interagency Agreements with the Indian Health Service)
- Clean Water and Drinking Water State Revolving Fund Programs (CW and DWSRF)
- Clean Water and Drinking Water Grants to U.S. Territories and the District of Columbia
- Clean Water Indian and Drinking Water Tribal Infrastructure Grant Set-aside (and any associated Interagency Agreements with the Indian Health Service)
- Coastal Wetlands Planning, Protection and Restoration Act, (CWPPRA) Programs
- Congressionally Directed Spending/Community Project Funding (also known as Community Grants)
- Geographic Programs[1]
- Gulf Hypoxia Program
- National Estuaries Program (CWA Section 320)

[1] Geographic Programs include: Great Lakes Restoration Initiative, Chesapeake Bay, San Francisco Bay, Puget Sound, Long Island Sound, Gulf of Mexico, South Florida, Lake Champlain, Lake Pontchartrain, Southern New England Estuaries, Columbia River Basin, Pacific Northwest

- 319 Nonpoint Source Management Program Implementation
- Reducing Lead in Drinking Water Grant Program (SDWA §1459B)
- Assistance for Small and Disadvantaged Communities Grants: Small, Underserved, and Disadvantaged Community Grant Program (SUDC), Emerging Contaminants in Small or Disadvantaged Communities (EC-SDC) and Drinking Water Infrastructure Resilience & Sustainability (SDWA §1459A)
- Sewer Overflow and Stormwater Reuse Municipal Grants (OSG)
- USMCA Implementing Legislation (Section 821 and Title IX, USMCA Supplemental Appropriations, 2020)
- U.S.-Mexico Border Water Infrastructure Program
- Voluntary School and Child Care Program Lead Testing and Remediation Grant Program (SDWA 1464(d))
- Water Infrastructure Finance and Innovation Act (WIFIA)

The questions and answers in this document apply to the implementation of BABA requirements for the Office of Water infrastructure programs listed above unless superseded by regulation, statute, or other applicable guidance. For many of the programs listed above which did not have domestic preference requirements prior to BABA, additional implementation details are pending or may be developed after the issuance of these procedures. In addition, EPA notes that more direction will be helpful to inform the determination and definition of domestic content in manufactured goods. Supplemental guidance on these and other issues, from either OMB or EPA, may be forthcoming. These implementation procedures may also apply to additional, unlisted EPA programs which may be required to apply BABA subsequent to publication of this memorandum (e.g., future funding programs which have been authorized, but not yet appropriated).

For more information on the BABA requirements, visit the EPA Office of Water's dedicated website – https://www.epa.gov/cwsrf/build-america-buy-america-baba – or contact your funding authority (such as your grants officer, portfolio manager, or state contact). For information on approved waivers, visit https://www.epa.gov/cwsrf/build-america-buy-america-baba-approved-waivers. You may also email questions to BABA-OW@epa.gov.

This Implementation Procedures document is organized to provide responses to questions in the following topic areas:

- Section 1: General 4
- Section 2: Product Coverage 5
- Section 3: Co-funding 9
- Section 4: Waivers 10
- Section 5: Documenting Compliance 12
- Section 6: Programs with American Iron and Steel Requirements 16
- Section 7: Program-Specific Issues 17
- Appendix 1: Example Build America, Buy America (BABA) Act Construction Contract Language 22
- Appendix 2: Example Build America, Buy America (BABA) Act Assistance Agreement Language 23

QUESTIONS AND ANSWERS

SECTION 1: GENERAL

- Q1.1: Will EPA provide documentation for BABA for bid solicitations and suggested contract language? Will EPA provide suggested language for Assistance Agreements?

    - A1.1: See Appendix 1, which includes suggested language for construction contracts which addresses the BABA requirements. In addition to the language suggested in Appendix 1, EPA also recommends that assistance recipients prepare contract bid solicitation documents with a statement for the consulting engineers and construction firms as follows: "By signing payment application and recommending payment, Contractor certifies they have reviewed documentation for all products and materials submitted for payment, and the certifications are sufficient to demonstrate compliance with Build America, Buy America Act requirements." In most cases, the assistance recipient's representatives assume the responsibility for their clients to conduct due diligence on compliance with applicable domestic preference requirements.

      All Federal Financial infrastructure assistance agreements subject to BABA must have a clause requiring compliance with the requirements. See Appendix 2 for example assistance agreement language.

- Q1.2: Would federally-financed infrastructure projects outside of the United States need to comply with the BABA requirements?

    - A1.2: No. According to the OMB Guidance (M-22-11), a "project" is defined as "…any activity related to the construction, alteration, maintenance, or repair of infrastructure in the United States." Therefore, the BABA requirements are not implicated for infrastructure projects occurring outside of the United States, such as projects funded through the United States-Mexico-Canada Agreement with infrastructure activities occurring in Mexico or Canada (that is, outside the United States).
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- Q1.3: If most of the project is BABA compliant, and a small portion is not, can an assistance recipient self-fund (i.e., paying with non-federal dollars) the non-compliant products?

    - A1.3: Any project that is funded in whole or in part with federal assistance must comply with the BABA requirements, unless the requirements are otherwise waived. All iron, steel, manufactured products, and construction materials used in a project must meet the BABA requirements unless waived. Absent a waiver, there is no "small portion" or product that does not need to satisfy the BABA requirements unless the requirements are waived (or specifically excluded as is the case for cement and cementitious materials; aggregates such as stone, sand, or gravel; aggregate binding agents or additives; or non-permanent products). An assistance recipient may request a waiver or inquire as to whether a broad waiver, such as a *de minimis* waiver, might apply.

- Q1.4: How do international trade agreements affect the implementation of the BABA requirements?

    - A1.4: The BABA requirements apply in a manner consistent with United States obligations under international trade agreements. Typically, these obligations only apply to direct procurement by the entities that are signatories to these trade agreements. In general, assistance recipients are not signatories to such agreements, so these trade agreements have no impact on BABA implementation. In the few instances where such an agreement applies to a municipality, that municipality is responsible for determining its applicability and requirements and communicating with the funding authority (such as EPA and/or a state) on the actions taken to comply with BABA.

SECTION 2: PRODUCT COVERAGE

- Q2.1: For products made of iron and steel, what is the difference between predominantly and primarily iron and steel?

    - A2.1: EPA considers the terms "predominantly" and "primarily" to be interchangeable, such that a product is considered predominantly (or primarily) iron and steel if it contains greater than 50 percent iron and steel by material cost.

- Q2.2: What is the definition of construction materials (with examples)?

    - A2.2: From OMB Guidance M-22-11: "construction materials" include an article, material, or supply (other than an item of primarily iron or steel; a manufactured product; cement and cementitious materials; aggregates such as stone, sand, or gravel; aggregate binding agents or additives; or non-permanent products) that is or consists primarily of:
        - non-ferrous metals,
        - plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables), (including optic glass),
        - lumber, and
        - drywall.

      For example, a plate of glass would be a construction material under BABA, but a framed window that incorporates the glass into a frame would be a manufactured product. Another common construction material for water infrastructure projects would be polyvinyl chloride (PVC) pipe and fittings. However, if PVC components are incorporated into a more complex product such as instrumentation and control equipment or a water treatment unit, those items would be manufactured products.

- Q2.3: What are manufactured products (with examples)?

    - A2.3: From OMB Guidance M-22-11: "…all manufactured products used in the project are produced in the United States—this means the manufactured product was manufactured in the United States; and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total

cost of all components of the manufactured product, unless another standard for determining the minimum amount of domestic content of the manufactured product has been established under applicable law or regulation…"

The manufactured products category would cover the majority of potential water infrastructure products, including complex products made up of a variety of material types and components. For water infrastructure projects, common manufactured products would include, but not be limited to, pumps, motors, blowers, aerators, generators, instrumentation and control systems, gauges, meters, measurement equipment, treatment equipment, dewatering equipment, actuators, and many other mechanical and electrical items.

- Q2.4: Which category will valves fall under for BABA? Will it differ from the American Iron and Steel (AIS) requirements?
    - A2.4: For programs that are subject to BABA and AIS (SRF, WIFIA, and Community Project Funding), projects using valves should classify them as iron and steel products under BABA as long as their material cost is made up of more than 50 percent iron and/or steel. Valves with 50 percent or less iron and/or steel by material cost would be considered manufactured products under the BABA requirements.

      In accordance with OMB Guidance M-22-11, an article, material, or supply should be classified into only one of the three categories: iron and steel, manufactured products, or construction materials. Under the AIS requirements, all valves made primarily of iron and steel (that is, those with iron and/or steel material cost greater than 50 percent) must comply with the AIS requirements. For BABA, EPA interprets Section IV of OMB Guidance M-22-11 to mean that iron and steel products are those items that are primarily iron and steel, the same as for the AIS requirements.

- Q2.5: Does EPA have a list of products to be classified as "Iron and Steel" under BABA?
    - A2.5: Although this list is not comprehensive, the following products were classified as AIS products if made primarily (more than 50 percent) of iron and/or steel by materials cost (for programs subject to both AIS and BABA, this list would be equivalent for "iron and steel" items or products under either requirement):

Products likely made "primarily" of iron and steel to be classified as Iron and Steel under BABA		
Lined and Unlined Pipe	Lined and Unlined Fittings	Tanks
Flanges	Pipe Clamps and Restraints	Structural Steel
Valves	Hydrants	Pre-Cast, Iron/Steel Reinforced Concrete (of all types, regardless of iron/steel content percentage)
Manhole Covers and other Municipal Castings	Access Hatches	Ballast Screens
Iron or Steel Benches	Bollards	Cast Bases
Cast Iron Hinged Hatches	Cast Iron Riser Rings	Catch Basin Inlets
Cleanout/Monument Boxes	Construction Covers and Frames	Curb and Corner Guards

Products likely made "primarily" of iron and steel to be classified as Iron and Steel under BABA		
Curb Boxes	Curb Openings	Curb Stops
Detectable Warning Plates	Downspout Shoes	Drainage Grates
Drainage Grate Frames and Curb Inlets	Inlets	Junction Boxes
Lampposts	Manhole Rings and Frames	Manhole Risers
Meter Boxes	Service Boxes	Steel Hinged Hatches
Steel Riser Rings	Trash Receptacles	Tree Grates
Tree Guards	Trench Grates	Valve Boxes
Valve Box Covers and Risers	Access Ramps	Aeration Pipes and Fittings (separate from aeration/blowers)
Angles	Backflow Preventers/Double Check Valves	Baffle Curtains
Iron or Steel Bar	Bathroom Stalls	Beam Clamps
Cable Hanging Systems	Clarifier Tanks	Coiled Steel
Column Piping	Concrete Reinforcing Bar, Wire, and Fibers	Condensate Sediment Traps
Corrugated Pipe	Couplings	Decking
Digestor Covers	Dome Structures	Door Hardware
Doors	Ductwork	Expansion Joints
Expansion Tanks (diaphragm, surge, and hydropneumatics)	Fasteners	Fencing and Fence Tubing
Fire Escapes	Flanged Pipe	Flap Gates
Framing	Gate Valves	Generic Hanging Brackets
Grating	Ground Testing Boxes	Ground Test Wells
Guardrails	HVAC Registers, Diffusers, and Grilles	Joists
Knife Gates	Ladders	Lifting Hooks, J-bar, Connectors within, and Anchors for Concrete
Lockers	Man Baskets and Material Platforms	Manhole Steps
Mud Valves	Municipal Casting Junctions	Non-mechanical (aka stationary) Louvers and Dampers
Overhead Rolling Doors/ Uplifting Doors (manual open, no motor)	Pipe Connectors	Pipe Hangers
Pipe Pilings (any type of steel piling)	Pipe Spool (pipe, flanges, connectors, etc.)	Pipe Supports
Pitless Adaptors	Pre-fab Steel Buildings/Sheds (simple structure, unfurnished)	Pre-stressed Concrete Cylinder Pipe (PCCP)
Railings	Reduced Pressure Zone (RPZ) Valves	Roofing
Service Saddles	Sheet Piling	Sinks (not part of eyewash systems)
Solenoid Valves	Stairs	Static Mixers
Stationary Screens	Surface Drains	Tapping Sleeves
Telescoping Valves	Tipping Buckets	Trusses
Tubing	Valve Stem Extensions	Valve Stems (excluding handwheels and actuators)
Wall Panels	Wall Sleeves/Floor Sleeves	Welding Rods
Well Casing	Well Screens	Wire
Wire Cloth	Wire Rod	Wire Rope and Cables

Q2.6: Does EPA have a list of products that could be made "primarily" of iron and steel but would be classified as "manufactured products" under BABA?

A2.6: Although this list is not comprehensive, the following products would be considered "manufactured products" under the BABA requirements, even if the item might be composed primarily of iron and steel by materials cost (Note: These items are not subject to the AIS requirements.):

Products likely made "primarily" of iron and steel to be classified as Manufactured Products under BABA		
Actuator Superstructures/ Support Structures	Aeration Nozzles and Injectors	Aerators
Analytical Instrumentation	Analyzers (e.g., ozone, oxygen)	Automated Water Fill Stations
Blowers/Aeration Equipment	Boilers, Boiler Systems	Chemical Feed Systems (e.g., polymer, coagulant, treatment chemicals)
Chemical Injection Quills	Chemical Injectors	Clarifier Mechanisms/Arms
Compressors	Controls and Switches	Conveyors
Cranes	Desiccant Air Dryer Tanks	Dewatering Equipment
Dewatering Roll-offs	Disinfection Systems	Drives (e.g., variable frequency drives)
Electric/Pneumatic/Manual Accessories Used to Operate Valves (such as electric valve actuators)	Electrical Cabinetry and Housings (such as electrical boxes/enclosures)	Electrical Conduit
Electrical Junction Boxes	Electronic Door Locks	Elevator Systems (hydraulic, etc.,)
Emergency Life Systems (including eyewash stations, emergency safety showers, fire extinguishers, fire suppression systems including sprinklers /piping/valves, first aid, etc.)	Exhaust Fans	Fall Protection Anchor Points
Fiberglass Tank w/Appurtenances	Filters (and appurtenances, including underdrains, backwash systems)	Flocculators
Fluidized Bed Incinerators	Galvanized Anodes/Cathodic Protection	Gear Reducers
Generators	Geothermal Systems	Grinders
Heat Exchangers	HVAC (excluding ductwork)	HVAC Dampers (if appurtenances to aerators/blowers)
HVAC Louvers (mechanical)	Intake and Exhaust Grates (if appurtenances to aerators/blowers)	Instrumentation
Laboratory Equipment	Ladder Fall Prevention Systems	Ladder Safety Posts
Lighting Fixtures	Lightning and Grounding Rods	Mechanical or Actuated Louvers/Dampers
Membrane Bioreactor Systems	Membrane Filtration Systems	Metal Office Furniture (fixed)
Meters (including flow, wholesale, water, and service connection)	Motorized Doors (unit)	Motorized Mixers
Motorized Screens (such as traveling screens)	Motors	Pelton Wheels
Pipeline Flash Reactors (similar to injectors)	Plate Settlers	Precast Concrete without Iron/Steel Reinforcement

Products likely made "primarily" of iron and steel to be classified as Manufactured Products under BABA		
Furnished Pre-fab Buildings (such as furnished with pumps, mechanics inside)	Presses (including belt presses)	Pressure Gauges
Pump Cans/Barrels and Strainers	Pumps	Mechanical Rakes
Safety Climb Cable	Sampling Stations (unless also act as hydrant)	Scrubbers
Sensors	Sequencing Batch Reactors (SBR)	Steel Shelving (fixed)
Slide and Sluice Gates	Spray Header Units	Steel Cabinets (fixed interior/furniture)
Supervisory Control and Data Acquisition (SCADA) Systems	Tracer Wire	Valve Manual Gears, Actuators, Handles
Voltage Transformer	Water Electrostatic Precipitators (WESP)	Water Heaters
Weir Gates		

- Q2.7: Is asphalt paving a covered product under BABA?
    - A2.7: No. EPA interprets Section 70917(c) of the IIJA to exclude asphalt from BABA requirements. Asphalt paving is a type of concrete composed of an aggregate material mixed with a binder (bitumen). EPA considers asphalt concrete to be excluded by section 70917(c) due to its similarities with cement and cementitious materials.

SECTION 3: CO-FUNDING

- Q3.1: If projects are co-funded with funding mechanisms that don't require BABA, must the entire project comply with BABA?
    - A3.1: Yes. Any project that is funded in whole or in part with federal assistance must comply with the BABA requirements, unless the requirements are otherwise waived. A "project" consists of all construction necessary to complete the building or work regardless of the number of contracts or assistance agreements involved so long as all the contracts and assistance agreements awarded are closely related in purpose, time, and place. This precludes the intentional splitting of projects into separate and smaller contracts or assistance agreements to avoid BABA's applicability on some portions of a larger project, particularly where the activities are integrally and proximately related to the whole. However, there are many situations in which major construction activities are clearly undertaken in separate phases that are distinct in purpose, time, or place, in which case, separate contracts or assistance agreements would carry separate requirements.

- Q3.2: How will project requirements be determined for co-funded projects subject to potentially different general applicability/programmatic waiver conditions (such as different adjustment period waivers)?

    - A3.2: OMB Guidance M-22-11 addresses cases with project co-funding from separate programs. EPA would apply the guidance's "cognizant" program determination to projects that are co-funded with different general applicability/programmatic waivers. For instance, if a project were co-funded between WIFIA and SRF and the majority of the Federal funding for the project is from WIFIA, then WIFIA would be the "cognizant" program for application and determination of waivers. In that case, any conditions from an applicable WIFIA waiver would apply.

SECTION 4: WAIVERS

- Q4.1: Who may apply for a waiver and how do you apply?

    - A4.1: Assistance recipients and their authorized representatives may apply for a project-specific waiver. EPA does not accept waiver requests from suppliers, distributors, or manufacturers unless the assistance recipient endorses and submits the request on its own behalf to the funding authority. In the case where multiple programs are providing federal funds to the project, the assistance recipient should submit the waiver request to the cognizant program, the one providing the greatest amount of federal funds for the project. For information on applying for cost waivers, see questions 4.4 and 4.5. For information on the SRF program roles and responsibilities, see question 7.6.

      Project-specific waiver requests should generally include: (1) a brief summary of the project, (2) a description and explanation of the need for the waiver for the product(s) in question, (3) a brief summary of the due diligence conducted in search of domestic alternatives (which could include correspondence between assistance recipient and supplier/distributors), (4) the quantity and materials of the product(s) in question, (5) all engineering specifications and project design considerations relevant to the product(s) in question, (6) the approximate unit cost of items (both foreign and domestic) in addition to an estimated cost of the materials and overall project, (7) the date any products will be needed on site in order to avoid significant project schedule disruptions, and (8) any other pertinent information relevant to EPA's consideration of the waiver (e.g., if relevant for SRF projects: whether the project is designated as an equivalency project, the date the plans and specifications were submitted to the state, the date of construction initiation, expected date of project completion, any special considerations such as local zoning and building ordinances, seismic requirements, or noise or odor control requirements).

      In the case of indirect federal assistance, such as the SRF programs, the state authority reviews and conveys the waiver request to EPA. States should submit waiver requests to the appropriate program waiver request inbox. For SRF projects, please use CWSRFWaiver@epa.gov or DWSRFWaiver@epa.gov.

- Q4.2: Can an assistance recipient request a waiver based on a specification written for a specific brand or model of product (that is, a specification that names a branded item or model)?

    - A4.2: In most cases, performance-based specifications are expected and required for the majority of infrastructure projects funded by EPA's financial assistance programs. In rare cases where "branded" or product-specific sourcing may be included in project specifications, it is suggested that the specifications include the item in question (that is, not simply a catalog page, but also materials of construction, sizing, quantities, and applicable engineering performance design characteristics for the project, etc.) in addition to the standard phrase "or equal." For the purposes of product alternative market research, EPA will evaluate the BABA requirements based on performance-based engineering specifications for the product(s) in question. If the project's specifications do not include performance-based specifications, or at least an "or equal" designation, EPA will base its research on an "or equal" designation using best professional judgment to the extent practicable.

- Q4.3: If a manufactured product is not readily available domestically, will EPA provide short-term "limited availability" product waivers?

    - A4.3: EPA will address the unavailability of domestic products through the waiver process, including potential national short-term waivers for specific products, if appropriate. To the extent practicable and with the intent to maximize domestic market and supply chain development, EPA intends to address issues of broad product unavailability with targeted, time-limited, and conditional waivers, as prescribed in OMB Guidance M-22-11. EPA will follow its robust and thorough product research processes (those put into place for the AIS requirements for the SRF and WIFIA programs and expanded for the new BABA requirements) to identify and determine those products for which proposed national/general applicability waivers may be appropriate.

- Q4.4: What information is needed when applying for a cost waiver under BABA?

    - A4.4: As part of the cost waiver request, the assistance recipient must demonstrate that implementation of the BABA requirements will increase the overall project cost more than 25 percent. Depending on the circumstances of the overall project cost increases, documentation to justify the cost waiver can vary but may include itemized cost estimates or bid tabulations comparing project costs with and without BABA implementation. Assistance recipients should begin assessing the potential cost impacts of the BABA requirements during the design phase of a project.

- Q4.5: Can administrative costs associated with tracking and verification of certifications be considered when determining if the cost of a project increases by 25 percent or more?

    - A4.5: Yes. Section 70914(b)(3) of the IIJA states that a waiver may be provided if the overall cost of the project increases by more than 25 percent due to the "inclusion of iron, steel, manufactured products, or construction materials produced in the United States." EPA interprets this to mean that the "inclusion" of the BABA-covered products could encompass

reasonable administrative costs associated with complying with the BABA requirements, such as staff, contractor, and technological resources to collect and track BABA compliance documentation.

- Q4.6: How can assistance recipients and construction contractors address product delivery delays?

    - A4.6: Assistance recipients should reasonably plan for material procurement to account for known potential supply chain issues or extended lead times and shall notify the funding authority well in advance of the issues so that prompt attention can be given to explore options. Where extended lead times for compliant products are impacting project schedules and may significantly impact construction progress, timely communication with the funding agency is important. For products that are unavailable within a reasonable timeframe to meet the objectives and schedule of a project, EPA may consider a non-availability waiver with adequate justification. An assistance recipient would need to apply for the waiver and contact its funding authority (such as EPA and/or a state) to initiate the waiver process.

SECTION 5: DOCUMENTING COMPLIANCE

- Q5.1: Who will be responsible for BABA enforcement?

    - A5.1: Responsibility for BABA implementation applies at all levels, from manufacturers to suppliers and distributors, construction contractors, assistance recipients, and funding authorities.

      The manufacturers have responsibility to provide adequate and accurate documentation of the products manufactured. If suppliers and distributors are involved, they are responsible for passing along compliance documentation for products supplied to projects that are subject to the BABA requirements.

      The assistance recipient and their representatives are primarily responsible for ensuring the documentation collected for products used on the project is sufficient to document compliance with the BABA requirements.

      The funding authority is responsible for providing oversight and guidance as needed to ensure the proper implementation of the requirements. The Uniform Grants Guidance (UGG) (Title 2 of the Code of Federal Regulations (CFR) Part 200) applies to many Federal financial assistance agreements that will include BABA requirements. The general provisions of 2 CFR Part 200 determine the responsible party for the grant funding authority.

      For information on SRF program roles and responsibilities, see question 7.6.

      At all levels, where fraud, waste, abuse, or any violation of the law is suspected, the Office of Inspector General (OIG) should be contacted immediately. The OIG can be reached at 1-888-546-8740 or OIG_Hotline@epa.gov. More information can be found at this website: http://www.epa.gov/oig/hotline.htm.

- Q5.2: When will the BABA requirements be assessed for compliance? Do assistance recipients need to have waivers for potential non-domestic products before assistance agreements are in place, at the time products are procured or products are incorporated into the project (i.e., used)?

    - A5.2: Compliance is assessed where the domestic product is used (or installed) at the project site. Proper compliance documentation, whether it is a BABA certification letter or a waiver, should accompany a product prior to its "use", in accordance with Section 70914(a) of IIJA. This may occur prior to assistance agreements being in place but is not necessary. Additionally, communication of BABA requirements through appropriate Terms and Conditions in financial assistance agreements and in project solicitation and contract documents is key in ensuring all parties involved are informed of the requirements for the project before construction is underway.

- Q5.3: How can product compliance with the BABA requirements be demonstrated?

    - A5.3: Assistance recipients and their representatives should ensure that the products delivered to the construction site are accompanied by proper documentation that demonstrate compliance with the law and be made available to the funding authority upon request. The documentation may be received and maintained in hard copy, electronically, or could be embedded in construction management software. The use of a signed certification letter for the project is the most direct and effective form of compliance documentation for ensuring products used on site are BABA-compliant prior to their installation; however, other forms of documentation are also acceptable as long as collectively, the following can be demonstrated:

        (1) Documentation linked to the project. For example, this can be in the form of the project name, project location, contract number, or project number.
        (2) Documentation linked to the product used on the project. For example, description of product(s) (simple explanation sufficient to identify the product(s)), or an attached (or electronic link to) purchase order, invoice, or bill of lading.
        (3) Documentation includes statement attesting that the products supplied to the assistance recipient are compliant with BABA requirement. Reference to the Infrastructure Investment and Jobs Act ("IIJA") or the Bipartisan Infrastructure Law (BIL) are also acceptable. For iron and steel items under BABA, references to the American Iron and Steel (AIS) requirements are also acceptable and reciprocal with BABA for such items.
        (4) Documentation that manufacturing occurred in the United States, which could include, for example, the location(s) of manufacturing for each manufacturing step that is being certified. It is acceptable for manufactured products to note a single point of manufacturing, documenting that the final point of manufacturing is in the United States. Note that each BABA category may require different determinations for compliance.
        (5) Signature of company representative (on company letterhead and signature can be electronic). The signatory of the certifying statement affirms their knowledge of the manufacturing processes for the referenced product(s) and attests that the product meets the BABA requirements.

In addition to compliance documentation, assistance recipients or their representatives should also conduct a visual inspection of the product when it arrives to the project site, especially for iron and steel products which are often stamped with the country of origin. (Note: A country of origin stamp alone is not sufficient verification of compliance with BABA and assistance receipts should not rely on it to ensure compliance.)

EPA may develop alternative procedures for demonstrating compliance. Additional project- or program-specific instructions may be developed on a case-by-case basis in order to meet individual circumstances.

- Q5.4: Will EPA provide a form or template for tracking and documenting compliance?
    - A5.4: EPA does not require a specified format for tracking or documenting compliance. Assistance recipients are free to develop any system (from simple to complex software) for tracking items used on the project and the accompanying compliance documentation, e.g., certification letters, applicable waivers, if it helps with implementation and compliance. Elements that may help with keeping track of compliance may include: product description, quantity required/used, product category (i.e., iron and steel, manufactured product, or construction material), status of obtaining certification letter, product cost, and whether the item might qualify as *de minimis*, or qualify under another applicable waiver.
- Q5.5: If a manufacturer claims to comply with the Buy American Act, does it also comply with BABA?
    - A5.5: No. With the exception of the AIS requirements – which EPA interprets to be equivalent to the "iron and steel" requirements under BABA – EPA does not have an interpretation about the comparability of other domestic preference requirements relative to BABA. Any products that are to be certified as compliant with BABA should include a specific reference to the BABA requirements and appropriate attestation from a responsible manufacturing company official. See Question 5.3 for EPA's recommendations for BABA certification letters.
- Q5.6: How will assistance recipients manage certification letters for hundreds, possibly thousands of products?
    - A5.6: EPA recognizes that the new BABA requirements will cover most products used in typical water and wastewater infrastructure projects, and that the number of items which may require certification at large and/or complex projects may reach several hundred. EPA is concerned about the potential administrative burden that this would place on assistance recipients. EPA recommends that projects with a high number of potentially covered products meet with their funding authority about potential compliance strategies to minimize burden and streamline compliance activity. Assistance recipients should prepare contract bid solicitation documents with a statement for the consulting engineers and construction firms as follows: "By signing payment application and recommending payment, Contractor certifies they have reviewed documentation for all products and materials submitted for payment, and the documentation is sufficient to demonstrate compliance with Build America,

Buy America Act requirements." In most cases, the assistance recipient's representatives may assume the responsibility for their clients to conduct due diligence on compliance with applicable domestic preference requirements.

- Q5.7: Who is responsible for documenting the 55 percent content requirement for manufactured products under BABA? What if the final manufacturer cannot trace or verify domestic origin for all components?
    - A5.7: The manufacturer who signs a certification letter is responsible for documenting compliance with any of the three categories of products (iron and steel, manufactured products, or construction materials). For manufactured products, BABA requires that greater than 55 percent of the total cost of all components of the manufactured product be from domestic sources. EPA recommends that the certification letter for manufactured products document whether the item passes the content test in the final product along with a statement attesting to compliance with the BABA requirements for manufactured products.

- Q5.8: How do final product fabricators document compliance when the final step of manufacturing may be simply assembling components?
    - A5.8: It is acceptable, in many cases, especially for highly complex manufactured products that utilize many sub-components, for the final point of assembly to certify without using a "step certification" process. Multiple certifications (i.e., step certifications) or a singular certification can be used for a product, as long as the certifying official is willing to attest to the product's compliance with BABA requirements at all stages of manufacturing.

- Q5.9: Will Material Test Reports be acceptable in lieu of a BABA certification for iron and steel?
    - A5.9: Material Test Reports (MTRs, commonly referred to as "Mill Certifications" or "Mill Certs") provide the chemical composition of steel and iron from a mill or foundry. If an MTR accompanies the delivery of steel or iron to a project site with an invoice or bill of lading, EPA will consider it sufficient to demonstrate compliance (equivalent to a certification letter) as long as the MTR includes a manufacturer representative's signature in addition to the location (city and state) of the mill/foundry. It is common for MTRs to be the first letter in a "step certification" if the product is further fabricated or painted, etc., by another manufacturer.

- Q5.10: Can a manufacturer use a fillable certification letter for products?
    - A5.10: EPA recommends that certifications be signed by representatives of the manufacturing entity. EPA does not oppose manufacturers using forms to internally develop letters within their company, thereby providing signed, non-manipulable certification letters to suppliers, distributors, and/or assistance recipients. A fillable form that can be changed by someone outside of the manufacturer after signature does not demonstrate compliance and may create compliance concerns for the manufacturer or assistance recipient.

- Q5.11: Are product certifications from suppliers and distributors allowed?

    - A5.11: EPA recommends that representatives of product manufacturers certify compliance and discourages suppliers and distributors from creating certification letters. EPA does not rule out the possibility that a third-party certification process, such as a certification by a distributor, may be viable. However, EPA is currently not aware of a system or proposed system that meets the EPA's recommendations for documentation of product certification.

- Q5.12: How long should assistance recipients keep compliance documentation?

    - A5.12: Assistance recipients should apply recordkeeping requirements for the project according to the procedures dictated by the funding authority. For most EPA grant programs, this is prescribed in the UGG at 2 CFR 200.334-200.338; e.g., the SRF programs require a minimum of three years. Other funding programs may require longer documentation retention periods.

SECTION 6: PROGRAMS WITH AMERICAN IRON AND STEEL REQUIREMENTS

- Q6.1: Does BABA supersede the American Iron and Steel (AIS) Requirements?

    - A6.1: The BABA requirements for items considered "iron and steel" are equivalent to those for covered iron and steel products under the AIS requirements in the Clean Water Act and the Safe Drinking Water Act. These requirements apply to the CWSRF, DWSRF, WIFIA, and Water infrastructure Community Grants. BABA includes a "Savings Provision" (Section 70917(b)) that states that BABA does not affect existing domestic content procurement preferences for infrastructure projects funded by Federal financial assistance programs that meet the requirements of section 70914. EPA views the AIS requirements as meeting the "iron and steel" product requirements of BABA Section 70914, as they both include the key requirement that items made of iron and steel be wholly manufactured in the United States from the point of melting and/or pouring the iron or steel components through final manufacturing step. Because of the "Savings Provision" of Section 70917, the AIS requirements satisfy the "iron and steel" requirements of BABA. For the programs that have AIS requirements, EPA intends to implement BABA requirements the same way for iron and steel items as it has done for AIS products.

- Q6.2: For iron and steel products, does a manufacturer need to demonstrate compliance from initial melting through the finished product?

    - A6.2: For iron and steel products, the BABA requirements are the same as the existing AIS requirements, in that all of the iron and steel in a covered product (that is, the product is comprised of more than 50 percent iron and steel by material cost) must be melted and poured in the United States and all subsequent manufacturing processes (such as grinding, rolling, bending, reheating, and casting) must occur in the United States.

Q6.3: Will EPA apply the same manufacturing standards for BABA iron and steel products as for the American Iron and Steel (AIS) requirements?

- A6.3: Yes. For AIS, EPA did not require raw materials used in the production of steel or iron to be domestically sourced. For BABA, EPA interprets the requirements to be the same. Hence, like AIS, raw materials in the production of iron and steel subject to BABA requirements would not need to be domestically sourced. The key step for both AIS and BABA domestic iron and/or steel production is the melting/pouring (that is, the location of the furnace), which must be in the United States.

- Q6.4: Will the certification process be similar to the process established for the American Iron and Steel requirements?

  - A6.4: EPA expects the certification process for the BABA requirements to be very similar to that established for the AIS requirements. For iron and steel products, the process should remain the same for AIS and BABA. EPA recommends for manufactured products and for construction materials that certification letters include direct reference to the product/material content requirements under BABA, in addition to an affirmative statement verifying that the product meets the BABA requirements.

- Q6.5: Will duplicate certification letters be required for AIS and BABA for iron/steel products?

  - A6.5: No. Compliance with BABA requirements will be sufficient to demonstrate compliance with AIS requirements for iron and steel products. If a project is subject to BABA, the only demonstration of compliance necessary is with the BABA requirements, of which the iron and steel requirements are equivalent to those of the AIS statutory requirements: the iron or steel in a product made primarily or predominantly of iron and steel (comprising more than 50 percent iron and steel by material cost) must be melted and/or poured in the United States and all subsequent manufacturing processes must occur in the United States.

SECTION 7: PROGRAM-SPECIFIC ISSUES

- Q7.1.: How do the BABA requirements apply to Community Grants?

  - A7.1: The Community Project Funding/Congressionally Directed Spending grants for the construction of drinking water, wastewater, and stormwater infrastructure and for water quality protection are subject to the requirements specified in the explanatory statement accompanying the Consolidated Appropriations Act (Explanatory Statement for Division G of P.L. 117-13, the Consolidated Appropriations Act of 2022). The explanatory statement asserts: "Applicable Federal requirements that would apply to a Clean Water State Revolving Fund or Drinking Water State Revolving Fund project grant recipient shall apply to a grantee receiving a CPF grant under this section." Therefore, the federally funded Community Project Funding/Congressionally Directed Spending grants are subject to the same requirements that apply to CWSRF or DWSRF projects, including BABA and AIS requirements. See also A1.2.

- Q7.2: Should SRF projects covered by the BABA SRF Projects Design Planning Adjustment Period Waiver follow the same procedures for demonstrating compliance as outlined for American Iron and Steel requirements?

    - A7.2: Yes. The SRF Design Planning Adjustment Period waiver does not waive the iron and steel requirements under BABA. The SRF programs have existing domestic preference requirements for SRF projects under CWA Section 608 and SDWA Section 1452(a)(4) (AIS requirements) to use iron and steel products that are produced in the United States. Sections 70917(a) and (b) of BIL explain the application of BABA to existing domestic preference requirements. Specifically, the savings provision in Section 70917(b) states that existing domestic preference requirements that meet BABA requirements are not affected by BABA. The statutory AIS requirements were existing at the time BABA became law and satisfy the BABA iron and steel requirements. Therefore, the statutory AIS requirements that have previously applied to SRF-funded projects will continue to do so, and compliance with AIS requirements will satisfy the BABA iron and steel requirements. Demonstration of compliance for iron and steel products will follow the AIS implementation policies for projects subject to the waiver.

- Q7.3: For SRF programs, is BABA considered a federal cross-cutting authority? (i.e., do "equivalency" rules apply?)

    - A7.3: Yes, BABA is considered a federal cross-cutting requirement that applies to SRF assistance equivalent to the federal capitalization grant (i.e., "equivalency" projects). EPA's SRF regulations at 40 CFR 35.3145 and 35.3575 require states and recipients of SRF funds equivalent to the amount of the federal capitalization grant to comply with federal cross-cutting requirements. Section 70914 of the IIJA, which states when a Buy America preference applies, explains that "none of the funds made available for a Federal financial assistance program for infrastructure…may be obligated for a project unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States." Therefore, BABA only applies to projects funded in an amount equivalent to the federal capitalization grant and not to those projects receiving funds in excess of the capitalization grant (i.e., "non-equivalency" projects). (Note: The AIS requirements continue to apply for all SRF projects, including non-equivalency projects, and all WIFIA and Community Grant projects, because equivalency does not apply.)

- Q7.4: Do the BABA requirements apply to Drinking Water State Revolving Fund set-asides?

    - A7.4: Due to requirements related to the deposit of funds in the DWSRF program, almost all of the funds used to conduct set-aside activities are Federal dollars. Therefore, Federal cross-cutting requirements must be applied to all set-aside activities. However, in the case of most set-aside activities, the cross-cutting requirements will not be implicated because of the nature of the activities conducted under the set-asides. Because the BABA requirements only apply to infrastructure, and infrastructure typically is not an eligible set-aside expenditure (with one potential exception being loans for incentive-based source water protection

measures under the Local Assistance and Other State Programs Set-Aside), the BABA requirements will not apply to most set-aside activities.

- Q7.5: What if an SRF project is refinanced using Federal financial assistance on or after May 14, 2022?

    - A7.5: If an SRF project began construction, financed from another funding source, prior to May 14, 2022, but is refinanced through an assistance agreement executed on or after that date, BABA requirements will apply to all construction that occurs on or after May 14, 2022, through completion of construction, unless a waiver applies. There is no retroactive application of the BABA requirements where a refinancing occurs for an SRF project that has completed construction prior to May 14, 2022. (Note: If SRF funding is used for the refinancing, the AIS requirements may still apply depending on the timing of construction.)

- Q7.6: What are the roles and responsibilities for SRF programs for BABA implementation?

    - A7.6: Implementation of the BABA requirements for the State Revolving Fund programs will continue the roles and responsibilities from the successful AIS implementation process.

      As with AIS, it is both the assistance recipient's and the state's responsibility to ensure compliance with the BABA requirements. The state is the recipient of a federal capitalization grant and must comply with all grant conditions, including a condition requiring adherence to BABA requirements.

      Consequently, states are strongly advised to conduct site visits of projects during construction and review documentation demonstrating the assistance recipient's proof of compliance. In EPA's experience, most states conduct periodic site visits and arrange timely meetings with funded projects. Observed best practices typically include a meeting early in the process (sometimes before bid and usually prior to commencing construction) and at least one project site visit during the construction process. Assistance recipients must maintain documentation of compliance with the BABA requirements, as explained in question 5.3. The documents must be kept by the assistance recipient and should be reviewed by the state during project reviews.

      The state's role in the waiver process is to review any waiver requests submitted to the state to ensure that all necessary information has been provided by the assistance recipient prior to forwarding the request to EPA. If a state finds the request lacking, the state should work with the assistance recipient to help obtain complete information. Question 4.1 explains the information needed by EPA to expediently review a waiver request.

      In order to implement the BABA requirements, EPA has developed an approach for effective and efficient implementation of the waiver process to allow projects to proceed in a timely manner. The framework described below will allow states, on behalf of the assistance recipients, to apply for waivers of the BABA requirements directly to EPA Headquarters. Only waiver requests received and/or endorsed from states will be considered. Pursuant to BABA, EPA has the responsibility to make findings as to the issuance of waivers to the BABA requirements.

Step-by-step SRF Waiver Process

The waiver process begins with the assistance recipient. To fulfill the BABA requirements, the assistance recipient must in good faith design the project (where applicable) and solicit bids for construction with American-made iron and steel, manufactured goods, and construction materials. It is essential that the assistance recipient include the BABA terms in any request for proposals or solicitations for bids, and in all contracts (see Appendix 2 for sample construction contract language). The assistance recipient may receive a waiver at any point before, during, or after the bid process, if one or more of three statutory conditions is demonstrated to EPA and approved.

To apply for a project-specific waiver, the assistance recipient should email the request in the form of a Word document (.doc) or editable PDF (.pdf) to the funding program. It is strongly recommended that each state identify a person or persons for BABA communications. The state designee(s) will review the application for the waiver and determine whether the necessary information has been included (Note: More information may be provided in the future regarding what information is required to be included in waiver requests). Once the waiver application is complete, the designee will forward the application to CWSRFWaiver@epa.gov or DWSRFWaiver@epa.gov.

Evaluation by EPA

After receiving an application for waiver of the BABA requirements and ensuring sufficient information was provided, EPA will publish the request on its website for 15 days and receive public comment. EPA will then determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver.

In the event that EPA finds that adequate documentation and justification has been submitted, the Administrator may grant a waiver to the assistance recipient. EPA will notify the state designee whether a waiver request has been approved or not approved as soon as such a decision has been made. Granting such a waiver is a four-step process:

1. Research – After receiving an application for a waiver, EPA will perform market research to determine whether the iron, steel, manufactured goods, or construction materials are available domestically.

2. Posting – After research, if no domestic product has been identified, EPA is required to publish the application and all material submitted with the application on EPA's website for 15 days. During that period, the public will have the opportunity to review the request and provide informal comment to EPA. The website can be found at: https://www.epa.gov/cwsrf/build-america-buy-america-baba-waivers-open-public-comment.

3. Evaluation – After receiving an application for waiver of the BABA requirements, EPA will determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver to determine whether or not to grant the waiver.

3. Signature of waiver approval by the Administrator or another agency official with delegated authority – As soon as the waiver is signed and dated, EPA will notify the State SRF program and post the signed waiver on the Agency's website. The assistance recipient should keep a copy of the signed waiver in its project files.

(Note: Additional steps may be required in the future regarding the waiver process depending on additional guidance from OMB)

APPENDIX 1

Example Build America, Buy America (BABA) Act Construction Contract Language

ALL CONSTRUCTION CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE BABA REQUIREMENTS. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN A PROJECT'S CONSTRUCTION CONTRACT. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE OR LOCAL LAW:

The Contractor acknowledges to and for the benefit of the _____ ("Owner") and the _____ (the "Funding Authority") that it understands the goods and services under this Agreement are being funded with federal monies and have statutory requirements commonly known as "Build America, Buy America;" that requires all of the iron and steel, manufactured products, and construction materials used in the project to be produced in the United States ("Build America, Buy America Requirements") including iron and steel, manufactured products, and construction materials provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Owner and Funding Authority (a) the Contractor has reviewed and understands the Build America, Buy America Requirements, (b) all of the iron and steel, manufactured products, and construction materials used in the project will be and/or have been produced in the United States in a manner that complies with the Build America, Buy America Requirements, unless a waiver of the requirements is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the Build America, Buy America Requirements, as may be requested by the Owner or the Funding Authority. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Owner or Funding Authority to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Owner or Funding Authority resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the Funding Authority or any damages owed to the Funding Authority by the Owner). If the Contractor has no direct contractual privity with the Funding Authority, as a lender or awardee to the Owner for the funding of its project, the Owner and the Contractor agree that the Funding Authority is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the Funding Authority.

APPENDIX 2

Example Build America, Buy America (BABA) Act Assistance Agreement Language

ALL FEDERAL FINANCIAL INFRASTRUCTURE ASSISTANCE AGREEMENTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE BABA REQUIREMENTS. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN AN ASSISTANCE AGREEMENT (E.G., SRF LOAN AGREEMENT). EPA MAKES NO CLAIMS REGARDING THE LEGAL SUFFICIENCY OF THIS CLAUSE WITH RESPECT TO STATE LAW:

Comply with all federal requirements applicable to the assistance received (including those imposed by the Infrastructure Investment and Jobs Act ("IIJA"), Public Law No. 117-58) which the Participant understands includes, but is not limited to, the following requirements: that all of the iron and steel, manufactured products, and construction materials used in the Project are to be produced in the United States ("Build America, Buy America Requirements") unless (i) the Participant has requested and obtained a waiver from the cognizant Agency[1] pertaining to the Project or the Project is otherwise covered by a general applicability waiver; or (ii) all of the contributing Agencies have otherwise advised the Participant in writing that the Build America, Buy America Requirements are not applicable to the Project.

Comply with all record keeping and reporting requirements under all applicable legal authorities, including any reports required by the funding authority (such as EPA and/or a state), such as performance indicators of program deliverables, information on costs and project progress. The Participant understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities and (ii) failure to comply with the applicable legal requirements and this Agreement may result in a default hereunder that results in a repayment of the assistance agreement in advance of the maturity of the Bonds, termination and/or repayment of grants, cooperative agreements, direct assistance or other types of financial assistance, and/or other remedial actions.

[1] From OMB Guidance M-22-11: To avoid a need for duplicative waiver requests from entities that receive funding for one infrastructure project through multiple Federal agencies, the Federal agency contributing the greatest amount of Federal funds for the project should be considered the "Cognizant Agency for Made in America" and should take responsibility for coordinating with the other Federal awarding agencies. Such coordination will provide uniform waiver criteria and adjudication processes, minimize duplicative efforts among Federal agencies, and reduce burdens on recipients. The Cognizant Agency for Made in America shall be responsible for consulting with the other Federal awarding agencies, publicizing the proposed joint waiver, and submitting the proposed joint waiver for review to MIAO.

APPENDIX I
AMERICAN IRON AND STEEL (AIS) REQUIREMENTS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 20 2014

OFFICE OF WATER

MEMORANDUM

SUBJECT: Implementation of American Iron and Steel provisions of P.L. 113-76, Consolidated Appropriations Act, 2014

FROM: For Andrew D. Sawyers, Director
Office of Wastewater Management (4201M)

Peter C. Grevatt, Director
Office of Ground Water and Drinking Water (4601M)

TO: Water Management Division Directors
Regions I - X

P.L. 113-76, Consolidated Appropriations Act, 2014 (Act), includes an "American Iron and Steel (AIS)" requirement in section 436 that requires Clean Water State Revolving Loan Fund (CWSRF) and Drinking Water State Revolving Loan Fund (DWSRF) assistance recipients to use iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works if the project is funded through an assistance agreement executed beginning January 17, 2014 (enactment of the Act), through the end of Federal Fiscal Year 2014.

Section 436 also sets forth certain circumstances under which EPA may waive the AIS requirement. Furthermore, the Act specifically exempts projects where engineering plans and specifications were approved by a State agency prior to January 17, 2014.

The approach described below explains how EPA will implement the AIS requirement. The first section is in the form of questions and answers that address the types of projects that must comply with the AIS requirement, the types of products covered by the AIS requirement, and compliance. The second section is a step-by-step process for requesting waivers and the circumstances under which waivers may be granted.

Implementation

The Act states:

Sec. 436. (a)(1) None of the funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12) shall be used for a project for the construction, alteration, maintenance, or repair of a public water system or treatment works unless all of the iron and steel products used in the project are produced in the United States.

(2) In this section, the term ''iron and steel products'' means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

(b) Subsection (a) shall not apply in any case or category of cases in which the Administrator of the Environmental Protection Agency (in this section referred to as the ''Administrator'') finds that—

(1) applying subsection (a) would be inconsistent with the public interest;

(2) iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or

(3) inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

(c) If the Administrator receives a request for a waiver under this section, the Administrator shall make available to the public on an informal basis a copy of the request and information available to the Administrator concerning the request, and shall allow for informal public input on the request for at least 15 days prior to making a finding based on the request. The Administrator shall make the request and accompanying information available by electronic means, including on the official public Internet Web site of the Environmental Protection Agency.

(d) This section shall be applied in a manner consistent with United States obligations under international agreements.

(e) The Administrator may retain up to 0.25 percent of the funds appropriated in this Act for the Clean and Drinking Water State Revolving Funds for carrying out

the provisions described in subsection (a)(1) for management and oversight of the requirements of this section.

(f) This section does not apply with respect to a project if a State agency approves the engineering plans and specifications for the project, in that agency's capacity to approve such plans and specifications prior to a project requesting bids, prior to the date of the enactment of this Act.

The following questions and answers provide guidance for implementing and complying with the AIS requirements:

Project Coverage

1) What classes of projects are covered by the AIS requirement?

All treatment works projects funded by a CWSRF assistance agreement, and all public water system projects funded by a DWSRF assistance agreement, from the date of enactment through the end of Federal Fiscal Year 2014, are covered. The AIS requirements apply to the entirety of the project, no matter when construction begins or ends. Additionally, the AIS requirements apply to all parts of the project, no matter the source of funding.

2) Does the AIS requirement apply to nonpoint source projects or national estuary projects?

No. Congress did not include an AIS requirement for nonpoint source and national estuary projects unless the project can also be classified as a 'treatment works' as defined by section 212 of the Clean Water Act.

3) Are any projects for the construction, alteration, maintenance, or repair of a public water system or treatment works excluded from the AIS requirement?

Any project, whether a treatment works project or a public water system project, for which engineering plans and specifications were approved by the responsible state agency prior to January 17, 2014, is excluded from the AIS requirements.

4) What if the project does not have approved engineering plans and specifications but has signed an assistance agreement with a CWSRF or DWSRF program prior to January 17, 2014?

The AIS requirements do not apply to any project for which an assistance agreement was signed prior to January 17, 2014.

5) What if the project does not have approved engineering plans and specifications, but bids were advertised prior to January 17, 2014 and an assistance agreement was signed after January 17, 2014?

If the project does not require approved engineering plans and specifications, the bid advertisement date will count in lieu of the approval date for purposes of the exemption in section 436(f).

6) What if the assistance agreement that was signed prior to January 17, 2014, only funded a part of the overall project, where the remainder of the project will be funded later with another SRF loan?

If the original assistance agreement funded any construction of the project, the date of the original assistance agreement counts for purposes of the exemption. If the original assistance agreement was only for planning and design, the date of that assistance agreement will count for purposes of the exemption only if there is a written commitment or expectation on the part of the assistance recipient to fund the remainder of the project with SRF funds.

7) What if the assistance agreement that was signed prior to January 17, 2014, funded the first phase of a multi-phase project, where the remaining phases will be funded by SRF assistance in the future?

In such a case, the phases of the project will be considered a single project if all construction necessary to complete the building or work, regardless of the number of contracts or assistance agreements involved, are closely related in purpose, time and place. However, there are many situations in which major construction activities are clearly undertaken in phases that are distinct in purpose, time, or place. In the case of distinct phases, projects with engineering plans and specifications approval or assistance agreements signed prior to January 17, 2014 would be excluded from AIS requirements while those approved/signed on January 17, 2014, or later would be covered by the AIS requirements.

8) What if a project has split funding from a non-SRF source?

Many States intend to fund projects with "split" funding, from the SRF program and from State or other programs. Based on the Act language in section 436, which requires that American iron and steel products be used in any project for the construction, alteration, maintenance, or repair of a public water system or treatment works receiving SRF funding between and including January 17, 2014 and September 30, 2014, any project that is funded in whole or in part with such funds must comply with the AIS requirement. A "project" consists of all construction necessary to complete the building or work regardless of the number of contracts or assistance agreements involved so long as all contracts and assistance agreements awarded are closely related in purpose, time and place. This precludes the intentional splitting of SRF projects into separate and smaller contracts or assistance agreements to avoid AIS coverage on some portion of a larger

project, particularly where the activities are integrally and proximately related to the whole. However, there are many situations in which major construction activities are clearly undertaken in separate phases that are distinct in purpose, time, or place, in which case, separate contracts or assistance agreement for SRF and State or other funding would carry separate requirements.

9) What about refinancing?

If a project began construction, financed from a non-SRF source, prior to January 17, 2014, but is refinanced through an SRF assistance agreement executed on or after January 17, 2014 and prior to October 1, 2014, AIS requirements will apply to all construction that occurs on or after January 17, 2014, through completion of construction, unless, as is likely, engineering plans and specifications were approved by a responsible state agency prior to January 17, 2014. There is no retroactive application of the AIS requirements where a refinancing occurs for a project that has completed construction prior to January 17, 2014.

10) Do the AIS requirements apply to any other EPA programs, besides the SRF program, such as the Tribal Set-aside grants or grants to the Territories and DC?

No, the AIS requirement only applies to funds made available by a State water pollution control revolving fund as authorized by title VI of the Federal Water Pollution Control Act (33 U.S.C. 1381 et seq.) or made available by a drinking water treatment revolving loan fund as authorized by section 1452 of the Safe Drinking Water Act (42 U.S.C. 300j–12)

<u>Covered Iron and Steel Products</u>

11) What is an iron or steel product?

For purposes of the CWSRF and DWSRF projects that must comply with the AIS requirement, an iron or steel product is one of the following made primarily of iron or steel that is permanently incorporated into the public water system or treatment works:

Lined or unlined pipes or fittings;
Manhole Covers;
Municipal Castings (defined in more detail below);
Hydrants;
Tanks;
Flanges;
Pipe clamps and restraints;
Valves;
Structural steel (defined in more detail below);
Reinforced precast concrete; and
Construction materials (defined in more detail below).

12) What does the term 'primarily iron or steel' mean?

'Primarily iron or steel' places constraints on the list of products above. For one of the listed products to be considered subject to the AIS requirements, it must be made of greater than 50% iron or steel, measured by cost. The cost should be based on the material costs.

13) Can you provide an example of how to perform a cost determination?

For example, the iron portion of a fire hydrant would likely be the bonnet, body and shoe, and the cost then would include the pouring and casting to create those components. The other material costs would include non-iron and steel internal workings of the fire hydrant (i.e., stem, coupling, valve, seals, etc). However, the assembly of the internal workings into the hydrant body would not be included in this cost calculation. If one of the listed products is not made primarily of iron or steel, United States (US) provenance is not required. An exception to this definition is reinforced precast concrete, which is addressed in a later question.

14) If a product is composed of more than 50% iron or steel, but is not listed in the above list of items, must the item be produced in the US? Alternatively, must the iron or steel in such a product be produced in the US?

The answer to both question is no. Only items on the above list must be produced in the US. Additionally, the iron or steel in a non-listed item can be sourced from outside the US.

15) What is the definition of steel?

Steel means an alloy that includes at least 50 percent iron, between .02 and 2 percent carbon, and may include other elements. Metallic elements such as chromium, nickel, molybdenum, manganese, and silicon may be added during the melting of steel for the purpose of enhancing properties such as corrosion resistance, hardness, or strength. The definition of steel covers carbon steel, alloy steel, stainless steel, tool steel and other specialty steels.

16) What does 'produced in the United States' mean?

Production in the United States of the iron or steel products used in the project requires that all manufacturing processes, including application of coatings, must take place in the United States, with the exception of metallurgical processes involving refinement of steel additives. All manufacturing processes includes processes such as melting, refining, forming, rolling, drawing, finishing, fabricating and coating. Further, if a domestic iron and steel product is taken out of the US for any part of the manufacturing process, it becomes foreign source material. However, raw materials such as iron ore, limestone and iron and steel scrap are not covered by the AIS requirement, and the

material(s), if any, being applied as a coating are similarly not covered. Non-iron or steel components of an iron and steel product may come from non-US sources. For example, for products such as valves and hydrants, the individual non-iron and steel components do not have to be of domestic origin.

17) Are the raw materials used in the production of iron or steel required to come from US sources?

No. Raw materials, such as iron ore, limestone, scrap iron, and scrap steel, can come from non-US sources.

18) If an above listed item is primarily made of iron or steel, but is only at the construction site temporarily, must such an item be produced in the US?

No. Only the above listed products made primarily of iron or steel, permanently incorporated into the project must be produced in the US. For example trench boxes, scaffolding or equipment, which are removed from the project site upon completion of the project, are not required to be made of U.S. Iron or Steel.

19) What is the definition of 'municipal castings'?

Municipal castings are cast iron or steel infrastructure products that are melted and cast. They typically provide access, protection, or housing for components incorporated into utility owned drinking water, storm water, wastewater, and surface infrastructure. They are typically made of grey or ductile iron, or steel. Examples of municipal castings are:

Access Hatches;
Ballast Screen;
Benches (Iron or Steel);
Bollards;
Cast Bases;
Cast Iron Hinged Hatches, Square and Rectangular;
Cast Iron Riser Rings;
Catch Basin Inlet;
Cleanout/Monument Boxes;
Construction Covers and Frames;
Curb and Corner Guards;
Curb Openings;
Detectable Warning Plates;
Downspout Shoes (Boot, Inlet);
Drainage Grates, Frames and Curb Inlets;
Inlets;
Junction Boxes;
Lampposts;
Manhole Covers, Rings and Frames, Risers;

Meter Boxes;
Service Boxes;
Steel Hinged Hatches, Square and Rectangular;
Steel Riser Rings;
Trash receptacles;
Tree Grates;
Tree Guards;
Trench Grates; and
Valve Boxes, Covers and Risers.

20) What is 'structural steel'?

Structural steel is rolled flanged shapes, having at least one dimension of their cross-section three inches or greater, which are used in the construction of bridges, buildings, ships, railroad rolling stock, and for numerous other constructional purposes. Such shapes are designated as wide-flange shapes, standard I-beams, channels, angles, tees and zees. Other shapes include H-piles, sheet piling, tie plates, cross ties, and those for other special purposes.

21) What is a 'construction material' for purposes of the AIS requirement?

Construction materials are those articles, materials, or supplies made primarily of iron and steel, that are permanently incorporated into the project, not including mechanical and/or electrical components, equipment and systems. Some of these products may overlap with what is also considered "structural steel". This includes, but is not limited to, the following products: wire rod, bar, angles, concrete reinforcing bar, wire, wire cloth, wire rope and cables, tubing, framing, joists, trusses, fasteners (i.e., nuts and bolts), welding rods, decking, grating, railings, stairs, access ramps, fire escapes, ladders, wall panels, dome structures, roofing, ductwork, surface drains, cable hanging systems, manhole steps, fencing and fence tubing, guardrails, doors, and stationary screens.

22) What is not considered a 'construction material' for purposes of the AIS requirement?

Mechanical and electrical components, equipment and systems are not considered construction materials. Mechanical equipment is typically that which has motorized parts and/or is powered by a motor. Electrical equipment is typically any machine powered by electricity and includes components that are part of the electrical distribution system.

The following examples (including their appurtenances necessary for their intended use and operation) are NOT considered construction materials: pumps, motors, gear reducers, drives (including variable frequency drives (VFDs)), electric/pneumatic/manual accessories used to operate valves (such as electric valve actuators), mixers, gates, motorized screens (such as traveling screens), blowers/aeration equipment, compressors, meters, sensors, controls and switches, supervisory control and

data acquisition (SCADA), membrane bioreactor systems, membrane filtration systems, filters, clarifiers and clarifier mechanisms, rakes, grinders, disinfection systems, presses (including belt presses), conveyors, cranes, HVAC (excluding ductwork), water heaters, heat exchangers, generators, cabinetry and housings (such as electrical boxes/enclosures), lighting fixtures, electrical conduit, emergency life systems, metal office furniture, shelving, laboratory equipment, analytical instrumentation, and dewatering equipment.

23) If the iron or steel is produced in the US, may other steps in the manufacturing process take place outside of the US, such as assembly?

No. Production in the US of the iron or steel used in a listed product requires that all manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

24) What processes must occur in the US to be compliant with the AIS requirement for reinforced precast concrete?

While reinforced precast concrete may not be at least 50% iron or steel, in this particular case, the reinforcing bar and wire must be produced in the US and meet the same standards as for any other iron or steel product. Additionally, the casting of the concrete product must take place in the US. The cement and other raw materials used in concrete production are not required to be of domestic origin.

If the reinforced concrete is cast at the construction site, the reinforcing bar and wire are considered to be a construction material and must be produced in the US.

Compliance

25) How should an assistance recipient document compliance with the AIS requirement?

In order to ensure compliance with the AIS requirement, specific AIS contract language must be included in each contract, starting with the assistance agreement, all the way down to the purchase agreements. Sample language for assistance agreements and contracts can be found in Appendix 3 and 4.

EPA recommends the use of a step certification process, similar to one used by the Federal Highway Administration. The step certification process is a method to ensure that producers adhere to the AIS requirement and assistance recipients can verify that products comply with the AIS requirement. The process also establishes accountability and better enables States to take enforcement actions against violators.

Step certification creates a paper trail which documents the location of the manufacturing process involved with the production of steel and iron materials. A step certification is a process under which each handler (supplier, fabricator, manufacturer,

processor, etc) of the iron and steel products certifies that their step in the process was domestically performed. Each time a step in the manufacturing process takes place, the manufacturer delivers its work along with a certification of its origin. A certification can be quite simple. Typically, it includes the name of the manufacturer, the location of the manufacturing facility where the product or process took place (not its headquarters), a description of the product or item being delivered, and a signature by a manufacturer's responsible party. Attached, as Appendix 5, are sample certifications. These certifications should be collected and maintained by assistance recipients.

Alternatively, the final manufacturer that delivers the iron or steel product to the worksite, vendor, or contractor, may provide a certification asserting that all manufacturing processes occurred in the US. While this type of certification may be acceptable, it may not provide the same degree of assurance. Additional documentation may be needed if the certification is lacking important information. Step certification is the best practice.

26) How should a State ensure assistance recipients are complying with the AIS requirement?

In order to ensure compliance with the AIS requirement, States SRF programs must include specific AIS contract language in the assistance agreement. Sample language for assistance agreements can be found in Appendix 3.

States should also, as a best practice, conduct site visits of projects during construction and review documentation demonstrating proof of compliance which the assistance recipient has gathered.

27) What happens if a State or EPA finds a non-compliant iron and/or steel product permanently incorporated in the project?

If a potentially non-compliant product is identified, the State should notify the assistance recipient of the apparent unauthorized use of the non-domestic component, including a proposed corrective action, and should be given the opportunity to reply. If unauthorized use is confirmed, the State can take one or more of the following actions: request a waiver where appropriate; require the removal of the non-domestic item; or withhold payment for all or part of the project. Only EPA can issue waivers to authorize the use of a non-domestic item. EPA may use remedies available to it under the Clean Water Act, the Safe Drinking Water Act, and 40 CFR part 31 grant regulations, in the event of a violation of a grant term and condition.

It is recommended that the State work collaboratively with EPA to determine the appropriate corrective action, especially in cases where the State is the one who identifies the item in noncompliance or there is a disagreement with the assistance recipient.

If fraud, waste, abuse, or any violation of the law is suspected, the Office of Inspector General (OIG) should be contacted immediately. The OIG can be reached at 1-

888-546-8740 or OIG_Hotline@epa.gov. More information can be found at this website: https://oig.hhs.gov/fraud/report-fraud/

28) How do international trade agreements affect the implementation of the AIS requirements?

The AIS provision applies in a manner consistent with United States obligations under international agreements. Typically, these obligations only apply to direct procurement by the entities that are signatories to such agreements. In general, SRF assistance recipients are not signatories to such agreements, so these agreements have no impact on this AIS provision. In the few instances where such an agreement applies to a municipality, that municipality is under the obligation to determine its applicability and requirements and document the actions taken to comply for the State.

Waiver Process

The statute permits EPA to issue waivers for a case or category of cases where EPA finds (1) that applying these requirements would be inconsistent with the public interest; (2) iron and steel products are not produced in the US in sufficient and reasonably available quantities and of a satisfactory quality; or (3) inclusion of iron and steel products produced in the US will increase the cost of the overall project by more than 25 percent.

In order to implement the AIS requirements, EPA has developed an approach to allow for effective and efficient implementation of the waiver process to allow projects to proceed in a timely manner. The framework described below will allow States, on behalf of the assistance recipients, to apply for waivers of the AIS requirement directly to EPA Headquarters. Only waiver requests received from states will be considered. Pursuant to the Act, EPA has the responsibility to make findings as to the issuance of waivers to the AIS requirements.

Definitions

The following terms are critical to the interpretation and implementation of the AIS requirements and apply to the process described in this memorandum:

Reasonably Available Quantity: The quantity of iron or steel products is available or will be available at the time needed and place needed, and in the proper form or specification as specified in the project plans and design.

Satisfactory Quality: The quality of iron or steel products, as specified in the project plans and designs.

Assistance Recipient: A borrower or grantee that receives funding from a State CWSRF or DWSRF program.

Step-By-Step Waiver Process

Application by Assistance Recipient

Each local entity that receives SRF water infrastructure financial assistance is required by section 436 of the Act to use American made iron and steel products in the construction of its project. However, the recipient may request a waiver. Until a waiver is granted by EPA, the AIS requirement stands, except as noted above with respect to municipalities covered by international agreements.

The waiver process begins with the SRF assistance recipient. In order to fulfill the AIS requirement, the assistance recipient must in good faith design the project (where applicable) and solicit bids for construction with American made iron and steel products. It is essential that the assistance recipient include the AIS terms in any request for proposals or solicitations for bids, and in all contracts (see Appendix 3 for sample construction contract language). The assistance recipient may receive a waiver at any point before, during, or after the bid process, if one or more of three conditions is met:

1. Applying the American Iron and Steel requirements of the Act would be inconsistent with the public interest;
2. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
3. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Proper and sufficient documentation must be provided by the assistance recipient. A checklist detailing the types of information required for a waiver to be processed is attached as Appendix 1.

Additionally, it is strongly encouraged that assistance recipients hold pre-bid conferences with potential bidders. A pre-bid conference can help to identify iron and steel products needed to complete the project as described in the plans and specifications that may not be available from domestic sources. It may also identify the need to seek a waiver prior to bid, and can help inform the recipient on compliance options.

In order to apply for a project waiver, the assistance recipient should email the request in the form of a Word document (.doc) to the State SRF program. It is strongly recommended that the State designate a single person for all AIS communications. The State SRF designee will review the application for the waiver and determine whether the necessary information has been included. Once the waiver application is complete, the State designee will forward the application to either of two email addresses. For CWSRF waiver requests, please send the application to: cwsrfwaiver@epa.gov. For DWSRF waiver requests, please send the application to: dwsrfwaiver@epa.gov.

Evaluation by EPA

After receiving an application for waiver of the AIS requirements, EPA Headquarters will publish the request on its website for 15 days and receive informal comment. EPA Headquarters will then use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.

In the event that EPA finds that adequate documentation and justification has been submitted, the Administrator may grant a waiver to the assistance recipient. EPA will notify the State designee that a waiver request has been approved or denied as soon as such a decision has been made. Granting such a waiver is a three-step process:

1. Posting – After receiving an application for a waiver, EPA is required to publish the application and all material submitted with the application on EPA's website for 15 days. During that period, the public will have the opportunity to review the request and provide informal comment to EPA. The website can be found at: http://water.epa.gov/grants_funding/aisrequirement.cfm

2. Evaluation – After receiving an application for waiver of the AIS requirements, EPA Headquarters will use the checklist in Appendix 2 to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver – that it is quantitatively and qualitatively sufficient – and to determine whether or not to grant the waiver.

3. Signature of waiver approval by the Administrator or another agency official with delegated authority – As soon as the waiver is signed and dated, EPA will notify the State SRF program, and post the signed waiver on our website. The assistance recipient should keep a copy of the signed waiver in its project files.

Public Interest Waivers

EPA has the authority to issue public interest waivers. Evaluation of a public interest waiver request may be more complicated than that of other waiver requests so they may take more time than other waiver requests for a decision to be made. An example of a public interest waiver that might be issued could be for a community that has standardized on a particular type or manufacturer of a valve because of its performance to meet their specifications. Switching to an alternative valve may require staff to be trained on the new equipment and additional spare parts would need to be purchased and stocked, existing valves may need to be unnecessarily replaced, and portions of the system may need to be redesigned. Therefore, requiring the community to install an alternative valve would be inconsistent with public interest.

EPA also has the authority to issue a public interest waiver that covers categories of products that might apply to all projects.

EPA reserves the right to issue national waivers that may apply to particular classes of assistance recipients, particular classes of projects, or particular categories of iron or steel products. EPA may develop national or (US geographic) regional categorical waivers through the identification of similar circumstances in the detailed justifications presented to EPA in a waiver request or requests. EPA may issue a national waiver based on policy decisions regarding the public's interest or a determination that a particular item is not produced domestically in reasonably available quantities or of a sufficient quality. In such cases, EPA may determine it is necessary to issue a national waiver.

If you have any questions concerning the contents of this memorandum, you may contact us, or have your staff contact Jordan Dorfman, Attorney-Advisor, State Revolving Fund Branch, Municipal Support Division, at dorfman.jordan@epa.gov or (202) 564-0614 or Kiri Anderer, Environmental Engineer, Infrastructure Branch, Drinking Water Protection Division, at anderer.kirsten@epa.gov or (202) 564-3134.

Attachments

Attachment 1: Information Checklist for Waiver Request

The purpose of this checklist is to help ensure that all appropriate and necessary information is submitted to EPA. EPA recommends that States review this checklist carefully and provide all appropriate information to EPA. This checklist is for informational purposes only and does not need to be included as part of a waiver application.

Items	✓	Notes
General • Waiver request includes the following information: — Description of the foreign and domestic construction materials — Unit of measure — Quantity — Price — Time of delivery or availability — Location of the construction project — Name and address of the proposed supplier — A detailed justification for the use of foreign construction materials • Waiver request was submitted according to the instructions in the memorandum • Assistance recipient made a good faith effort to solicit bids for domestic iron and steel products, as demonstrated by language in requests for proposals, contracts, and communications with the prime contractor		
Cost Waiver Requests • Waiver request includes the following information: — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — Supporting documentation indicating that the contractor made a reasonable survey of the market, such as a description of the process for identifying suppliers and a list of contacted suppliers		
Availability Waiver Requests • Waiver request includes the following supporting documentation necessary to demonstrate the availability, quantity, and/or quality of the materials for which the waiver is requested: — Supplier information or pricing information from a reasonable number of domestic suppliers indicating availability/delivery date for construction materials — Documentation of the assistance recipient's efforts to find available domestic sources, such as a description of the process for identifying suppliers and a list of contacted suppliers. — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of construction materials • Waiver request includes a statement from the prime contractor and/or supplier confirming the non-availability of the domestic construction materials for which the waiver is sought • Has the State received other waiver requests for the materials described in this waiver request, for comparable projects?		

Attachment 2: HQ Review Checklist for Waiver Request

Instructions: To be completed by EPA. Review all waiver requests using the questions in the checklist, and mark the appropriate box as Yes, No or N/A. Marks that fall inside the shaded boxes may be grounds for denying the waiver. If none of your review markings fall into a shaded box, the waiver is eligible for approval if it indicates that one or more of the following conditions applies to the domestic product for which the waiver is sought:

1. The iron and/or steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
2. The inclusion of iron and/or steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Review Items	Yes	No	N/A	Comments
Cost Waiver Requests • Does the waiver request include the following information? — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products				
— Relevant excerpts from the bid documents used by the contractors to complete the comparison				
— A sufficient number of bid documents or pricing information from domestic sources to constitute a reasonable survey of the market				
• Does the Total Domestic Project exceed the Total Foreign Project Cost by more than 25%?				
Availability Waiver Requests • Does the waiver request include supporting documentation sufficient to show the availability, quantity, and/or quality of the iron and/or steel product for which the waiver is requested? — Supplier information or other documentation indicating availability/delivery date for materials — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of materials				
• Does supporting documentation provide sufficient evidence that the contractors made a reasonable effort to locate domestic suppliers of materials, such as a description of the process for identifying suppliers and a list of contacted suppliers?				
• Based on the materials delivery/availability date indicated in the supporting documentation, will the materials be unavailable when they are needed according to the project schedule? (By item, list schedule date and domestic delivery quote date or other relevant information)				
• Is EPA aware of any other evidence indicating the non-availability of the materials for which the waiver is requested? Examples include: — Multiple waiver requests for the materials described in this waiver request, for comparable projects in the same State — Multiple waiver requests for the materials described in this waiver request, for comparable projects in other States — Correspondence with construction trade associations indicating the non-availability of the materials				
• Are the available domestic materials indicated in the bid documents of inadequate quality compared those required by the project plans, specifications, and/or permits?				

Attachment 3: Example Loan Agreement Language

ALL ASSISTANCE AGREEMENT MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN SRF ASSISTANCE AGREEMENTS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE LAW:

Comply with all federal requirements applicable to the Loan (including those imposed by the 2014 Appropriations Act and related SRF Policy Guidelines) which the Participant understands includes, among other, requirements that all of the iron and steel products used in the Project are to be produced in the United States ("American Iron and Steel Requirement") unless (i) the Participant has requested and obtained a waiver from the Agency pertaining to the Project or (ii) the Finance Authority has otherwise advised the Participant in writing that the American Iron and Steel Requirement is not applicable to the Project.

Comply with all record keeping and reporting requirements under the Clean Water Act/Safe Drinking Water Act, including any reports required by a Federal agency or the Finance Authority such as performance indicators of program deliverables, information on costs and project progress. The Participant understands that (i) each contract and subcontract related to the Project is subject to audit by appropriate federal and state entities and (ii) failure to comply with the Clean Water Act/Safe Drinking Water Act and this Agreement may be a default hereunder that results in a repayment of the Loan in advance of the maturity of the Bonds and/or other remedial actions.

Attachment 4: Sample Construction Contract Language

ALL CONTRACTS MUST HAVE A CLAUSE REQUIRING COMPLIANCE WITH THE AIS REQUIREMENT. THIS IS AN EXAMPLE OF WHAT COULD BE INCLUDED IN ALL CONTRACTS IN PROJECTS THAT USE SRF FUNDS. EPA MAKES NO CLAIMS REGARDING THE LEGALITY OF THIS CLAUSE WITH RESPECT TO STATE OR LOCAL LAW:

The Contractor acknowledges to and for the benefit of the City of _____("Purchaser") and the _____(the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contactor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without limitation attorney's fees) incurred by the Purchaser or State resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or in part, from the State or any damages owed to the State by the Purchaser). While the Contractor has no direct contractual privity with the State, as a lender to the Purchaser for the funding of its project, the Purchaser and the Contractor agree that the State is a third-party beneficiary and neither this paragraph (nor any other provision of this Agreement necessary to give this paragraph force or effect) shall be amended or waived without the prior written consent of the State.

Attachment 5: Sample Certification 1

The following information is provided as a sample letter of certification for BABA and AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: BABA and AIS Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the (melting, bending, coating, galvanizing, cutting, etc.) process for (manufacturing or fabricating) the following products and/or materials shipped or provided for the subject project is in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

BIL extends this procurement requirement to all construction projects going forward with the inclusion of the Build America, Buy America Act (BABA). Starting on May 14, 2022, all steel, iron, manufactured products, non-ferrous metals, plastic and polymer-based products (including polyvinylchloride, composite building materials, and polymers used in fiber optic cables), glass (including optic glass), lumber, and drywall used in infrastructure projects for federal financial assistance programs must be produced in the United States.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

Attachment 5: Sample Certification 2

The following information is provided as a sample letter of certification for BABA and AIS compliance. Documentation must be provided on company letterhead.

Date

Company Name

Company Address

City, State Zip

Subject: BABA and AIS Certification for Project (XXXXXXXXXX)

I, (company representative), certify that the following products and/or materials shipped/provided to the subject project are in full compliance with the American Iron and Steel requirement as mandated in EPA's State Revolving Fund Programs.

BIL extends this procurement requirement to all construction projects going forward with the inclusion of the Build America, Buy America Act (BABA). Starting on May 14, 2022, all steel, iron, manufactured products, non-ferrous metals, plastic and polymer-based products (including polyvinyl chloride, composite building materials, and polymers used in fiber optic cables), glass (including optic glass), lumber, and drywall used in infrastructure projects for federal financial assistance programs must be produced in the United States.

Item, Products and/or Materials:

1. Xxxx
2. Xxxx
3. Xxxx

Such process took place at the following location:

If any of the above compliance statements change while providing material to this project we will immediately notify the prime contractor and the engineer.

Signed by company representative

2.0 COMMONWEALTH OF MASSACHUSETTS PROVISIONS

APPENDIX E
CONSTRUCTION BID SPECIFICATIONS
SPECIAL PROVISIONS FOR DISADVANTAGED BUSINESS ENTERPRISES
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM BACKGROUND

In May 2008 a United States Environmental Protection Agency (EPA) rule became effective that changed the Minority Business Enterprise (MBE) and Women Business Enterprise (WBE) Program to a Disadvantaged Business Enterprise (DBE) Program.

For firms to qualify under the old MBE/WBE program they needed to be socially disadvantaged and had to be certified by the Supplier Diversity Office (SDO). Under the new DBE rule, the firms must be both **socially** and **economically** disadvantaged, **citizens of the United States**, and certified as a DBE. Women and certain minorities are presumed to be socially disadvantaged. The economic disadvantage is measured by the owner's initial and continuing personal net worth of less than $1,320,000.

Because the Clean Water Act requires the use of MBEs and WBEs, these firms will still be utilized in the State Revolving Fund (SRF) Loan Program, but they must also be certified as DBEs.

SDO will continue to be the certifying agency for the SRF program. SDO certifies firms under the federal Department of Transportation program, which is acceptable for use in the SRF program. An additional form has been added to the DBE package to verify that DBEs are owned or controlled by United States citizens.

BID SPECIFICATIONS

I. In this contract, the percentage of business activity to be performed by disadvantaged business enterprise(s) (DBE) shall not be less than the following percentages of the total contract price or the percentage submitted by the contractor in the Schedule of Participation, whichever is greater:

Disadvantaged MBE (D/MBE) 4.2% Disadvantaged WBE (D/WBE) 4.5%

II. DEFINITIONS

For the purpose of these provisions, the following terms are defined as follows:

A. Awarding Authority – Entity that awards a prime contract under a State Revolving Fund loan.

B. Bidder - Any individual, partnership, joint venture, corporation, or firm submitting a price, directly or through an authorized representative, for the purpose of performing construction or construction related activities under a Contract.

C. Certified DBE – A DBE certified by the United States Small Business Administration, under its 8(a) Business Development Program (13 CFR part 124, subpart A) or its Small Disadvantaged Business Program (13 CFR part 124, subpart B); The United States Department of Transportation (DOT), under its regulations for Participation by DBSs in DOT programs (49 CFR parts 23 and 26); or SDO in accordance with 40 CFR part 33; provided that the certification meets the U.S. citizenship requirement under 40 CFR §33.202 or §33.203.

D. Compliance Unit - A subdivision of MassDEP's Affirmative Action Office designated to ensure compliance under these provisions.

E. Contractor - Any business that contracts or subcontracts for construction, demolition, renovation, survey, or maintenance work in the various classifications customarily used in work and that is acting in this capacity under the subject contract.

F. Construction Related Services - Those services performed at the work site ancillary to, and/or in support of, the construction work, such as hauling, trucking, equipment operation, surveying or other technical services, etc. For the purposes hereof, supply and delivery of materials (e.g. pre-cast concrete elements) to the site by a supplier who has manufactured those goods, or substantially altered them before re-sales shall be considered as "construction related services

G. Construction Work - The activities at the work site, or labor and use of materials in the performance of constructing, reconstructing, erecting, demolishing, altering, installing, disassembling, excavating, etc, all or part of the work required by the Contract Documents.

H. Disadvantaged Business Enterprise (DBE) - An entity owned or controlled by a socially and economically disadvantaged individual as described by Public Law 102-389 (42 U.S.C. 4370d) or an entity owned and controlled by a socially and economically disadvantaged individual as described by Title X of the Clean Air Act Amendments of 1990 (42 U.S.C. 7601 note); a Small Business Enterprise (SBE); a Small Business in a Rural Area (SBRA); or a Labor Surplus Area Firm (LAF), a Historically Underutilized Business (HUB) Zone Small Business Concern, or a concern under a successor program.

I. Equipment Rental Firm - A firm that owns equipment and assumes actual and contractual responsibility for renting said equipment to perform a useful function of the work of the contract consistent with normal industry practice

J. Good Faith Efforts – The race and/or gender neutral measures described in 40 CFR 33, subpart C.

K. HUBZone - A historically underutilized business zone, which is an area located within one or more qualified census tracts, qualified metropolitan counties, or lands within the external boundaries of an Indian reservation.

L. HUBZone small business concern - A small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

M. Joint Venture - An agreement between SDO certified DBE and a non-DBE or non-DBE controlled enterprise.

1. A pairing of companies will be considered a DBE joint venture if the SDO certified DBE which is part of the relationship has more than 51% of the profits that are derived from that project.

2. A joint venture between a certified DBE subcontractor and a non DBE subcontractor, in which the DBE for that proportion of the joint venture's contract equal to the DBE participation in the joint venture.

3. Whenever a general bid is filed by a joint venture with a certified DBE participant in the joint venture that does not exercise more than 51% control over management and profits, that joint venture shall be entitled to credit as a DBE for that portion of the joint venture's contract equal to the DBE participation in the joint venture. Minority As deemed by SDO.

N. Labor surplus area firm (LSAF) - A concern that together with its first-tier subcontractors will perform substantially in labor surplus areas (as identified by the Department of Labor in accordance with 20 CFR part 654). Performance is substantially in labor surplus areas if the costs incurred under the contract on account of manufacturing, production or performance of appropriate services in labor surplus areas exceed 50 percent of the contract price.

O. Letter of Intent – Certified document signed by the principal(s) of the DBE with respect to the work to be performed under contract.

P. Local Government Unit (LGU) – A city, town, or municipal district which applies for a loan under the Clean Water Trust Program.

Q. Material Supplier – A vendor certified by SDO as a DBE in sales to supply industry from an established place of business or source of supply, and that vendor.

1. Manufactures goods from raw materials, or substantially utilizes them in the work, or substantially alters them before resale, entitling the general contractor to DBE credit for 100% of the purchase order.

2. Provides and maintains a storage facility for materials utilized in the work, entitling the general contractor to DBE credit for 10% of the purchase order

R. Minority and Women Business Enterprise (M/WBE) – Any business concern certified by the SDO as a bona-fide M/WBE. A bona-fide M/WBE is a business whose minority group/women ownership interests are real, which have at least 51% ownership and control over management and operation.

S. Percent of Total Price – Is the percentage to be paid to the DBE, work they perform, as compared to the total bid price

T. Recipient - An agency, person or political subdivision which has been awarded or received financial assistance by the Trust or MassDEP.

U. Small business, small business concern or small business enterprise (SBE) - A concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding, and qualified as a small business under the criteria and size standards in 13 CFR part 121.

V. Small business in a rural area (SBRA) - A small business operating in an area identified as a rural county with a code 6-9 in the Rural-Urban continuum Classification Code developed by the United States Department of Agriculture in 1980.

W. SDO – The Supplier Diversity Office.

X. Subcontractor – A company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an award of financial assistance.

Y. Total Contract Price – The total amount of compensation to be paid for all materials, work or services rendered in the performance of the contract

Z. Trust – The Massachusetts Clean Water Trust established by M.G.L. c.29.

III. REQUIREMENTS FOR CONTRACT AWARD

DBE packages must be submitted by the two lowest bidders on the project. Following bid opening, the LGU shall notify the two lowest bidders to submit DBE packages to the LGU or the LGUs consultant, as directed. By the close of business on the third business day after notification, the two lowest bidders, including a bidder who is a MBE, WBE or DBE, shall submit the following information:

A. A Schedule of Participation (Form EEO-DEP-190). The Schedule of Participation shall list those certified DBEs the bidder intends to use in fulfilling the contract obligations, the nature of the work to be performed by each certified DBE subcontractor and the total price they are to be paid.

1. A listing of bona-fide services such as a professional, technical, consultant or managerial services, assistance in the procurement of essential personnel, facilities, equipment, materials, or supplies required for performance of the contract, and reasonable fees or commissions charged.

2. A listing of haulers, truckers, or delivery services, not the contractors, including reasonable fees for delivery of said materials or supplies to be included on the project.

B. A Letter of Intent (Form EEO-DEP-191) for each DBE the bidder intends to use on the project. The Letter of Intent shall include, among other things, a reasonable description of the work the certified DBE is proposing to perform and the prices the certified DBE proposes to charge for the work. A Letter of Intent shall be jointly signed by the certified DBE and the General Contractor who proposes to use them in the performance of the Contract.

C. Each DBE must also sign and return the DBE Certification of United States Citizenship form to verify that the firm is owned or controlled by a United States citizen.

D. The SDO "DBE Certification" as prepared by each certified DBE.

E. A completed Request for Waiver form and backup documentation should the goals not be achieved (See IV below).

IV. REQUIREMENTS FOR MODIFICATION OR WAIVERS.

The bidder shall make every possible effort to meet the minimum requirements of certified DBE participation. If the percentage of DBE participation submitted by the bidder on its Schedule of Participation (EEO-DEP-190) does not meet the minimum requirements, the bid may be rejected by the Awarding Authority and found not to be eligible for award of the contract.

In the event that the bidder is unable to meet the minimum requirements of DBE participation, the bidder shall submit with his/her submittal required in Section III. Requirement of Contract Award a Request for Waiver form (EEO-DEP-490). The Awarding Authority shall review the waiver request to determine if the request should proceed. If approved by the Awarding Authority, the Awarding Authority shall submit the waiver request and supporting documentation, with a recommendation to MassDEP within five days of receipt of the Request for Waiver. MassDEP in conjunction with the project manager, Compliance Unit, will determine whether the waiver will be granted.

The waiver request shall include detailed information as specified below to establish that the bidder has made a good faith effort to comply with the minimum requirements of DBE participation specified in Part I. In addition, the bidder must show that such efforts were undertaken well in advance of the time set for opening of bids to allow adequate response. A waiver request shall include the following:

A. A detailed record of the effort made to contact and negotiate with the certified DBE, including, but not limited to:

   1. names, addresses and telephone numbers of all such companies contacted;

   2. copies of written notices(s) which were sent to certified DBE potential subcontractors, prior to bid opening;

   3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

   4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price;

   5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/ women-focused media detailing the opportunities for participation.

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after MassDEP receives all required information and documentation, it shall make a decision in writing, whether the waiver is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing. If the waiver request is denied, the bid shall be rejected by the Awarding Authority, or the contract will be determined ineligible for SRF funding.

   If a Request for Waiver is denied by MassDEP and the bid is rejected by the Awarding Authority, the Awarding Authority may then move to the second bidder on the project. At the Awarding Authority's discretion, it may collect a DBE package from the third bidder on the project.

V. DISADVANTAGED BUSINESS ENTERPRISES PARTICIPATION

A. Reporting Requirements

1. The Contractor's utilization of certified DBEs will be documented based upon submittal of the LGU's monthly Payment Requisitions as reported on Form-2000. The Form-2000 form will show all certified DBEs performing work on the project regardless of any billing activity for that month. For auditing and accounting purposes, the Contractor periodically may be required to submit copies of canceled checks verifying that payments have been made to the certified DBE as listed on the schedule. The Contractor may also be required to submit current schedules on utilization of all DBEs to indicate when their services will commence and be billed for.

2. During the life of the Contract, the Contractor's fulfillment of the percentage requirements in Part I shall be determined with reference to the Contract price as follows:

   A. If the price in the Contract executed exceeds the base bid price (e.g., because an alternate was selected or because unit prices were used in awarding the Contract), the Contractor shall submit for approval by MassDEP a revised Schedule of Participation by certified DBEs satisfying the percentage requirements and such other information concerning additional DBE participation as may be requested by MassDEP.

   B. If the Contract price increases after execution due to change orders or other adjustments, MassDEP may require the Contractor to subcontract additional work or to purchase additional goods and services from certified DBEs up to the percentages stated in Part I.

VI. COMPLIANCE

A. If the Schedule or any of the Letters of Intent are materially incomplete or not submitted in a timely manner, the LGU may rescind its vote of award; treat the bid informal as to substance and reject the bid. If the bid is incomplete in any other respect than the Schedule the LGU with the approval of MassDEP may waive the informalities upon satisfactory completion of the required information by the Contractor and the certified DBE as applicable.

B. If the LGU finds that the percentage of certified DBE participation submitted by the contractor on its Schedule does not meet the percentage requirement in Part I, it shall rescind its vote of award and find such contractor not to be eligible for award of the contract.

C. The Contractor shall not perform with its own organization, or subcontract to any other primary or subcontractor any work designated for the named certified DBEs on the schedule submitted by the Contractor under Part III without the approval of MassDEP.

D. A Contractor's compliance with the percentage requirement in Part I shall continue to be determined by reference to the required percentage of the total contract price as stated in Section I even though the total of actual contract payments may be greater or less than the bid price.

E. If the Contractor for reasons beyond its control cannot comply with Part III in accordance with the Schedule submitted under Part III, Section B, the contractor must submit to MassDEP as soon as they are aware of the deficiency, the reason for its inability to comply. Proposed revisions to the Schedule stating how the contractor intends to meet its obligations under these conditions must be submitted within ten (10) working days of notification.

F. If the Contractor is becomes aware by any means that that DBE is no longer certified, the Contractor shall immediately notify MassDEP. The Contractor shall use good faith efforts to retain a substitute certified DBE.

G. If a certified DBE listed by the bidder in its Schedule of M/WBE contractors fails to obtain a performance or payment bond requested by the bidder, said failure shall not entitle the bidder to avoid the requirements of Part III (A). After a bidder has been awarded the contract, he shall not change the certified DBE listed in its Schedule at the time of the award or make any other such substitutions without the written approval of MassDEP.

VII. SANCTIONS

A. If the Contractor does not comply with the terms of these Special Provisions, the Awarding Authority may (1) suspend any payment for the work that should have been performed by a certified DBE pursuant to the schedule, or (2) require specific performance of the Contractor's obligation by requiring the Contractor to subcontract with a DBE for any contract or specialty item at the contract price established for that item in the proposal submitted by the Contractor.

B. To the extent that the Contractor has not complied with the terms of these Special Provisions, the Awarding Authority may retain in connection with Estimates and Payments an amount determined by multiplying the bid price of this contract by the percentage in Section I, less the amount paid to DBE's for work performed under the contract and any payments already suspended under VII A.

C. The Awarding Authority may suspend, terminate or cancel this contract, in whole or in part, or may call upon the Contractor's surety to perform all terms and conditions in the contract, unless the contractor is able to demonstrate his compliance with the terms

of these Special Provisions, and further deny to the Contractor, the right to participate in any future contracts awarded by the Awarding Authority for a period of up to three years.

D. In any proceeding involving the imposition of sanctions by the Awarding Authority, no sanctions shall be imposed if the Awarding Authority finds that the contractor has taken every possible measure to comply with these Special Provisions or that some other justifiable reason exists for waiving these Special Provisions in whole or in part.

E. The contract shall provide such information as is necessary in the judgment of the Awarding Authority to ascertain its compliance with the terms of these Special Provisions.

F. A contractor shall have the right to request suspension of any sanctions imposed under this section upon demonstrating that he is in compliance with these Special Provisions.

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

SCHEDULE OF PARTICIPATION FOR SRF CONSTRUCTION

Project Title: _____ **Project Location:** _____

Disadvantaged Minority Business Enterprise Participation in the SRF Loan Work

Name & Address of D/MBE	Nature of Participation	Dollar Value of Participation
1.		
2.		
3.		
	Total D/MBE Commitment: $	
Percentage D/MBE Participation = (Total D/MBE Commitment) / (Bid Price) =		**%**

Disadvantaged Women Business Enterprise Participation in the SRF Loan Work

Name & Address of D/WBE	Nature of Participation	Dollar Value of Participation
1.		
2.		
3.		
	Total D/WBE Commitment: $	
Percentage D/WBE Participation = (Total D/WBE Commitment) / (Bid Price) =		**%**

The Bidder agrees to furnish implementation reports as required by MassDEP to indicate the D/MBEs and D/WBE(s) which it has used or intends to use. Breach of this commitment constitutes a breach of the contract.

Name of Bidder: _____

Date: _____ By: _____
Signature

NOTE: Participation of a DBE may be counted in only their certified category; the same dollar participation cannot be used in computing the percentage of D/MBE participation and again of D/WBE participation.

LETTER OF INTENT FOR SRF CONSTRUCTION

This form is to be completed by the D/MBE and D/WBE and must be submitted by the Bidder no later than close of business on the third business day after notification by the LGU. A separate form must be completed for each D/MBE and D/WBE involved in the project.

Project Title: _____ Project Location: _____

TO: _____
(Name of Bidder)

FROM: _____
(Please Indicate Status ☐ D/MBE or ☐ D/WBE)

º I/we intend to perform work in connection with the above project as (check one):

☐ An individual
☐ A corporation
☐ Other (explain): _____

☐ A partnership
☐ A joint venture with: _____

º It is understood that if you are awarded the contract, you intend to enter into an agreement to perform the activity described below for the prices indicated.

DBE PARTICIPATION

Description of Activity	Date of Project Commencement	$ Amount	% Bid Price
		$	**%**

º The undersigned certify that they will enter into a formal agreement upon execution of the contract for the above referenced project.

BIDDER	**DBE**
(Authorized Original Signature) Date ADDRESS:	(Authorized Original Signature) Date ADDRESS:
TELEPHONE #:	TELEPHONE #:
FEIN:	FEIN:
EMAIL ADDRESS:	EMAIL ADDRESS:

ORIGINALS:

- **º Compliance Mgr. City/Town Project Location**
- **º DEP Program Manager for DEP's AAO Director**

*** Attach a copy of current (within 2 years) DBE Certification**

DBE CERTIFICATION OF UNITED STATES CITIZENSHIP

For the SRF program, under the EPA Disadvantage Business Enterprise (DBE) Rule, a DBE must be owned or controlled by a socially and economically disadvantaged person that is also a **citizen of the United States** (*See* 40 CFR 33.202). "Ownership" is defined at 13 CFR 124.105 and "control" is defined at 13 CFR 124.106.

DBEs are certified for the SRF program through the Supplier Diversity Office using the federal Department of Transportation (DOT) DBE rules. EPA allows the use of DBEs certified under the DOT rules as long as they are also United States citizens. To ensure compliance with the EPA rule, MassDEP must verify United States citizenship through the completion of the following form for each DBE used on the project.

SRF Project Number _____

Contract Number _____

Contract Title _____

DBE Subcontractor _____

The undersigned, on behalf of the above named DBE subcontractor, hereby certifies that the DBE firm is either owned or controlled by a person or persons that are citizens of the United States.

_____
Printed Name and Title of DBE Signatory

_____
DBE Signature

_____
Date

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM DBE SUBCONTRACTOR PARTICIPATION FORM

The United States Environmental Protection Agency (EPA) requires that this form be provided to all subcontractors on the project. At the option of the subcontractor, this form may be filled out and submitted directly to the EPA DBE Coordinator.

NAME OF SUBCONTRACTOR	PROJECT NAME
ADDRESS	CONTRACT NO.
TELEPHONE NO.	E-MAIL ADDRESS
PRIME CONTRACTOR NAME:	

Please use the space below to report any concerns regarding the above EPA-funded project (e.g., reason for termination by prime contractor, late payment, etc.).

_____

_____

_____

_____

_____

CONTRACT ITEM NO.	ITEM OF WORK OR DESCRIPTION OF SERVICES RECEIVED FROM THE PRIME CONTRACTOR	AMOUNT SUBCONTRACTOR WAS PAID BY PRIME CONTRACTOR

_____ _____

Subcontractor Signature Title/Date

Equivalent to EPA form 6100-2

REQUEST FOR WAIVER FOR SRF CONSTRUCTION

Upon exhausting all known sources and making every possible effort to meet the minimum requirements for DBE participation, the Bidder may seek relief either partially or entirely from these requirements by submitting a completed waiver package by the close of business on the third business day after notification by the LGU. Failure to comply with this process shall be cause to reject the bid thereby rendering the Bidder not eligible for award of the contract.

General Information

Project Title: _____ Project Location: _____

Bid Opening (time/date) _____

Bidder: _____

Mailing Address: _____

Contact Person: _____ Telephone No. _____

Minimum Requirements

The bidder must demonstrate that good faith efforts were undertaken to comply with the percentage goals as specified. The firm seeking relief must show that such efforts were taken appropriately in advance of the time set for opening bid proposals to allow adequate time for response(s) by submitting the following:

A. A detailed record of the effort made to contact and negotiate with disadvantaged minority and/or woman owned businesses, including:

1. names, addresses, telephone numbers and contact dates of all such companies contacted;

2. copies of written notice(s) which were sent to DBE potential subcontractors prior to bid opening;

3. a detailed statement as to why each subcontractor contacted (i) was not willing to do the job or (ii) was not qualified to perform the work as solicited; and

4. in the case(s) where a negotiated price could not be reached the bidder should detail what efforts were made to reach an agreement on a competitive price.

5. copies of advertisements, dated not less than ten (10) days prior to bid opening, as appearing in general publications, trade-oriented publications, and applicable minority/women-focused media detailing the opportunities for participation;

B. MassDEP may require the bidder to produce such additional information as it deems appropriate.

C. No later than fifteen (15) days after submission of all required information and documentation, MassDEP shall make a determination, in writing, whether the waiver request is granted and shall provide that determination to the bidder and Awarding Authority. If the waiver request is denied, the facts upon which a denial is based will be set forth in writing.

CERTIFICATION

The undersigned herewith certifies that the above information and appropriate attachments are true and accurate to the best of my knowledge and that I have been authorized to act on behalf of the bidder in this matter.

_____ _____

(authorized original signature) DATE

DISADVANTAGED BUSINESS ENTERPRISE PARTICIPATION
MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF MUNICIPAL SERVICES

STATE REVOLVING FUND LOAN PROGRAM – SCHEDULE OF SUBCONTRACTOR PARTICIPATION

Local Governmental Unit _____

Project Name _____

SRF Identification Number _____

General Contractor _____

Contract Value _____

The United States Environmental Protection Agency (EPA) requires that all SRF borrowers develop and maintain a list of all MBE/WBE and non MBE/WBE subcontractors on the project.

This form must be completed and returned to MassDEP within 90 days of award of the contract.

Subcontractor	Point of Contact	Mailing Address	Telephone Number	E-Mail Address	MBE	WBE	DBE	Subcontract Value

Part I ADMINISTRATION OF THE GOVERNMENT

Title III LAWS RELATING TO STATE OFFICERS

Chapter 30 GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Section 39F CONSTRUCTION CONTRACTS; ASSIGNMENT AND SUBROGATION; SUBCONTRACTOR DEFINED; ENFORCEMENT OF CLAIM FOR DIRECT PAYMENT; DEPOSIT, REDUCTION OF DISPUTED AMOUNTS

Section 39F. (1) Every contract awarded pursuant to sections forty-four A to L, inclusive, of chapter one hundred and forty-nine shall contain the following subparagraphs (a) through (i) and every contract awarded pursuant to section thirty-nine M of chapter thirty shall contain the following subparagraphs (a) through (h) and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount

specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor or which is to be included in a

payment to the general contractor for payment to the subcontractor as provided in subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be

delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be

earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor.

(i) If the subcontractor does not receive payment as provided in subparagraph (a) or if the general contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (a), the subcontractor may demand direct payment by following the procedure in subparagraph (d) and the general contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor performed or furnished the labor and materials for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the general contractor. Thereafter the awarding authority shall proceed as provided in subparagraph (e), (f), (g) and (h).

(2) Any assignment by a subcontractor of the rights under this section to a surety company furnishing a bond under the provisions of section twenty-nine of chapter one hundred forty-nine shall be invalid. The assignment and subrogation rights of the surety to amounts included in a demand for direct payment which are in the possession of the awarding authority or which are on

deposit pursuant to subparagraph (f) of paragraph (1) shall be subordinate to the rights of all subcontractors who are entitled to be paid under this section and who have not been paid in full.

(3) "Subcontractor" as used in this section (i) for contracts awarded as provided in sections forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub-bid or who is approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, (ii) for contracts awarded as provided in paragraph (a) of section thirty-nine M of chapter thirty shall mean a person approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, and (iii) for contracts with the commonwealth not awarded as provided in forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall also mean a person contracting with the general contractor to supply materials used or employed in a public works project for a price in excess of five thousand dollars.

(4) A general contractor or a subcontractor shall enforce a claim to any portion of the amount of a demand for direct payment deposited as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the other and the bank shall not be a necessary party. A subcontractor shall enforce a claim for direct payment or a right to require a deposit as

provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the awarding authority and the general contractor shall not be a necessary party. Upon motion of any party the court shall advance for speedy trial any petition filed as provided in this paragraph. Sections fifty-nine and fifty-nine B of chapter two hundred thirty-one shall apply to such petitions. The court shall enter an interlocutory decree upon which execution shall issue for any part of a claim found due pursuant to sections fifty-nine and fifty-nine B and, upon motion of any party, shall advance for speedy trial the petition to collect the remainder of the claim. Any party aggrieved by such interlocutory decree shall have the right to appeal therefrom as from a final decree. The court shall not consolidate for trial the petition of any subcontractor with the petition of one or more subcontractors or the same general contract unless the court finds that a substantial portion of the evidence of the same events during the course of construction (other than the fact that the claims sought to be consolidated arise under the same general contract) is applicable to the petitions sought to be consolidated and that such consolidation will prevent unnecessary duplication of evidence. A decree in any such proceeding shall not include interest on the disputed amount deposited in excess of the interest earned for the period of any such deposit. No person except a subcontractor filing a demand for direct payment for which no funds due the general contractor are available for direct payment shall have a right to file a petition in court of equity against the awarding

authority claiming a demand for direct payment is premature and such subcontractor must file the petition before the awarding authority has made a direct payment to the subcontractor and has made a deposit of the disputed portion as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1).

(5) In any petition to collect any claim for which a subcontractor has filed a demand for direct payment the court shall, upon motion of the general contractor, reduce by the amount of any deposit of a disputed amount by the awarding authority as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1) any amount held under a trustee writ or pursuant to a restraining order or injunction.

Part I ADMINISTRATION OF THE GOVERNMENT

Title III LAWS RELATING TO STATE OFFICERS

Chapter 30 GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Section 39G COMPLETION OF PUBLIC WORKS; SEMI-FINAL AND FINAL ESTIMATES; PAYMENTS; EXTRA WORK; DISPUTED ITEMS

Section 39G. Upon substantial completion of the work required by a contract with the commonwealth, or any agency or political subdivision thereof, for the construction, reconstruction, alteration, remodeling, repair or improvement of public ways, including bridges and other highway structures, sewers and, water mains, airports and other public works, the contractor shall present in writing to the awarding authority its certification that the work has been substantially completed. Within twenty-one days thereafter, the awarding authority shall present to the contractor either a written declaration that the work has been substantially completed or an itemized list of incomplete or unsatisfactory work items required by the contract sufficient to demonstrate that the

work has not been substantially completed. The awarding authority may include with such list a notice setting forth a reasonable time, which shall not in any event be prior to the contract completion date, within which the contractor must achieve substantial completion of the work. In the event that the awarding authority fails to respond, by presentation of a written declaration or itemized list as aforesaid, to the contractor's certification within the twenty-one day period, the contractor's certification shall take effect as the awarding authority's declaration that the work has been substantially completed.

Within sixty-five days after the effective date of a declaration of a substantial completion, the awarding authority shall prepare and forthwith send to the contractor for acceptance a substantial completion estimate for the quantity and price of the work done and all but one per cent retainage, if held by the awarding authority, on that work, including the quantity, price and all but one per cent retainage, if held by the awarding authority, for the undisputed part of each work item and extra work item in dispute but excluding the disputed part thereof, less the estimated cost of completing all incomplete and unsatisfactory work items and less the total periodic payments made to date for the work. The awarding authority also shall deduct from the substantial completion estimate an amount equal to the sum of all demands for direct payment filed by subcontractors and not yet paid to subcontractors or deposited in joint accounts pursuant to section thirty-nine F, but no contract subject to said section thirty-nine F

shall contain any other provision authorizing the awarding authority to deduct any amount by virtue of claims asserted against the contract by subcontractors, material suppliers or others.

If the awarding authority fails to prepare and send to the contractor any substantial completion estimate required by this section on or before the date herein above set forth, the awarding authority shall pay to the contractor interest on the amount which would have been due to the contractor pursuant to such substantial completion estimate at the rate of three percentage points above the rediscount rate then charged by the Federal Reserve Bank of Boston from such date to the date on which the awarding authority sends that substantial completion estimate to the contractor for acceptance or to the date of payment therefor, whichever occurs first. The awarding authority shall include the amount of such interest in the substantial completion estimate.

Within fifteen days after the effective date of the declaration of substantial completion, the awarding authority shall send to the contractor by certified mail, return receipt requested, a complete list of all incomplete or unsatisfactory work items, and, unless delayed by causes beyond his control, the contractor shall complete all such work items within forty-five days after the receipt of such list or before the then contract completion date, whichever is later. If the contractor fails to complete such work within such time, the awarding authority may, subsequent to seven days' written notice to the contractor by certified mail, return

receipt requested, terminate the contract and complete the incomplete or unsatisfactory work items and charge the cost of same to the contractor.

Within thirty days after receipt by the awarding authority of a notice from the contractor stating that all of the work required by the contract has been completed, the awarding authority shall prepare and forthwith send to the contractor for acceptance a final estimate for the quantity and price of the work done and all retainage, if held by the awarding authority, on that work less all payments made to date, unless the awarding authority's inspection shows that work items required by the contract remain incomplete or unsatisfactory, or that documentation required by the contract has not been completed. If the awarding authority fails to prepare and send to the contractor the final estimate within thirty days after receipt of notice of completion, the awarding authority shall pay to the contractor interest on the amount which would have been due to the contractor pursuant to such final estimate at the rate hereinabove provided from the thirtieth day after such completion until the date on which the awarding authority sends the final estimate to the contractor for acceptance or the date of payment therefor, whichever occurs first, provided that the awarding authority's inspection shows that no work items required by the contract remain incomplete or unsatisfactory. Interest shall not be paid hereunder on amounts for which interest is required to be paid in connection with the substantial completion estimate as

hereinabove provided. The awarding authority shall include the amount of the interest required to be paid hereunder in the final estimate.

The awarding authority shall pay the amount due pursuant to any substantial completion or final estimate within thirty-five days after receipt of written acceptance for such estimate from the contractor and shall pay interest on the amount due pursuant to such estimate at the rate hereinabove provided from that thirty-fifth day to the date of payment. Within 15 days, 30 days in the case of the commonwealth, after receipt from the contractor, at the place designated by the awarding authority, if such place is so designated, of a periodic estimate requesting payment of the amount due for the preceding periodic estimate period, the awarding authority shall make a periodic payment to the contractor for the work performed during the preceding periodic estimate period and for the materials not incorporated in the work but delivered and suitably stored at the site, or at some location agreed upon in writing, to which the contractor has title or to which a subcontractor has title and has authorized the contractor to transfer title to the awarding authority, upon certification by the contractor that he is the lawful owner and that the materials are free from all encumbrances. The awarding authority shall include with each such payment interest on the amount due pursuant to such periodic estimate at the rate herein above provided from the due date. In the case of periodic payments, the contracting authority may deduct from its payment a retention based on its

estimate of the fair value of its claims against the contractor, a retention for direct payments to subcontractors based on demands for same in accordance with the provisions of section thirty-nine F, and a retention to secure satisfactory performance of the contractual work not exceeding five per cent of the approved amount of any periodic payment, and the same right to retention shall apply to bonded subcontractors entitled to direct payment under section thirty-nine F of chapter thirty; provided, that a five per cent value of all items that are planted in the ground shall be deducted from the periodic payments until final acceptance.

No periodic, substantial completion or final estimate or acceptance or payment thereof shall bar a contractor from reserving all rights to dispute the quantity and amount of, or the failure of the awarding authority to approve a quantity and amount of, all or part of any work item or extra work item.

Substantial completion, for the purposes of this section, shall mean either that the work required by the contract has been completed except for work having a contract price of less than one per cent of the then adjusted total contract price, or substantially all of the work has been completed and opened to public use except for minor incomplete or unsatisfactory work items that do not materially impair the usefulness of the work required by the contract.

Part I ADMINISTRATION OF THE GOVERNMENT

Title III LAWS RELATING TO STATE OFFICERS

Chapter 30 GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Section 39I DEVIATIONS FROM PLANS AND SPECIFICATIONS

Section 39I. Every contractor having a contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public building or public works for the commonwealth, or of any political subdivision thereof, shall perform all the work required by such contract in conformity with the plans and specifications contained therein. No wilful and substantial deviation from said plans and specifications shall be made unless authorized in writing by the awarding authority or by the engineer or architect in charge of the work who is duly authorized by the awarding authority to approve such deviations. In order to avoid delays in the prosecution of the work required by such contract such deviation from the plans or specifications may be authorized by a written order of the awarding authority or such

engineer or architect so authorized to approve such deviation. Within thirty days thereafter, such written order shall be confirmed by a certificate of the awarding authority stating: (1) If such deviation involves any substitution or elimination of materials, fixtures or equipment, the reasons why such materials, fixtures or equipment were included in the first instance and the reasons for substitution or elimination, and, if the deviation is of any other nature, the reasons for such deviation, giving justification therefor; (2) that the specified deviation does not materially injure the project as a whole; (3) that either the work substituted for the work specified is of the same cost and quality, or that an equitable adjustment has been agreed upon between the contracting agency and the contractor and the amount in dollars of said adjustment; and (4) that the deviation is in the best interest of the contracting authority.

Such certificate shall be signed under the penalties of perjury and shall be a permanent part of the file record of the work contracted for.

Whoever violates any provision of this section wilfully and with intent to defraud shall be punished by a fine of not more than five thousand dollars or by imprisonment for not more than six months, or both.

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Section 39J PUBLIC CONSTRUCTION CONTRACTS; EFFECT OF DECISIONS OF CONTRACTING BODY OR ADMINISTRATIVE BOARD

Section 39J. Notwithstanding any contrary provision of any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or public works by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount of the contract is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, a decision, by the contracting body or by any administrative board, official or agency, or by any architect or engineer, on a dispute, whether of fact or of law, arising under said contract shall

not be final or conclusive if such decision is made in bad faith, fraudulently, capriciously, or arbitrarily is unsupported by substantial evidence, or is based upon error of law.

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Section 39L PUBLIC CONSTRUCTION WORK BY FOREIGN CORPORATIONS; RESTRICTIONS AND REPORTS

Section 39L. The commonwealth and every county, city, town, district, board, commission or other public body which, as the awarding authority, requests proposals, bids or sub-bids for any work in the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or other public works (1) shall not enter into a contract for the work with, and shall not approve as a subcontractor furnishing labor and materials for a part of the work, a foreign corporation which has not filed with the awarding authority a certificate of the state secretary stating that the corporation has complied with requirements of section 15.03 of subdivision A of Part 15 of chapter 156D and the date of compliance, and further has filed all annual reports required by

section 16.22 of subdivision B of Part 16 of said chapter 156D, and (2) shall report to the state secretary and to the department of corporations and taxation any foreign corporation performing work under such contract or subcontract, and any person, other than a corporation, performing work under such contract or subcontract, and residing or having a principal place of business outside the commonwealth.

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Section 39M CONTRACTS FOR CONSTRUCTION AND MATERIALS; MANNER OF AWARDING

Section 39M. (a) Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is and estimated by the awarding authority to cost less than $10,000 dollars shall be obtained through the exercise of sound business practices as defined in section 2 of chapter 30B. The awarding authority shall make and keep a record of each procurement that, at a minimum, shall include the name and address of the person from whom the services were procured. An awarding authority that utilizes a vendor on a statewide contract procured through the

operational services division, or a blanket contract procured by the awarding authority pursuant to this section, shall be deemed to have obtained the contract through sound business practices.

Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is estimated by the awarding authority to cost not less than $10,000 but not more than $50,000 shall be awarded to the responsible bidder offering to perform the contract at the lowest price. The awarding authority shall make public notification of the contract and shall seek written responses from no fewer than 3 persons who customarily perform such work. For purposes of this subsection, the term "public notification" shall include, but need not be limited to, posting, at least 2 weeks before the time specified in the notification for the receipt of responses, the contract and scope-of-work statement: (1) on the website of the awarding authority, (2) on the COMMBUYS system administered by the operational services division, (3) in the central register published pursuant to section 20A of chapter 9 and (4) in a conspicuous place in or near the primary office of the awarding authority; provided, however, that if the awarding authority obtains a minimum of 2 written responses from a vendor list established through a blanket contract or a statewide contract procured through the operational services division, and the lowest of those written responses is deemed acceptable to the awarding

authority, public notification is not required. The solicitation shall include a scope-of-work statement that defines the work to be performed and provides potential responders with sufficient information regarding the objectives and requirements of the awarding authority and the time period within which the work shall be completed. The awarding authority shall record the names and addresses of all persons from whom written responses were sought, the names of the persons submitting written responses and the date and amount of each written response.

An awarding authority may utilize a vendor list established through a statewide contract procured through the operational services division to identify 1 or more of the persons from whom it will seek written responses for purposes of this subsection. An awarding authority may also procure a blanket contract to establish a listing of vendors in certain defined categories of work that are under contract to provide services for multiple individual tasks of not more than $50,000 each, and from whom written responses will be sought. Any such blanket contract procured by the awarding authority shall be procured pursuant to this section or sections 44A to 44J, inclusive, of chapter 149 which are applicable to projects over $50,000.

Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district or housing authority that is estimated by the awarding authority to

cost more than $50,000, and every contract for the construction, reconstruction, installation, demolition, maintenance or repair of any building by a public agency, as defined by subsection (1) of section 44A of chapter 149, estimated to cost more than $50,000 but not more than $150,000, shall be awarded to the lowest eligible responsible bidder on the basis of competitive bids publicly opened and read by the awarding authority forthwith upon expiration of the time for the filing thereof; provided, however, that such awarding authority may reject any and all bids, if it is in the public interest to do so. Every bid for such contract shall be accompanied by a bid deposit in the form of: (1) a bid bond, (2) cash, or (3) a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to the awarding authority. The amount of the bid deposit shall be 5 per cent of the value of the bid. Any person submitting a bid pursuant to this section shall, on such bid, certify as follows:

The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

(Name of person signing bid)

(Company)

This subsection shall not apply to the award of any contract subject to the provisions of sections 44A to 44J, inclusive, of chapter 149 and every such contract shall continue to be awarded as provided therein. In cases of extreme emergency: (1) caused by enemy attack, sabotage or other such hostile actions or (2) resulting from an imminent security threat explosion, fire, flood, earthquake, hurricane, tornado or other such catastrophe, an awarding authority may, without competitive bids and notwithstanding any general or special law, award contracts otherwise subject to this subsection to perform work and to purchase or rent materials and equipment, all as may be necessary for temporary repair and restoration to service of any and all public work in order to preserve the health and safety of persons or property; provided, that this exception shall not apply to any permanent reconstruction, alteration, remodeling or repair of any public work.

(b) Specifications for such contracts, and specifications for contracts awarded pursuant to the provisions of said sections forty-four A to forty-four L of said chapter one hundred and forty-nine, shall be written to provide for full competition for each item of material to be furnished under the contract; except, however, that said specifications may be otherwise written for sound reasons in the public interest stated in writing in the public records of the awarding authority or promptly given in writing by the awarding authority to anyone making a written request therefor, in either instance such writing to be prepared after reasonable

investigation. Every such contract shall provide that an item equal to that named or described in the said specifications may be furnished; and an item shall be considered equal to the item so named or described if, in the opinion of the awarding authority: (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications. For each item of material the specifications shall provide for either a minimum of three named brands of material or a description of material which can be met by a minimum of three manufacturers or producers, and for the equal of any one of said name or described materials.

(c) The term "lowest responsible and eligible bidder" shall mean the bidder: (1) whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the work; (2) who shall certify, that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (3) who shall certify that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll

report for each employee; (4) who, where the provisions of section 8B of chapter 29 apply, shall have been determined to be qualified thereunder; and (5) who obtains within 10 days of the notification of contract award the security by bond required under section 29 of chapter 149; provided that for the purposes of this section the term "security by bond" shall mean the bond of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority; provided further, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable.

(d) The provisions of this section shall not apply (1) to the extent that they prevent the approval of such specifications by any contributing federal agency, (2) to materials purchased under specifications of the state department of highways at prices established by the said department pursuant to advertisement and bidding in connection with work to be performed under the provisions of chapter eighty-one or chapter ninety, (3) to any transaction between the commonwealth and any of its political subdivisions or between the commonwealth and any public service corporation, and (4) to any contract of not more than $50,000 awarded by a governmental body, as defined by section two of chapter thirty B, in accordance with the provisions of section five of said chapter thirty B; and (5) to any contract solely for the purchase of material awarded by a governmental body, as

defined by section 2 of chapter 30B, in accordance with section 5 of said chapter 30B, or procured through the operational services division pursuant to sections 22 and 52 of chapter 7.

(e) The word "material" as used in this section shall mean and include any article, assembly, system, or any component part thereof.

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Section 39N CONSTRUCTION CONTRACTS; EQUITABLE ADJUSTMENT IN CONTRACT PRICE FOR DIFFERING SUBSURFACE OR LATENT PHYSICAL CONDITIONS

Section 39N. Every contract subject to section forty-four A of chapter one hundred and forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may

request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents and are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly.

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Section 39O CONTRACTS FOR CONSTRUCTION AND MATERIALS; SUSPENSION, DELAY OR INTERRUPTION DUE TO ORDER OF AWARDING AUTHORITY; ADJUSTMENT IN CONTRACT PRICE; WRITTEN CLAIM

Section 39O. Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety and, in the event a suspension, delay, interruption or failure to act of the awarding authority increases the cost of performance to any subcontractor, that subcontractor shall have the same rights against the general contractor for payment for an increase in the cost of his performance as provisions (a) and (b) give the general contractor against the awarding authority, but nothing in provisions (a) and

(b) shall in any way change, modify or alter any other rights which the general contractor or the subcontractor may have against each other.

(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more or due to a failure of the awarding authority to act within the time specified in this contract, the awarding authority shall make an adjustment in the contract price for any increase in the cost of performance of this contract but shall not include any profit to the general contractor on such increase; and provided further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any

costs in the claim incurred more than twenty days before the general contractor notified the awarding authority in writing of the act or failure to act involved in the claim.

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Section 39P CONTRACTS FOR CONSTRUCTION AND MATERIALS; AWARDING AUTHORITY'S DECISIONS ON INTERPRETATION OF SPECIFICATIONS, ETC.; TIME LIMIT; NOTICE

Section 39P. Every contract subject to section thirty-nine M of this chapter or section forty-four A of chapter one hundred forty-nine which requires the awarding authority, any official, its architect or engineer to make a decision on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, shall require that the decision be made promptly and, in any event, no later than thirty days after the written submission for decision; but if such decision requires extended investigation and study, the awarding authority, the official, architect or engineer shall, within thirty days after the receipt of the

submission, give the party making the submission written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made.

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Chapter 30 GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Section 39Q CONTRACTS FOR CAPITAL FACILITY CONSTRUCTION; CONTENTS; ANNUAL CLAIMS REPORT

Section 39Q. (1) Every contract awarded by any state agency as defined by section thirty-nine A of chapter seven for the construction, reconstruction, alteration, remodeling, repair or demolition of any capital facility as defined by the aforesaid section thirty-nine A shall contain the following subparagraphs (a) through (d) in their entirety:

(a) Disputes regarding changes in and interpretations of the terms or scope of the contract and denials of or failures to act upon claims for payment for extra work or materials shall be resolved according to the following procedures, which shall constitute the exclusive method for resolving such disputes. Written notice of the matter in dispute shall be submitted promptly by the claimant

to the chief executive official of the state agency which awarded the contract or his designee. No person or business entity having a contract with a state agency shall delay, suspend, or curtail performance under that contract as a result of any dispute subject to this section. Any disputed order, decision or action by the agency or its authorized representative shall be fully performed or complied with pending resolution of the dispute.

(b) Within thirty days of submission of the dispute to the chief executive official of the state agency or his designee, he shall issue a written decision stating the reasons therefor, and shall notify the parties of their right of appeal under this section. If the official or his designee is unable to issue a decision within thirty days, he shall notify the parties to the dispute in writing of the reasons why a decision cannot be issued within thirty days and of the date by which the decision shall issue. Failure to issue a decision within the thirty-day period or within the additional time period specified in such written notice shall be deemed to constitute a denial of the claim and shall authorize resort to the appeal procedure described below. The decision of the chief executive official or his designee shall be final and conclusive unless an appeal is taken as provided below.

(c) Within twenty-one calendar days of the receipt of a written decision or of the failure to issue a decision as stated in the preceding subparagraph, any aggrieved party may file a notice of claim for an adjudicatory hearing with the division of hearing officers or the aggrieved party may file an action directly in a

court of competent jurisdiction and shall serve copies thereof upon all other parties in the form and manner prescribed by the rules governing the conduct of adjudicatory proceedings of the division of hearing officers. In the event an aggrieved party exercises his option to file an action directly in court as provided in the previous sentence, the twenty-one day period shall not apply to such filing and the period of filing such action shall be the same period otherwise applicable for filing a civil action in superior court. The appeal shall be referred to a hearing officer experienced in construction law and shall be prosecuted in accordance with the formal rules of procedure for the conduct of adjudicatory hearings of the division of hearing officers, except as provided below. The hearing officer shall issue a final decision as expeditiously as possible, but in no event more than one hundred and twenty calendar days after conclusion of the adjudicatory hearing, unless the decision is delayed by a request for extension of time for filing post-hearing briefs or other submissions assented to by all parties. Whenever, because an extension of time has been granted, the hearing officer is unable to issue a decision within one hundred and twenty days, he shall notify all parties of the reasons for the delay and the date when the decision will issue. Failure to issue a decision within the one hundred and twenty-day period or within the additional period specified in such written notice shall give the petitioner the right to pursue any legal remedies available to him without further delay.

(d) When the amount in dispute is less than ten thousand dollars, a contractor who is party to the dispute may elect to submit the appeal to a hearing officer experienced in construction law for expedited hearing in accordance with the informal rules of practice and procedure of the division of hearing officers. An expedited hearing under this subparagraph shall be available at the sole option of the contractor. The hearing officer shall issue a decision no later than sixty days following the conclusion of any hearing conducted pursuant to this subparagraph. The hearing officer's decision shall be final and conclusive, and shall not be set aside except in cases of fraud.

(2) The commissioner of administration shall require the division of hearings officers to prepare annually a report concerning the construction contract claims submitted to the division during the preceding twelve months, in such form as the commissioner shall prescribe. The report shall contain, at a minimum, the following information: the number of claims submitted; the names of all parties to each such claim; a brief description of the claim; the date of submission and of disposition of the claim; its disposition, whether by settlement, withdrawal, default or written decision; and the number of claims currently pending. The original of the report shall be submitted to the commissioner of administration by January fifteenth, and a copy shall be filed with the state librarian and shall be a public document.

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Section 39R KEEPING AND MAINTAINING OF BOOKS, RECORDS AND ACCOUNTS; STATEMENT OF MANAGEMENT ON INTERNAL ACCOUNTING CONTROL; FINANCIAL STATEMENTS; ENFORCEMENT

Section 39R. (a) The words defined herein shall have the meaning stated below whenever they appear in this section:

(1) "Contractor" means any person, corporation, partnership, joint venture, sole proprietorship, or other entity awarded a contract pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A to forty-four H, inclusive, of chapter one hundred and forty-nine, which is for an amount or estimated amount greater than one hundred thousand dollars.

(2) "Contract" means any contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred and forty-nine, which is for amount or estimated amount greater than one hundred thousand dollars.

(3) "Records" means books of original entry, accounts, checks, bank statements and all other banking documents, correspondence, memoranda, invoices, computer printouts, tapes, discs, papers and other documents or transcribed information of any type, whether expressed in ordinary or machine language.

(4) "Independent Certified Public Accountant" means a person duly registered in good standing and entitled to practice as a certified public accountant under the laws of the place of his residence or principal office and who is in fact independent. In determining whether an accountant is independent with respect to a particular person, appropriate consideration should be given to all relationships between the accountant and that person or any affiliate thereof. Determination of an accountant's independence shall not be confined to the relationships existing in connection with the filing of reports with the awarding authority.

(5) "Audit", when used in regard to financial statements, means an examination of records by an independent certified public accountant in accordance with generally accepted accounting principles and auditing standards for the purpose of expressing a *certified* opinion thereon, or, in the alternative, a qualified opinion or a declination to express an opinion for stated reasons.

(6) "Accountant's Report", when used in regard to financial statements, means a document in which an independent certified public accountant indicates the scope of the audit which he has made and sets forth his opinion regarding the financial statements taken as a whole with a listing of noted exceptions and qualifications, or an assertion to the effect that an overall opinion cannot be expressed. When an overall opinion cannot be expressed the reason therefor shall be stated. An accountant's report shall include as a part thereof a signed statement by the responsible corporate officer attesting that management has fully disclosed all material facts to the independent certified public accountant, and that the audited financial statement is a true and complete statement of the financial condition of the contractor.

(7) "Management", when used herein, means the chief executive officers, partners, principals or other person or persons primarily responsible for the financial and operational policies and practices of the contractor.

(8) Accounting terms, unless otherwise defined herein, shall have a meaning in accordance with generally accepted accounting principles and auditing standards.

(b) Subsection (a)(2) hereof notwithstanding, every agreement or contract awarded or executed pursuant to sections thirty-eight A1/2 to thirty-eight O, inclusive, of chapter seven, or eleven C of chapter twenty-five A, and pursuant to section thirty-nine M of chapter thirty or to section forty-four A through H, inclusive, of chapter one hundred and forty-nine, shall provide that:

(1) The contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the contractor, and

(2) until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the contractor or of his subcontractors that directly pertain to, and involve transactions relating to, the contractor or his subcontractors, and

(3) if the agreement is a contract as defined herein, the contractor shall describe any change in the method of maintaining records or recording transactions which materially affect any statements filed with the awarding authority, including in his description the date of the change and reasons therefor, and shall accompany said

description with a letter from the contractor's independent certified public accountant approving or otherwise commenting on the changes, and

(4) if the agreement is a contract as defined herein, the contractor has filed a statement of management on internal accounting controls as set forth in paragraph (c) below prior to the execution of the contract, and

(5) if the agreement is a contract as defined herein, the contractor has filed prior to the execution of the contracts and will continue to file annually, an audited financial statement for the most recent completed fiscal year as set forth in paragraph (d) below.

(c) Every contractor awarded a contract shall file with the awarding authority a statement of management as to whether the system of internal accounting controls of the contractor and its subsidiaries reasonably assures that:

(1) transactions are executed in accordance with management's general and specific authorization;

(2) transactions are recorded as necessary

i. to permit preparation of financial statements in conformity with generally accepted accounting principles, and

ii. to maintain accountability for assets;

(3) access to assets is permitted only in accordance with management's general or specific authorization; and

(4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Every contractor awarded a contract shall also file with the awarding authority a statement prepared and signed by an independent certified public accountant, stating that he has examined the statement of management on internal accounting controls, and expressing an opinion as to

(1) whether the representations of management in response to this paragraph and paragraph (b) above are consistent with the result of management's evaluation of the system of internal accounting controls; and

(2) whether such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

(d) Every contractor awarded a contract by the commonwealth or by any political subdivision thereof shall annually file with the commissioner of capital asset management and maintenance during the term of the contract a financial statement prepared by an independent certified public accountant on the basis of an audit by such accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report. Such statements shall be made available to the awarding authority upon request.

(e) The office of inspector general, the commissioner of capital asset management and maintenance and any other awarding authority shall enforce the provisions of this section. The commissioner of capital asset management and maintenance may after providing an opportunity for the inspector general and other interested parties to comment, promulgate pursuant to the provisions of chapter thirty A such rules, regulations and guidelines as are necessary to effectuate the purposes of this section. Such rules, regulations and guidelines may be applicable to all awarding authorities. A contractor's failure to satisfy any of the requirements of this section may be grounds for debarment pursuant to section forty-four C of chapter one hundred and forty-nine.

(f) Records and statements required to be made, kept or filed under the provisions of this section shall not be public records as defined in section seven of chapter four and shall not be open to public inspection; provided, however, that such records and statements shall be made available pursuant to the provisions of clause (2) of paragraph (b).

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Chapter 30 GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Section 39S CONTRACTS FOR CONSTRUCTION; REQUIREMENTS

Section 39S. (a) As used in this section the word "person" shall mean any natural person, joint venture, partnership corporation or other business or legal entity. Any person submitting a bid for, or signing a contract to work on, the construction, reconstruction, alteration, remodeling or repair of any public work by the commonwealth, or political subdivision thereof, or by any county, city, town, district, or housing authority, and estimated by the awarding authority to cost more than $10,000, and any person submitting a bid for, or signing a contract to work on, the construction, reconstruction, installation, demolition, maintenance or repair of any building by a public agency, estimated to cost more than $10,000, shall certify on the bid, or contract, under penalties of perjury, as follows:

(1) that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (2) that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; and (3) that all employees to be employed in the work subject to this bid have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration.

(b) Any employee found on a worksite subject to this section without documentation of successful completion of a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration shall be subject to immediate removal.

(c) The attorney general, or his designee, shall have the power to enforce this section including the power to institute and prosecute proceedings in the superior court to restrain the award of contracts and the performance of contracts in all cases where, after investigation of the facts, he has made a finding that the award or performance has resulted in violation, directly or indirectly, of

subsection (b), and he shall not be required to pay to the clerk of the court an entry fee in connection with the institution of the proceeding.

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Title XIV PUBLIC WAYS AND WORKS

Chapter 82 THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

Section 40 DEFINITIONS

Section 40. The following words, as used in this section and sections 40A to 40E, inclusive, shall have the following meanings:—

"Company", natural gas pipeline company, petroleum or petroleum products pipeline company, public utility company, cable television company, and municipal utility company or department that supply gas, electricity, telephone, communication or cable television services or private water companies within the city or town where such excavation is to be made.

"Description of excavation location", such description shall include the name of the city or town, street, way, or route number where appropriate, the name of the streets at the nearest

intersection to the excavation, the number of the buildings closest to the excavation or any other description, including landmarks, utility pole numbers or other information which will accurately define the location of the excavation.

"Emergency", a condition in which the safety of the public is in imminent danger, such as a threat to life or health or where immediate correction is required to maintain or restore essential public utility service.

"Excavation", an operation for the purpose of movement or removal of earth, rock or the materials in the ground including, but not limited to, digging, blasting, augering, backfilling, test boring, drilling, pile driving, grading, plowing in, hammering, pulling in, jacking in, trenching, tunneling and demolition of structures, excluding excavation by tools manipulated only by human power for gardening purposes and use of blasting for quarrying purposes.

"Excavator", any entity including, but not limited to, a person, partnership, joint venture, trust, corporation, association, public utility, company or state or local government body which performs excavation operations.

"Premark", to delineate the general scope of the excavation or boring on the paved surface of the ground using white paint, or stakes or other suitable white markings on nonpaved surfaces. No premarking shall be acceptable if such marks can reasonably

interfere with traffic or pedestrian control or are misleading to the general public. Premarking shall not be required of any continuous excavation that is over 500 feet in length.

"Safety zone", a zone designated on the surface by the use of standard color-coded markings which contains the width of the facilities plus not more than 18 inches on each side.

"Standard color-coded markings", red - electric power lines, cables, conduit or light cables; yellow - gas, oil, street petroleum, or other gaseous materials; orange - communications cables or conduit, alarm or signal lines; blue - water, irrigation and slurry lines; green - sewer and drain lines; white - premark of proposed excavation.

"System", the underground plant damage prevention system as defined in section 76D of chapter 164.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XIV PUBLIC WAYS AND WORKS

Chapter 82 THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

Section 40A EXCAVATIONS; NOTICE

Section 40A. No excavator installing a new facility or an addition to an existing facility or the relay or repair of an existing facility shall, except in an emergency, make an excavation, in any public or private way, any company right-of-way or easement or any public or privately owned land or way, unless at least 72 hours, exclusive of Saturdays, Sundays and legal holidays but not more than 30 days before the proposed excavation is to be made, such excavator has premarked not more than 500 feet of the proposed excavation and given an initial notice to the system. Such initial notice shall set forth a description of the excavation location in the manner as herein defined. In addition, such initial notice shall indicate whether any such excavation will involve blasting and, if so, the date and the location at which such blasting is to occur.

The notice requirements shall be waived in an emergency as defined herein; provided, however, that before such excavation begins or during a life-threatening emergency, notification shall be given to the system and the initial point of boring or excavation shall be premarked. The excavator shall ensure that the underground facilities of the utilities in the area of such excavation shall not be damaged or jeopardized.

In no event shall any excavation by blasting take place unless notice thereof, either in the initial notice or a subsequent notice accurately specifying the date and location of such blasting shall have been given and received at least 72 hours in advance, except in the case of an unanticipated obstruction requiring blasting when such notice shall be not less than four hours prior to such blasting. If any such notice cannot be given as aforesaid because of an emergency requiring blasting, it shall be given as soon as may be practicable but before any explosives are discharged.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XIV PUBLIC WAYS AND WORKS

Chapter 82 THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

Section 40B DESIGNATION OF LOCATION OF UNDERGROUND FACILITIES

Section 40B. Within 72 hours, exclusive of Saturdays, Sundays and legal holidays, from the time the initial notice is received by the system or at such time as the company and the excavator agree, such company shall respond to the initial notice or subsequent notice by designating the location of the underground facilities within 15 feet in any direction of the premarking so that the existing facilities are to be found within a safety zone. Such safety zone shall be so designated by the use of standard color-coded markings. The providing of such designation by the company shall constitute prima facie evidence of an exercise of reasonable precaution by the company as required by this section; provided, however, that in the event that the excavator has given

notice as aforesaid at a location at which because of the length of excavation the company cannot reasonably designate the entire location of its facilities within such 72 hour period, then such excavator shall identify for the company that portion of the excavation which is to be first made and the company shall designate the location of its facilities in such portion within 72 hours and shall designate the location of its facilities in the remaining portion of the location within a reasonable time thereafter. When an emergency notification has been given to the system, the company shall make every attempt to designate its facilities as promptly as possible.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XIV PUBLIC WAYS AND WORKS

Chapter 82 THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

Section 40C EXCAVATOR'S RESPONSIBILITY TO MAINTAIN DESIGNATION MARKINGS; DAMAGE CAUSED BY EXCAVATOR

Section 40C. After a company has designated the location of its facilities at the location in accordance with section 40B, the excavator shall be responsible for maintaining the designation markings at such locations, unless such excavator requests remarking at the location due to the obliteration, destruction or other removal of such markings. The company shall then remark such location within 24 hours following receipt of such request.

When excavating in close proximity to the underground facilities of any company when such facilities are to be exposed, non-mechanical means shall be employed, as necessary, to avoid damage in locating such facility and any further excavation shall

be performed employing reasonable precautions to avoid damage to any underground facilities including, but not limited to, any substantial weakening of structural or lateral support of such facilities, penetration or destruction of any pipe, main, wire or conduit or the protective coating thereof, or damage to any pipe, main, wire or conduit.

If any damage to such pipe, main, wire or conduit or its protective coating occurs, the company shall be notified immediately by the excavator responsible for causing such damage.

The making of an excavation without providing the notice required by section 40A with respect to any proposed excavation which results in any damage to a pipe, main, wire or conduit, or its protective coating, shall be prima facie evidence in any legal or administrative proceeding that such damage was caused by the negligence of such person.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XIV PUBLIC WAYS AND WORKS

Chapter 82 THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

Section 40D LOCAL LAWS REQUIRING EXCAVATION PERMITS; PUBLIC WAYS

Section 40D. Nothing in this section shall affect or impair local ordinances or by-laws requiring a permit to be obtained before excavation in a public way or on private property; but notwithstanding any general or special law, ordinance or by-law to the contrary, to the extent that any permit issued under the provisions of the state building code or state fire code requires excavation by an excavator on a public way or on private property, the permit shall not be valid unless the excavator notifies the system as required pursuant to sections 40 and 40A, before the commencement of the excavation, and has complied with the permitting requirements of chapter 82A.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XIV PUBLIC WAYS AND WORKS

Chapter 82 THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

Section 40E VIOLATIONS OF SECS. 40A TO 40E; PUNISHMENT

Section 40E. Any person or company found by the department of telecommunications and energy, after a hearing, to have violated any provision of sections 40A to 40E, inclusive, shall be fined $1,000 for the first offense and not less than $5,000 nor more than $10,000 for any subsequent offense within 12 consecutive months as set forth by the rules of said department; provided, however, that nothing herein shall be construed to require forfeiture of any penal sum by a state or local government body for violation of section 40A or 40C; and provided, further, that nothing herein shall be construed to require the forfeiture of any penal sum by a residential property owner for the failure to premark for an excavation on such person's residential property.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XIV PUBLIC WAYS AND WORKS

Chapter 82A EXCAVATION AND TRENCH SAFETY

Section 1 UNATTENDED OPEN TRENCHES; SAFETY HAZARDS; RULES AND REGULATIONS; FINES

Section 1. An excavator shall not leave an open trench unattended without first making reasonable effort to eliminate any recognized safety hazard that may exist as a result of leaving the open trench unattended. The commissioner of the division of professional licensure, in conjunction with the director of labor and workforce development, or his designee, shall promulgate rules and regulations governing all construction related excavations and trench safety. The rules and regulations shall include, but not be limited to, a description of recognized safety hazards that may exist as a result of leaving open trenches or excavations unattended, a description of the procedures required or recommended by the division of professional licensure to eliminate safety hazards which may include covering, barricading

or otherwise protecting open trenches from accidental entry, and a penalty structure for each violation of the proposed rules and regulations to be imposed by the agency empowered with ensuring compliance with the rules and regulations. This penalty structure shall include the imposition of a fine for each violation of the regulations promulgated pursuant to this section. Any such fines collected by the office of public safety and inspections of the division of professional licensure or the department of labor and workforce development shall be available for expenditure, without further appropriation, by those agencies in an amount not to exceed $100,000 during each fiscal year for the sole purpose of providing construction safety training for licensed operators of hoisting equipment, police department officials, fire department officials and building officials. Those agencies may also charge a reasonable fee to help defray the costs associated with said training. Any monies collected from the imposition of these fines in excess of $100,000 shall be transmitted monthly by those departments to the state treasurer who shall then deposit the excess funds into the General Fund. The office of public safety and inspections of the division of professional licensure, in conjunction with the department of labor and workforce development, shall file a report detailing the amount of fines imposed, collected and expended pursuant to this section with the house and senate committees on ways and means and with the joint committee on public safety not later than August 15 of each year. The rules and regulations shall not be effective until the

office of public safety and inspections of the division of professional licensure has received a formal determination from the United States Secretary of Labor that the proposed rules or regulations do not seek to assume responsibility for development and enforcement therein of occupational safety and health standards relating to any occupational safety or health issue with respect to which a federal standard has already been promulgated under 29 U.S.C. section 667 or until the rules and regulations are approved by the United States Secretary of Labor as a state plan for the development of the standards and their enforcement pursuant to 29 U.S.C. section 667(c).

Part I ADMINISTRATION OF THE GOVERNMENT

Title XXI LABOR AND INDUSTRIES

Chapter 149 LABOR AND INDUSTRIES

Section 34 PUBLIC CONTRACTS; STIPULATION AS TO HOURS AND DAYS OF WORK; VOID CONTRACTS

Section 34. Every contract, except for the purchase of material or supplies, involving the employment of laborers, workmen, mechanics, foremen or inspectors, to which the commonwealth or any county or any town, subject to section thirty, is a party, shall contain a stipulation that no laborer, workman, mechanic, foreman or inspector working within the commonwealth, in the employ of the contractor, sub-contractor or other person doing or contracting to do the whole or a part of the work contemplated by the contract, shall be required or permitted to work more than eight hours in any one day or more than forty-eight hours in any one week, or more than six days in any one week, except in cases of emergency, or, in case any town subject to section thirty-one is a party to such a contract, more than eight hours in any one day, except as aforesaid; provided, that in contracts entered into by the department of highways for the construction or reconstruction of

highways there may be inserted in said stipulation a provision that said department, or any contractor or sub-contractor for said department, may employ laborers, workmen, mechanics, foremen and inspectors for more than eight hours in any one day in such construction or reconstruction when, in the opinion of the commissioner, public necessity so requires. Every such contract not containing the aforesaid stipulation shall be null and void.

Part I ADMINISTRATION OF THE GOVERNMENT

Title XXI LABOR AND INDUSTRIES

Chapter 149 LABOR AND INDUSTRIES

Section 44J INVITATIONS TO BID; NOTICE; CONTENTS; VIOLATIONS; PENALTY

Section 44J. (1) No public agency or authority of the commonwealth or any political subdivision thereof shall award any contract for which competitive bids are required pursuant to section forty-four A of this chapter or section thirty-nine M of chapter thirty, or for which competitive proposals are required pursuant to subsection (4) of section forty-four E of this chapter or section eleven C of chapter twenty-five A, unless a notice inviting bids or proposals therefor shall have been posted no less than one week prior to the time specified in such notice for the receipt of said bids or proposals in a conspicuous place in or near the offices of the awarding authority, and shall have remained posted until the time so specified, and unless such notice shall also have been published at least once not less than two weeks prior to the time so specified in the central register published by the secretary of state pursuant to section twenty A of chapter nine and in a newspaper

of general circulation in the locality of the proposed project, and on the COMMBUYS system administered by the operational services division. Said notice shall also be published at such other times and in such other newspapers or trade periodicals as the commissioner of capital asset management and maintenance may require, having regard to the locality of the work involved.

(2) Said notice shall specify the time and place where plans and specifications of the proposed work may be had; the time and place of submission of general bids; and the time and place for opening of the general bids. For contracts subject to the provisions of sections forty-four A to H, inclusive, of this chapter, said notice shall also specify the time and place for submission of filed sub-bids, where required pursuant to section forty-four F; and the time and place for opening of said filed sub-bids.

Said notice shall also provide sufficient facts concerning the nature and scope of such project, the type and elements of construction, and such other information as will assist applicants in deciding to bid on such contract.

(3) No contract or preliminary plans and specifications shall be split or divided for the purpose of evading the provisions of this section.

(4) General bids and filed sub-bids for any contract subject to this section shall be in writing and shall be opened in public at the time and place specified in the posted or published notice, and after being so opened shall be open to public inspection.

(5) The provisions of this section shall not apply to any transaction between the commonwealth and any public service corporation.

(6) The provisions of this section may be waived in cases of extreme emergency involving the health and safety of the people and their property, upon the written approval of said commissioner. The written approval shall contain a description of the circumstances and the reasons for the commissioner's determination.

(7) Whoever violates any provision of this section shall be punished by a fine of not more than ten thousand dollars or by imprisonment in the state prison for not more than three years or in a jail or house of correction for not more than two and one-half years, or by both said fine and imprisonment; and in the event of final conviction, said person shall be incapable of holding any office of honor, trust or profit under the commonwealth or under any county, district of municipal agency.

Each and every person who shall cause or conspire to cause any contract or preliminary plans and specifications to be split or divided for the purpose of evading the provisions of this section shall forfeit and pay to the commonwealth, a political subdivision thereof or other awarding authority subject to this section, the sum of not more than five thousand dollars and, in addition, such person or persons shall pay, apportioned among them, double the amount of damages which the commonwealth or political

subdivision thereof or other awarding authority may have sustained by reason of the doing of such act, together with the costs of the action.

(8) If an awarding authority rejects all general bids or does not receive any general bids, and advertises for a second opening of general bids with the original filed sub-bids as set forth in subsection (1) of section forty-four E the notice for receipt of such general bids may be published in the central register and elsewhere as required not less than one week prior to the time specified for such second opening of general bids.

(9) No request for proposals or invitation for bids issued under sections 38A 1/2 to 38*O*, inclusive, of chapter 7, section 11C of chapter 25A, section 39M of chapter 30, this section and sections 44A to 44H, inclusive, shall be advertised if the awarding authority's cost estimate is greater than 1 year old.

Massachusetts Wage Rates to be included with final Contract Documents

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THE COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF LABOR AND WORKFORCE DEVELOPMENT
DEPARTMENT OF LABOR STANDARDS
Prevailing Wage Rates

MAURA HEALY
Governor
KIM DRISCOLL
Lt. Governor

As determined by the Director under the provisions of the Massachusetts General Laws, Chapter 149, Sections 26 to 27H

LAUREN JONES
Secretary
MICHAEL FLANAGAN
Director

Awarding Authority:	Yarmouth	**City/Town:**	YARMOUTH
Contract Number:			
Description of Work:	10,000-ft of 8- to 24-in PVC gravity sewer; 3,000-ft of 8-in and 12-in PVC force main; 2 wastewater pump stations; manholes; sewer services; water main replacement; earthwork; dewatering; and paving		
Job Location:	Route 28, Yarmouth, MA		

Information about Prevailing Wage Schedules for Awarding Authorities and Contractors

- The wage rates will remain in effect for the duration of the project, except in the case of multi-year public construction projects. For construction projects lasting longer than one year, awarding authorities must request an updated wage schedule no later than two weeks before the anniversary of the date the contract was executed by the awarding authority and the general contractor. For multi-year CM AT RISK projects, the awarding authority must request an annual update no later than two weeks before the anniversary date, determined as the earlier of: (a) the execution date of the GMP Amendment, or (b) the execution date of the first amendment to permit procurement of construction services. The updated wage schedule must be provided to all contractors, including general and sub-contractors, working on the construction project.
- This annual update requirement is generally not applicable to 27F “rental of equipment” contracts. For such contracts, the prevailing wage rates issued by DLS shall remain in effect for the duration of the contract term. However, if the prevailing wage rate sheet issued does not contain wage rates for each year covered by the contract term, the Awarding Authority must request updated rate sheets from DLS and provide them to the contractor to ensure the correct rates are being paid throughout the duration of the contract. Additionally, if an Awarding Authority exercises an option to renew or extend the contract term, they must request updated rate sheets form DLS and provide them to the contractor.
- This wage schedule applies only to the specific project referenced at the top of this page and uniquely identified by the “Wage Request Number” on all pages of this schedule.
- An Awarding Authority must request an updated wage schedule if it has not opened bids or selected a contractor within 90 days of the date of issuance of the wage schedule. For CM AT RISK projects (bid pursuant to G.L. c.149A), the earlier of: (a) the execution date of the GMP Amendment, or (b) the bid for the first construction scope of work must be within 90-days of the wage schedule issuance date.
- The wage schedule shall be incorporated in any advertisement or call for bids for the project as required by M.G.L. c. 149, § 27. The wage schedule shall be made a part of the contract awarded for the project. The wage schedule must be posted in a conspicuous place at the work site for the life of the project in accordance with M.G.L. c. 149 § 27. The wages listed on the wage schedule must be paid to employees performing construction work on the project whether they are employed by the prime contractor, a filed sub-bidder, or a sub-contractor.
- Apprentices working on the project are required to be registered with the Massachusetts Division of Apprentice Standards (DAS). Apprentices must keep their apprentice identification card on their persons during all work hours on the project. An apprentice registered with DAS may be paid the lower apprentice wage rate at the applicable step as provided on the prevailing wage schedule. **Any apprentice not registered with DAS regardless of whether they are registered with another federal, state, local, or private agency must be paid the journeyworker's rate.**
- Every contractor or subcontractor working on the construction project must submit weekly payroll reports and a Statement of Compliance directly to the awarding authority by mail or email and keep them on file for three years. Each weekly payroll report must contain: the employee’s name, address, occupational classification, hours worked, and wages paid. Do not submit weekly payroll reports to DLS. For a sample payroll reporting form go to http://www.mass.gov/dols/pw.
- Contractors with questions about the wage rates or classifications included on the wage schedule have an affirmative obligation to inquire with DLS at (617) 626-6953.
- Contractors must obtain the wage schedules from awarding authorities. Failure of a contractor or subcontractor to pay the prevailing wage rates listed on the wage schedule to all employees who perform construction work on the project is a violation of the law and subjects the contractor or subcontractor to civil and criminal penalties.
- Employees not receiving the prevailing wage rate set forth on the wage schedule may file a complaint with the Fair Labor Division of the office of the Attorney General at (617) 727-3465.

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
(2 AXLE) DRIVER - EQUIPMENT TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$40.95	$15.57	$20.17	$0.00	$0.00	$76.69
	12/1/2025	$40.95	$15.57	$21.78	$0.00	$0.00	$78.30
	1/1/2026	$40.95	$16.17	$21.78	$0.00	$0.00	$78.90
	6/1/2026	$41.95	$16.17	$21.78	$0.00	$0.00	$79.90
	12/1/2026	$41.95	$16.17	$23.52	$0.00	$0.00	$81.64
	1/1/2027	$41.95	$16.77	$23.52	$0.00	$0.00	$82.24
(3 AXLE) DRIVER - EQUIPMENT TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$41.02	$15.57	$20.17	$0.00	$0.00	$76.76
	12/1/2025	$41.02	$15.57	$21.78	$0.00	$0.00	$78.37
	1/1/2026	$41.02	$16.17	$21.78	$0.00	$0.00	$78.97
	6/1/2026	$42.02	$16.17	$21.78	$0.00	$0.00	$79.97
	12/1/2026	$42.02	$16.17	$23.52	$0.00	$0.00	$81.71
	1/1/2027	$42.02	$16.77	$23.52	$0.00	$0.00	$82.31
(4 & 5 AXLE) DRIVER - EQUIPMENT TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$41.14	$15.57	$20.17	$0.00	$0.00	$76.88
	12/1/2025	$41.14	$15.57	$21.78	$0.00	$0.00	$78.49
	1/1/2026	$41.14	$16.17	$21.78	$0.00	$0.00	$79.09
	6/1/2026	$42.14	$16.17	$21.78	$0.00	$0.00	$80.09
	12/1/2026	$42.14	$16.17	$23.52	$0.00	$0.00	$81.83
	1/1/2027	$42.14	$16.77	$23.52	$0.00	$0.00	$82.43
ADS/SUBMERSIBLE PILOT PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2) For apprentice rates see "Apprentice- PILE DRIVER"	8/1/2024	$117.16	$10.08	$11.62	$12.67	$0.00	$151.53
AIR TRACK OPERATOR LABORERS LABORERS - ZONE 2	6/1/2025	$40.59	$10.15	$9.50	$9.11	$0.00	$69.35
	12/1/2025	$41.97	$10.15	$9.50	$9.11	$0.00	$70.73
	6/1/2026	$43.41	$10.15	$9.50	$9.11	$0.00	$72.17
	12/1/2026	$44.85	$10.15	$9.50	$9.11	$0.00	$73.61
	6/1/2027	$46.30	$10.15	$9.50	$9.11	$0.00	$75.06
	12/1/2027	$47.75	$10.15	$9.50	$9.11	$0.00	$76.51
	6/1/2028	$49.25	$10.15	$9.50	$9.11	$0.00	$78.01
	12/1/2028	$50.75	$10.15	$9.50	$9.11	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"							
AIR TRACK OPERATOR (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.59	$10.15	$9.50	$9.21	$0.00	$69.45
	12/1/2025	$41.97	$10.15	$9.50	$9.21	$0.00	$70.83
	6/1/2026	$43.41	$10.15	$9.50	$9.21	$0.00	$72.27
	12/1/2026	$44.85	$10.15	$9.50	$9.21	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)							
ASBESTOS REMOVER - PIPE / MECH. EQUIPT. HEAT & FROST INSULATORS LOCAL 6 HEAT & FROST INSULATORS LOCAL 6 (BOSTON)	6/1/2025	$43.80	$14.50	$4.30	$6.75	$0.00	$69.35
	12/1/2025	$44.80	$14.50	$4.30	$6.75	$0.00	$70.35
ASPHALT RAKER LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
ASPHALT RAKER (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
ASPHALT/CONCRETE/CRUSHER PLANT-ON SITE OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$58.33	$15.55	$13.25	$3.25	$0.00	$90.38
	12/1/2025	$59.78	$15.55	$13.25	$3.25	$0.00	$91.83
	6/1/2026	$61.08	$15.55	$13.25	$3.25	$0.00	$93.13
	12/1/2026	$62.53	$15.55	$13.25	$3.25	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
BACKHOE/FRONT-END LOADER OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$58.33	$15.55	$13.25	$3.25	$0.00	$90.38
	12/1/2025	$59.78	$15.55	$13.25	$3.25	$0.00	$91.83
	6/1/2026	$61.08	$15.55	$13.25	$3.25	$0.00	$93.13
	12/1/2026	$62.53	$15.55	$13.25	$3.25	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
BARCO-TYPE JUMPING TAMPER LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
BLOCK PAVER, RAMMER / CURB SETTER LABORERS LABORERS - ZONE 2	6/1/2025	$40.59	$10.15	$9.50	$9.11	$0.00	$69.35
	12/1/2025	$41.97	$10.15	$9.50	$9.11	$0.00	$70.73
	6/1/2026	$43.41	$10.15	$9.50	$9.11	$0.00	$72.17
	12/1/2026	$44.85	$10.15	$9.50	$9.11	$0.00	$73.61
	6/1/2027	$46.30	$10.15	$9.50	$9.11	$0.00	$75.06
	12/1/2027	$47.75	$10.15	$9.50	$9.11	$0.00	$76.51
	6/1/2028	$49.25	$10.15	$9.50	$9.11	$0.00	$78.01
	12/1/2028	$50.75	$10.15	$9.50	$9.11	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"							
BLOCK PAVER, RAMMER / CURB SETTER (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.59	$10.15	$9.50	$9.21	$0.00	$69.45
	12/1/2025	$41.97	$10.15	$9.50	$9.21	$0.00	$70.83
	6/1/2026	$43.41	$10.15	$9.50	$9.21	$0.00	$72.27
	12/1/2026	$44.85	$10.15	$9.50	$9.21	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
BOILER MAKER BOILERMAKERS LOCAL 29 BOILERMAKERS LOCAL 29	1/1/2024	$48.12	$7.07	$14.60	$6.00	$0.00	$75.79

Apprentice: BOILER MAKER

Effective Date: 1/1/2024

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	65.00	$31.28	$7.07	$9.32	$3.90	$0.00	$51.57
2	65.00	$31.28	$7.07	$9.32	$3.90	$0.00	$51.57
3	70.00	$33.68	$7.07	$10.03	$4.20	$0.00	$54.98
4	75.00	$36.09	$7.07	$10.74	$4.50	$0.00	$58.40
5	80.00	$38.50	$7.07	$11.45	$4.80	$0.00	$61.82
6	85.00	$40.90	$7.07	$12.18	$5.10	$0.00	$65.25
7	90.00	$43.31	$7.07	$12.88	$5.40	$0.00	$68.66
8	95.00	$45.71	$7.07	$13.62	$5.70	$0.00	$72.10

Apprentice to Journeyworker Ratio: 1:4

BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING) BRICKLAYERS LOCAL 3 BRICKLAYERS LOCAL 3 (NEW BEDFORD)	8/1/2025	$67.95	$11.49	$15.57	$8.02	$0.00	$103.03
	2/1/2026	$69.30	$11.49	$15.57	$8.02	$0.00	$104.38
	8/1/2026	$71.50	$11.49	$15.57	$8.02	$0.00	$106.58
	2/1/2027	$72.90	$11.49	$15.57	$8.02	$0.00	$107.98

Apprentice: BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)

Effective Date: 8/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$33.98	$11.49	$15.57	$8.02	$0.00	$69.06
2	60.00	$40.77	$11.49	$15.57	$8.02	$0.00	$75.85
3	70.00	$47.57	$11.49	$15.57	$8.02	$0.00	$82.65
4	80.00	$54.36	$11.49	$15.57	$8.02	$0.00	$89.44
5	90.00	$61.16	$11.49	$15.57	$8.02	$0.00	$96.24

Apprentice: BRICK/STONE/ARTIFICIAL MASONRY (INCL. MASONRY WATERPROOFING)

Effective Date: 2/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$34.65	$11.49	$15.57	$8.02	$0.00	$69.73
2	60.00	$41.58	$11.49	$15.57	$8.02	$0.00	$76.66
3	70.00	$48.51	$11.49	$15.57	$8.02	$0.00	$83.59
4	80.00	$55.44	$11.49	$15.57	$8.02	$0.00	$90.52
5	90.00	$62.37	$11.49	$15.57	$8.02	$0.00	$97.45

Apprentice to Journeyworker Ratio: 1:5

BULLDOZER/GRADER/SCRAPER OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
OPERATING ENGINEERS LOCAL 4	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
CAISSON & UNDERPINNING BOTTOM MAN LABORERS LABORERS - FOUNDATION AND MARINE	6/1/2025	$48.35	$10.15	$9.50	$9.80	$0.00	$77.80
	12/1/2025	$49.85	$10.15	$9.50	$9.80	$0.00	$79.30
	6/1/2026	$51.40	$10.15	$9.50	$9.80	$0.00	$80.85
	12/1/2026	$52.90	$10.15	$9.50	$9.80	$0.00	$82.35
For apprentice rates see "Apprentice- LABORER"							
CAISSON & UNDERPINNING LABORER LABORERS LABORERS - FOUNDATION AND MARINE	6/1/2025	$47.20	$10.15	$9.50	$9.80	$0.00	$76.65
	12/1/2025	$48.70	$10.15	$9.50	$9.80	$0.00	$78.15
	6/1/2026	$50.25	$10.15	$9.50	$9.80	$0.00	$79.70
	12/1/2026	$51.75	$10.15	$9.50	$9.80	$0.00	$81.20
For apprentice rates see "Apprentice- LABORER"							
CAISSON & UNDERPINNING TOP MAN LABORERS LABORERS - FOUNDATION AND MARINE	6/1/2025	$47.53	$10.15	$9.50	$9.80	$0.00	$76.98
	12/1/2025	$49.03	$10.15	$9.50	$9.80	$0.00	$78.48
	6/1/2026	$50.58	$10.15	$9.50	$9.80	$0.00	$80.03
	12/1/2026	$52.08	$10.15	$9.50	$9.80	$0.00	$81.53
For apprentice rates see "Apprentice- LABORER"							
CARBIDE CORE DRILL OPERATOR LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
CARPENTER CARPENTERS CARPENTERS -ZONE 2 (Eastern Massachusetts)	9/1/2025	$50.35	$10.33	$11.47	$8.50	$0.00	$80.65
	3/1/2026	$51.60	$10.33	$11.47	$8.50	$0.00	$81.90
	9/1/2026	$52.85	$10.33	$11.47	$8.50	$0.00	$83.15
	3/1/2027	$54.10	$10.33	$11.47	$8.50	$0.00	$84.40

Apprentice: CARPENTER

Effective Date: 9/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	45.00	$22.66	$10.33	$0.00	$1.73	$0.00	$34.72
2	45.00	$22.66	$10.33	$0.00	$1.73	$0.00	$34.72
3	55.00	$27.69	$10.33	$0.00	$3.40	$0.00	$41.42
4	55.00	$27.69	$10.33	$0.00	$3.40	$0.00	$41.42
5	70.00	$35.25	$10.33	$11.41	$5.10	$0.00	$62.09
6	70.00	$35.25	$10.33	$11.41	$5.10	$0.00	$62.09
7	80.00	$40.28	$10.33	$11.44	$6.80	$0.00	$68.85
8	80.00	$40.28	$10.33	$11.44	$6.80	$0.00	$68.85

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
CARPENTER WOOD FRAME	10/1/2025	$27.75	$7.02	$3.80	$1.00	$0.00	$39.57
CARPENTERS	10/1/2026	$28.85	$7.02	$3.80	$1.00	$0.00	$40.67
CARPENTERS-ZONE 3 (Wood Frame)							

All Aspects of New Wood Frame Work

Apprentice: CARPENTER

Effective Date: 3/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	45.00	$23.22	$10.33	$0.00	$1.73	$0.00	$35.28
2	45.00	$23.22	$10.33	$0.00	$1.73	$0.00	$35.28
3	55.00	$28.38	$10.33	$0.00	$3.40	$0.00	$42.11
4	55.00	$28.38	$10.33	$0.00	$3.40	$0.00	$42.11
5	70.00	$36.12	$10.33	$11.41	$5.10	$0.00	$62.96
6	70.00	$36.12	$10.33	$11.41	$5.10	$0.00	$62.96
7	80.00	$41.28	$10.33	$11.44	$6.80	$0.00	$69.85
8	80.00	$41.28	$10.33	$11.44	$6.80	$0.00	$69.85

Apprentice to Journeyworker Ratio: 1:5

Apprentice: CARPENTER WOOD FRAME

Effective Date: 10/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	60.00	$16.65	$7.02	$0.00	$0.00	$0.00	$23.67
2	60.00	$16.65	$7.02	$0.00	$0.00	$0.00	$23.67
3	65.00	$18.04	$7.02	$0.00	$1.00	$0.00	$26.06
4	70.00	$19.43	$7.02	$0.00	$1.00	$0.00	$27.45
5	75.00	$20.81	$7.02	$3.80	$1.00	$0.00	$32.63
6	80.00	$22.20	$7.02	$3.80	$1.00	$0.00	$34.02
7	85.00	$23.59	$7.02	$3.80	$1.00	$0.00	$35.41
8	90.00	$24.98	$7.02	$3.80	$1.00	$0.00	$36.80

Apprentice: CARPENTER WOOD FRAME

Effective Date: 10/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	60.00	$17.31	$7.02	$0.00	$0.00	$0.00	$24.33
2	60.00	$17.31	$7.02	$0.00	$0.00	$0.00	$24.33
3	65.00	$18.75	$7.02	$0.00	$1.00	$0.00	$26.77
4	70.00	$20.20	$7.02	$0.00	$1.00	$0.00	$28.22
5	75.00	$21.64	$7.02	$3.80	$1.00	$0.00	$33.46
6	80.00	$23.08	$7.02	$3.80	$1.00	$0.00	$34.90
7	85.00	$24.52	$7.02	$3.80	$1.00	$0.00	$36.34
8	90.00	$25.97	$7.02	$3.80	$1.00	$0.00	$37.79

Apprentice to Journeyworker Ratio: 1:5

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
CEMENT MASONRY/PLASTERING BRICKLAYERS LOCAL 3 BRICKLAYERS LOCAL 3 (NEW BEDFORD)	7/1/2024	$49.19	$13.35	$16.43	$7.78	$1.80	$88.55

Apprentice: CEMENT MASONRY/PLASTERING

Effective Date: 7/1/2024

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$24.60	$13.35	$16.43	$0.00	$0.00	$54.38
2	60.00	$29.51	$13.35	$16.43	$2.78	$1.80	$63.87
3	65.00	$31.97	$13.35	$16.43	$3.78	$1.80	$67.33
4	70.00	$34.43	$13.35	$16.43	$4.78	$1.80	$70.79
5	75.00	$36.89	$13.35	$16.43	$5.78	$1.80	$74.25
6	80.00	$39.35	$13.35	$16.43	$6.78	$1.80	$77.71
7	90.00	$44.27	$13.35	$16.43	$7.78	$1.80	$83.63

Apprentice to Journeyworker Ratio: 1:3

CHAIN SAW OPERATOR LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
CLAM SHELLS/SLURRY BUCKETS/HEADING MACHINES OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$59.51	$15.55	$13.25	$3.25	$0.00	$91.56
	12/1/2025	$60.98	$15.55	$13.25	$3.25	$0.00	$93.03
	6/1/2026	$62.31	$15.55	$13.25	$3.25	$0.00	$94.36
	12/1/2026	$63.79	$15.55	$13.25	$3.25	$0.00	$95.84
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
COMPRESSOR OPERATOR OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$37.52	$15.55	$13.25	$3.25	$0.00	$69.57
	12/1/2025	$38.47	$15.55	$13.25	$3.25	$0.00	$70.52
	6/1/2026	$39.33	$15.55	$13.25	$3.25	$0.00	$71.38
	12/1/2026	$40.28	$15.55	$13.25	$3.25	$0.00	$72.33
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
DELEADER (BRIDGE) PAINTERS LOCAL 35 PAINTERS LOCAL 35 - ZONE 2	7/1/2025	$58.51	$10.30	$11.95	$12.50	$0.00	$93.26
	1/1/2026	$59.56	$10.35	$12.00	$12.60	$0.00	$94.51

Apprentice: DELEADER (BRIDGE)

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$29.26	$10.30	$0.00	$0.00	$0.00	$39.56

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Apprentice: DELEADER (BRIDGE)

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
2	55.00	$32.18	$10.30	$0.00	$6.88	$0.00	$49.36
3	60.00	$35.11	$10.30	$0.00	$7.50	$0.00	$52.91
4	65.00	$38.03	$10.30	$0.00	$8.13	$0.00	$56.46
5	70.00	$40.96	$10.30	$11.95	$8.75	$0.00	$71.96
6	75.00	$43.88	$10.30	$11.95	$9.38	$0.00	$75.51
7	80.00	$46.81	$10.30	$11.95	$10.00	$0.00	$79.06
8	90.00	$52.66	$10.30	$11.95	$11.25	$0.00	$86.16

Apprentice: DELEADER (BRIDGE)

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$29.78	$10.35	$0.00	$0.00	$0.00	$40.13
2	55.00	$32.76	$10.35	$0.00	$6.93	$0.00	$50.04
3	60.00	$35.74	$10.35	$0.00	$7.56	$0.00	$53.65
4	65.00	$38.71	$10.35	$0.00	$8.19	$0.00	$57.25
5	70.00	$41.69	$10.35	$12.00	$8.82	$0.00	$72.86
6	75.00	$44.67	$10.35	$12.00	$9.45	$0.00	$76.47
7	80.00	$47.65	$10.35	$12.00	$10.08	$0.00	$80.08
8	90.00	$53.60	$10.35	$12.00	$11.34	$0.00	$87.29

Apprentice to Journeyworker Ratio: 1:1

DEMO: ADZEMAN LABORERS LABORERS - ZONE 2	6/2/2025	$47.25	$10.15	$9.50	$9.65	$0.00	$76.55
	12/1/2025	$48.75	$10.15	$9.50	$9.65	$0.00	$78.05
	6/1/2026	$50.30	$10.15	$9.50	$9.65	$0.00	$79.60
	12/7/2026	$51.80	$10.15	$9.50	$9.65	$0.00	$81.10
	6/7/2027	$53.40	$10.15	$9.50	$9.65	$0.00	$82.70
	12/6/2027	$55.00	$10.15	$9.50	$9.65	$0.00	$84.30
	6/5/2028	$56.68	$10.15	$9.50	$9.65	$0.00	$85.98
	12/4/2028	$58.35	$10.15	$9.50	$9.65	$0.00	$87.65
For apprentice rates see "Apprentice- LABORER"							
DEMO: BACKHOE/LOADER/HAMMER OPERATOR LABORERS LABORERS - ZONE 2	6/2/2025	$48.25	$10.15	$9.50	$9.65	$0.00	$77.55
	12/1/2025	$49.75	$10.15	$9.50	$9.65	$0.00	$79.05
	6/1/2026	$51.30	$10.15	$9.50	$9.65	$0.00	$80.60
	12/7/2026	$52.80	$10.15	$9.50	$9.65	$0.00	$82.10
	6/7/2027	$54.40	$10.15	$9.50	$9.65	$0.00	$83.70
	12/6/2027	$56.00	$10.15	$9.50	$9.65	$0.00	$85.30
	6/5/2028	$57.68	$10.15	$9.50	$9.65	$0.00	$86.98
	12/4/2028	$59.35	$10.15	$9.50	$9.65	$0.00	$88.65
For apprentice rates see "Apprentice- LABORER"							
DEMO: BURNERS	6/2/2025	$48.00	$10.15	$9.50	$9.65	$0.00	$77.30

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
LABORERS LABORERS - ZONE 2	12/1/2025	$49.50	$10.15	$9.50	$9.65	$0.00	$78.80
	6/1/2026	$51.05	$10.15	$9.50	$9.65	$0.00	$80.35
	12/7/2026	$52.55	$10.15	$9.50	$9.65	$0.00	$81.85
	6/7/2027	$54.15	$10.15	$9.50	$9.65	$0.00	$83.45
	12/6/2027	$55.75	$10.15	$9.50	$9.65	$0.00	$85.05
	6/5/2028	$57.43	$10.15	$9.50	$9.65	$0.00	$86.73
	12/4/2028	$59.10	$10.15	$9.50	$9.65	$0.00	$88.40
For apprentice rates see "Apprentice- LABORER"							
DEMO: CONCRETE CUTTER/SAWYER LABORERS LABORERS - ZONE 2	6/2/2025	$48.25	$10.15	$9.50	$9.65	$0.00	$77.55
	12/1/2025	$49.75	$10.15	$9.50	$9.65	$0.00	$79.05
	6/1/2026	$51.30	$10.15	$9.50	$9.65	$0.00	$80.60
	12/7/2026	$52.80	$10.15	$9.50	$9.65	$0.00	$82.10
	6/7/2027	$54.40	$10.15	$9.50	$9.65	$0.00	$83.70
	12/6/2027	$56.00	$10.15	$9.50	$9.65	$0.00	$85.30
	6/5/2028	$57.68	$10.15	$9.50	$9.65	$0.00	$86.98
	12/4/2028	$59.35	$10.15	$9.50	$9.65	$0.00	$88.65
For apprentice rates see "Apprentice- LABORER"							
DEMO: JACKHAMMER OPERATOR LABORERS LABORERS - ZONE 2	6/2/2025	$48.00	$10.15	$9.50	$9.65	$0.00	$77.30
	12/1/2025	$49.50	$10.15	$9.50	$9.65	$0.00	$78.80
	6/1/2026	$51.05	$10.15	$9.50	$9.65	$0.00	$80.35
	12/7/2026	$52.55	$10.15	$9.50	$9.65	$0.00	$81.85
	6/7/2027	$54.15	$10.15	$9.50	$9.65	$0.00	$83.45
	12/6/2027	$55.75	$10.15	$9.50	$9.65	$0.00	$85.05
	6/5/2028	$57.43	$10.15	$9.50	$9.65	$0.00	$86.73
	12/4/2028	$59.10	$10.15	$9.50	$9.65	$0.00	$88.40
For apprentice rates see "Apprentice- LABORER"							
DEMO: WRECKING LABORER LABORERS LABORERS - ZONE 2	6/2/2025	$47.25	$10.15	$9.50	$9.65	$0.00	$76.55
	12/1/2025	$48.75	$10.15	$9.50	$9.65	$0.00	$78.05
	6/1/2026	$50.30	$10.15	$9.50	$9.65	$0.00	$79.60
	12/7/2026	$51.80	$10.15	$9.50	$9.65	$0.00	$81.10
	6/7/2027	$53.40	$10.15	$9.50	$9.65	$0.00	$82.70
	12/6/2027	$55.00	$10.15	$9.50	$9.65	$0.00	$84.30
	6/5/2028	$56.68	$10.15	$9.50	$9.65	$0.00	$85.98
	12/4/2028	$58.35	$10.15	$9.50	$9.65	$0.00	$87.65
For apprentice rates see "Apprentice- LABORER"							
DIRECTIONAL DRILL MACHINE OPERATOR OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
DIVER PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2)	8/1/2024	$78.11	$10.08	$11.62	$12.67	$0.00	$112.48
as of 8-1-24, Apprentices with diving licenses begin at second year. % of Diver wage 70/80/90 2A $69.83, 3A $91.79,4A $102.14 Total Rate							
DIVER TENDER	8/1/2024	$51.97	$10.08	$11.62	$12.67	$0.00	$86.34

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2)							
as of 8-1-24, Apprentices with diving licenses begin at second year. % of Piledriver wage 70/80/90 2A $54.20, 3A $73.93,4A $82.05 Total Rate							
DIVER TENDER (EFFLUENT) PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2)	8/1/2024	$83.69	$10.08	$11.62	$12.67	$0.00	$118.06
For apprentice rates see "Apprentice- PILE DRIVER"							
DIVER/SLURRY (EFFLUENT) PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2)	8/1/2024	$117.16	$10.08	$11.62	$12.67	$0.00	$151.53
For apprentice rates see "Apprentice- PILE DRIVER"							
DRAWBRIDGE OPERATOR (Construction) DRAWBRIDGE - SEIU LOCAL 888 DRAWBRIDGE - SEIU LOCAL 888	7/1/2020	$26.77	$6.67	$3.93	$0.00	$0.16	$37.53
ELECTRICIAN ELECTRICIANS LOCAL 223	9/1/2025	$52.25	$12.25	$14.86	$3.75	$0.00	$83.11
ELECTRICIANS LOCAL 223	9/1/2026	$54.72	$12.50	$15.56	$4.00	$0.00	$86.78

Apprentice: ELECTRICIAN

Effective Date: 9/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	40.00	$20.90	$12.25	$0.63	$0.00	$0.00	$33.78
2	45.00	$23.51	$12.25	$0.71	$0.00	$0.00	$36.47
3	50.00	$26.13	$12.25	$0.78	$0.00	$0.00	$39.16
4	55.00	$28.74	$12.25	$6.61	$2.50	$0.00	$50.10
5	60.00	$31.35	$12.25	$7.21	$2.50	$0.00	$53.31
6	65.00	$33.96	$12.25	$7.82	$2.50	$0.00	$56.53
7	70.00	$36.58	$12.25	$8.41	$2.50	$0.00	$59.74
8	75.00	$39.19	$12.25	$9.02	$2.50	$0.00	$62.96

Apprentice: ELECTRICIAN

Effective Date: 9/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	40.00	$21.89	$12.50	$0.66	$0.00	$0.00	$35.05
2	45.00	$24.62	$12.50	$0.74	$0.00	$0.00	$37.86
3	50.00	$27.36	$12.50	$0.82	$0.00	$0.00	$40.68
4	55.00	$30.10	$12.50	$6.92	$2.75	$0.00	$52.27
5	60.00	$32.83	$12.50	$7.54	$2.75	$0.00	$55.62
6	65.00	$35.57	$12.50	$8.18	$2.75	$0.00	$59.00
7	70.00	$38.30	$12.50	$8.81	$2.75	$0.00	$62.36
8	75.00	$41.04	$12.50	$9.43	$2.75	$0.00	$65.72

Apprentice to Journeyworker Ratio: 2:3

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
ELEVATOR CONSTRUCTOR	1/1/2025	$74.17	$16.28	$10.96	$10.40	$0.00	$111.81
ELEVATOR CONSTRUCTORS LOCAL 4	1/1/2026	$77.26	$16.38	$11.06	$10.70	$0.00	$115.40
ELEVATOR CONSTRUCTORS LOCAL 4	1/1/2027	$80.55	$16.48	$11.16	$11.00	$0.00	$119.19

Apprentice: ELEVATOR CONSTRUCTOR

Effective Date: 1/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$37.09	$0.00	$0.00	$0.00	$0.00	$37.09
2	55.00	$40.79	$16.28	$10.96	$10.40	$0.00	$78.43
3	65.00	$48.21	$16.28	$10.96	$10.40	$0.00	$85.85
4	70.00	$51.92	$16.28	$10.96	$10.40	$0.00	$89.56
5	80.00	$59.34	$16.28	$10.96	$10.40	$0.00	$96.98

Apprentice: ELEVATOR CONSTRUCTOR

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$38.63	$0.00	$0.00	$0.00	$0.00	$38.63
2	55.00	$42.49	$16.38	$11.06	$10.70	$0.00	$80.63
3	65.00	$50.22	$16.38	$11.06	$10.70	$0.00	$88.36
4	70.00	$54.08	$16.38	$11.06	$10.70	$0.00	$92.22
5	80.00	$61.81	$16.38	$11.06	$10.70	$0.00	$99.95

Apprentice to Journeyworker Ratio: 1:1

ELEVATOR CONSTRUCTOR HELPER	1/1/2025	$51.92	$16.28	$10.96	$10.40	$0.00	$89.56
ELEVATOR CONSTRUCTORS LOCAL 4	1/1/2026	$54.08	$16.38	$11.06	$10.07	$0.00	$91.59
ELEVATOR CONSTRUCTORS LOCAL 4	1/1/2027	$56.39	$16.48	$11.16	$11.00	$0.00	$95.03
For apprentice rates see "Apprentice - ELEVATOR CONSTRUCTOR"							
FENCE & GUARD RAIL ERECTOR (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
LABORERS	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)							
FIELD ENG.INST.PERSON-BLDG,SITE,HVY/HWY	11/1/2025	$53.76	$15.85	$13.15	$3.25	$0.00	$86.01
OPERATING ENGINEERS LOCAL 4	5/1/2026	$55.20	$15.85	$13.15	$3.25	$0.00	$87.45
OPERATING ENGINEERS LOCAL 4	11/1/2026	$56.49	$15.85	$13.15	$3.25	$0.00	$88.74
	5/1/2027	$57.92	$15.85	$13.15	$3.25	$0.00	$90.17
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
FIELD ENG.PARTY CHIEF-BLDG,SITE,HVY/HWY	11/1/2025	$55.37	$15.85	$13.15	$3.25	$0.00	$87.62
OPERATING ENGINEERS LOCAL 4	5/1/2026	$56.82	$15.85	$13.15	$3.25	$0.00	$89.07
OPERATING ENGINEERS LOCAL 4	11/1/2026	$58.12	$15.85	$13.15	$3.25	$0.00	$90.37
	5/1/2027	$59.57	$15.85	$13.15	$3.25	$0.00	$91.82
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
FIELD ENG.ROD PERSON-BLDG,SITE,HVY/HWY	11/1/2025	$26.23	$15.85	$13.15	$3.25	$0.00	$58.48
OPERATING ENGINEERS LOCAL 4	5/1/2026	$27.08	$15.85	$13.15	$3.25	$0.00	$59.33
OPERATING ENGINEERS LOCAL 4	11/1/2026	$27.84	$15.85	$13.15	$3.25	$0.00	$60.09
	5/1/2027	$28.69	$15.85	$13.15	$3.25	$0.00	$60.94
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
FIRE ALARM INSTALLER	9/1/2025	$52.25	$12.25	$14.86	$3.75	$0.00	$83.11
ELECTRICIANS LOCAL 223	9/1/2026	$54.72	$12.50	$15.56	$4.00	$0.00	$86.78
ELECTRICIANS LOCAL 223							
For apprentice rates see "Apprentice- ELECTRICIAN"							
FIRE ALARM REPAIR / MAINTENANCE	9/1/2025	$52.25	$12.25	$14.86	$3.75	$0.00	$83.11
/ COMMISSIONING	9/1/2026	$54.72	$12.50	$15.56	$4.00	$0.00	$86.78
ELECTRICIANS LOCAL 223							
ELECTRICIANS LOCAL 223							
For apprentice rates see "Apprentice- TELECOMMUNICATIONS TECHNICIAN"							
FIREMAN (ASST. ENGINEER)	6/1/2025	$47.02	$15.55	$13.25	$3.25	$0.00	$79.07
OPERATING ENGINEERS LOCAL 4	12/1/2025	$48.19	$15.55	$13.25	$3.25	$0.00	$80.24
OPERATING ENGINEERS LOCAL 4	6/1/2026	$49.25	$15.55	$13.25	$3.25	$0.00	$81.30
	12/1/2026	$50.43	$15.55	$13.25	$3.25	$0.00	$82.48
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
FLAGGER & SIGNALER (HEAVY & HIGHWAY)	6/1/2025	$28.09	$10.15	$9.50	$9.21	$0.00	$56.95
LABORERS	12/1/2025	$28.09	$10.15	$9.50	$9.21	$0.00	$56.95
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2026	$29.21	$10.15	$9.50	$9.21	$0.00	$58.07
	12/1/2026	$29.21	$10.15	$9.50	$9.21	$0.00	$58.07
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
FLOORCOVERER	3/1/2024	$48.93	$10.33	$11.47	$8.80	$0.00	$79.53
FLOORCOVERERS LOCAL 2168							
FLOORCOVERERS LOCAL 2168 ZONE II							

Apprentice: FLOORCOVERER

Effective Date: 3/1/2024

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$24.47	$10.33	$0.00	$1.76	$0.00	$36.56
2	55.00	$26.91	$10.33	$0.00	$1.76	$0.00	$39.00
3	60.00	$29.36	$10.33	$0.00	$3.52	$0.00	$43.21
4	65.00	$31.80	$10.33	$0.00	$3.52	$0.00	$45.65
5	70.00	$34.25	$10.33	$11.47	$5.28	$0.00	$61.33
6	75.00	$36.70	$10.33	$11.47	$5.28	$0.00	$63.78
7	80.00	$39.14	$10.33	$11.47	$7.04	$0.00	$67.98
8	85.00	$41.59	$10.33	$11.47	$7.04	$0.00	$70.43

Apprentice Notes

Steps are 750 hrs.

Apprentice to Journeyworker Ratio: 1:1

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
FORK LIFT/CHERRY PICKER	6/1/2025	$58.33	$15.55	$13.25	$3.25	$0.00	$90.38
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.78	$15.55	$13.25	$3.25	$0.00	$91.83
OPERATING ENGINEERS LOCAL 4	6/1/2026	$61.08	$15.55	$13.25	$3.25	$0.00	$93.13
	12/1/2026	$62.53	$15.55	$13.25	$3.25	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
GENERATOR/LIGHTING PLANT/HEATERS	6/1/2025	$37.52	$15.55	$13.25	$3.25	$0.00	$69.57
OPERATING ENGINEERS LOCAL 4	12/1/2025	$38.47	$15.55	$13.25	$3.25	$0.00	$70.52
OPERATING ENGINEERS LOCAL 4	6/1/2026	$39.33	$15.55	$13.25	$3.25	$0.00	$71.38
	12/1/2026	$40.28	$15.55	$13.25	$3.25	$0.00	$72.33
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS)	6/1/2025	$43.13	$10.80	$8.25	$5.50	$0.00	$67.68
GLAZIERS LOCAL 1333	6/1/2026	$44.73	$11.20	$8.40	$6.05	$0.00	$70.38
GLAZIERS LOCAL 1333	6/1/2027	$46.73	$11.60	$8.55	$6.60	$0.00	$73.48
	6/1/2028	$48.73	$12.00	$8.70	$7.20	$0.00	$76.63

Apprentice: GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS)

Effective Date: 6/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$21.57	$10.80	$8.25	$5.50	$0.00	$46.12
2	56.25	$24.26	$10.80	$8.25	$5.50	$0.00	$48.81
3	62.50	$26.96	$10.80	$8.25	$5.50	$0.00	$51.51
4	68.75	$29.65	$10.80	$8.25	$5.50	$0.00	$54.20
5	75.00	$32.35	$10.80	$8.25	$5.50	$0.00	$56.90
6	81.25	$35.04	$10.80	$8.25	$5.50	$0.00	$59.59
7	87.50	$37.74	$10.80	$8.25	$5.50	$0.00	$62.29
8	93.75	$40.43	$10.80	$8.25	$5.50	$0.00	$64.98

Apprentice: GLAZIER (GLASS PLANK/AIR BARRIER/INTERIOR SYSTEMS)

Effective Date: 6/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$22.37	$11.20	$8.40	$6.05	$0.00	$48.02
2	56.25	$25.16	$11.20	$8.40	$6.05	$0.00	$50.81
3	62.50	$27.96	$11.20	$8.40	$6.05	$0.00	$53.61
4	68.75	$30.75	$11.20	$8.40	$6.05	$0.00	$56.40
5	75.00	$33.55	$11.20	$8.40	$6.05	$0.00	$59.20
6	81.25	$36.34	$11.20	$8.40	$6.05	$0.00	$61.99
7	87.50	$39.14	$11.20	$8.40	$6.05	$0.00	$64.79
8	93.75	$41.93	$11.20	$8.40	$6.05	$0.00	$67.58

Apprentice to Journeyworker Ratio: 3:1

HOISTING ENGINEER/CRANES/GRADALLS	6/1/2025	$58.33	$15.55	$13.25	$3.25	$0.00	$90.38
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.78	$15.55	$13.25	$3.25	$0.00	$91.83
OPERATING ENGINEERS LOCAL 4	6/1/2026	$61.08	$15.55	$13.25	$3.25	$0.00	$93.13

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
	12/1/2026	$62.53	$15.55	$13.25	$3.25	$0.00	$94.58

Apprentice: HOISTING ENGINEER/CRANES/GRADALLS

Effective Date: 6/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	55.00	$32.08	$0.00	$0.00	$0.00	$0.00	$32.08
2	60.00	$35.00	$15.55	$13.25	$3.25	$0.00	$67.05
3	65.00	$37.91	$15.55	$13.25	$3.25	$0.00	$69.96
4	70.00	$40.83	$15.55	$13.25	$3.25	$0.00	$72.88
5	75.00	$43.75	$15.55	$13.25	$3.25	$0.00	$75.80
6	80.00	$46.66	$15.55	$13.25	$3.25	$0.00	$78.71
7	85.00	$49.58	$15.55	$13.25	$3.25	$0.00	$81.63
8	90.00	$52.50	$15.55	$13.25	$3.25	$0.00	$84.55

Apprentice: HOISTING ENGINEER/CRANES/GRADALLS

Effective Date: 12/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	55.00	$32.88	$0.00	$0.00	$0.00	$0.00	$32.88
2	60.00	$35.87	$15.55	$13.25	$3.25	$0.00	$67.92
3	65.00	$38.86	$15.55	$13.25	$3.25	$0.00	$70.91
4	70.00	$41.85	$15.55	$13.25	$3.25	$0.00	$73.90
5	75.00	$44.84	$15.55	$13.25	$3.25	$0.00	$76.89
6	80.00	$47.82	$15.55	$13.25	$3.25	$0.00	$79.87
7	85.00	$50.81	$15.55	$13.25	$3.25	$0.00	$82.86
8	90.00	$53.80	$15.55	$13.25	$3.25	$0.00	$85.85

Apprentice to Journeyworker Ratio: 1:6

HVAC (DUCTWORK) SHEETMETAL WORKERS LOCAL 17 SHEETMETAL WORKERS LOCAL 17 - B	10/1/2025	$44.05	$14.91	$13.35	$6.15	$2.24	$80.70
	4/1/2026	$45.55	$14.91	$13.35	$6.15	$2.24	$82.20
For apprentice rates see "Apprentice- SHEET METAL WORKER"							
HVAC (ELECTRICAL CONTROLS) ELECTRICIANS LOCAL 223 ELECTRICIANS LOCAL 223	9/1/2025	$52.25	$12.25	$14.86	$3.75	$0.00	$83.11
	9/1/2026	$54.72	$12.50	$15.56	$4.00	$0.00	$86.78
For apprentice rates see "Apprentice- ELECTRICIAN"							
HVAC (TESTING AND BALANCING - AIR) SHEETMETAL WORKERS LOCAL 17 SHEETMETAL WORKERS LOCAL 17 - B	10/1/2025	$44.05	$14.91	$13.35	$6.15	$2.24	$80.70
	4/1/2026	$45.55	$14.91	$13.35	$6.15	$2.24	$82.20
For apprentice rates see "Apprentice- SHEET METAL WORKER"							
HVAC (TESTING AND BALANCING -WATER) PLUMBERS & PIPEFITTERS LOCAL 51 PLUMBERS & PIPEFITTERS LOCAL 51	8/25/2025	$55.24	$10.80	$16.80	$4.60	$0.00	$87.44
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"							

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
HVAC MECHANIC PLUMBERS & PIPEFITTERS LOCAL 51 PLUMBERS & PIPEFITTERS LOCAL 51	8/25/2025	$55.24	$10.80	$16.80	$4.60	$0.00	$87.44
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"							
HYDRAULIC DRILLS LABORERS LABORERS - ZONE 2	6/1/2025	$40.59	$10.15	$9.50	$9.11	$0.00	$69.35
	12/1/2025	$41.97	$10.15	$9.50	$9.11	$0.00	$70.73
	6/1/2026	$43.41	$10.15	$9.50	$9.11	$0.00	$72.17
	12/1/2026	$44.85	$10.15	$9.50	$9.11	$0.00	$73.61
	6/1/2027	$46.30	$10.15	$9.50	$9.11	$0.00	$75.06
	12/1/2027	$47.75	$10.15	$9.50	$9.11	$0.00	$76.51
	6/1/2028	$49.25	$10.15	$9.50	$9.11	$0.00	$78.01
	12/1/2028	$50.75	$10.15	$9.50	$9.11	$0.00	$79.51
For apprentice rates see "Apprentice- LABORER"							
HYDRAULIC DRILLS (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.59	$10.15	$9.50	$9.21	$0.00	$69.45
	12/1/2025	$41.97	$10.15	$9.50	$9.21	$0.00	$70.83
	6/1/2026	$43.41	$10.15	$9.50	$9.21	$0.00	$72.27
	12/1/2026	$44.85	$10.15	$9.50	$9.21	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
INSULATOR (PIPES & TANKS) HEAT & FROST INSULATORS LOCAL 6 HEAT & FROST INSULATORS LOCAL 6 (BOSTON)	9/1/2025	$60.34	$14.75	$9.52	$10.09	$0.00	$94.70
	9/1/2026	$63.76	$14.75	$9.52	$10.09	$0.00	$98.12

Apprentice: INSULATOR (PIPES & TANKS)

Effective Date: 9/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$30.17	$14.75	$9.27	$5.05	$0.00	$59.24
2	60.00	$36.20	$14.75	$9.32	$6.05	$0.00	$66.32
3	70.00	$42.24	$14.75	$9.37	$7.06	$0.00	$73.42
4	80.00	$48.27	$14.75	$9.42	$8.07	$0.00	$80.51

Apprentice: INSULATOR (PIPES & TANKS)

Effective Date: 9/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$31.88	$14.75	$9.27	$5.05	$0.00	$60.95
2	60.00	$38.26	$14.75	$9.32	$6.05	$0.00	$68.38
3	70.00	$44.63	$14.75	$9.37	$7.06	$0.00	$75.81
4	80.00	$51.01	$14.75	$9.42	$8.07	$0.00	$83.25

Apprentice to Journeyworker Ratio: 1:4

IRONWORKER/WELDER IRONWORKERS LOCAL 37 IRONWORKERS LOCAL 37	3/16/2021	$42.46	$7.70	$12.10	$5.00	$0.00	$67.26

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Apprentice: IRONWORKER/WELDER

Effective Date: 3/16/2021

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	70.00	$29.72	$7.70	$12.10	$5.00	$0.00	$54.52
2	75.00	$31.85	$7.70	$12.10	$5.00	$0.00	$56.65
3	80.00	$33.97	$7.70	$12.10	$5.00	$0.00	$58.77
4	85.00	$36.09	$7.70	$12.10	$5.00	$0.00	$60.89
5	90.00	$38.21	$7.70	$12.10	$5.00	$0.00	$63.01
6	95.00	$40.34	$7.70	$12.10	$5.00	$0.00	$65.14

Apprentice to Journeyworker Ratio: 1:4

JACKHAMMER & PAVING BREAKER OPERATOR LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01

For apprentice rates see "Apprentice- LABORER"

LABORER LABORERS LABORERS - ZONE 2	6/1/2025	$39.84	$10.15	$9.50	$9.11	$0.00	$68.60
	12/1/2025	$41.22	$10.15	$9.50	$9.11	$0.00	$69.98
	6/1/2026	$42.66	$10.15	$9.50	$9.11	$0.00	$71.42
	12/1/2026	$44.10	$10.15	$9.50	$9.11	$0.00	$72.86
	6/1/2027	$45.55	$10.15	$9.50	$9.11	$0.00	$74.31
	12/1/2027	$47.00	$10.15	$9.50	$9.11	$0.00	$75.76
	6/1/2028	$48.50	$10.15	$9.50	$9.11	$0.00	$77.26
	12/1/2028	$50.00	$10.15	$9.50	$9.11	$0.00	$78.76

Apprentice: LABORER

Effective Date: 6/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	60.00	$23.90	$10.15	$9.50	$9.11	$0.00	$52.66
2	70.00	$27.89	$10.15	$9.50	$9.11	$0.00	$56.65
3	80.00	$31.87	$10.15	$9.50	$9.11	$0.00	$60.63
4	90.00	$35.86	$10.15	$9.50	$9.11	$0.00	$64.62

Apprentice: LABORER

Effective Date: 12/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	60.00	$25.03	$9.90	$9.25	$9.11	$0.00	$53.29

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Apprentice: LABORER

Effective Date: 12/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
2	70.00	$29.20	$9.90	$9.25	$9.11	$0.00	$57.46
3	80.00	$33.38	$9.90	$9.25	$9.11	$0.00	$61.64
4	90.00	$37.55	$9.90	$9.25	$9.11	$0.00	$65.81

Apprentice to Journeyworker Ratio: 1:5

LABORER (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$39.84	$10.15	$9.50	$9.21	$0.00	$68.70
	12/1/2025	$41.22	$10.15	$9.50	$9.21	$0.00	$70.08
	6/1/2026	$42.66	$10.15	$9.50	$9.21	$0.00	$71.52
	12/1/2026	$44.10	$10.15	$9.50	$9.21	$0.00	$72.96

Apprentice: LABORER (HEAVY & HIGHWAY)

Effective Date: 6/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	60.00	$23.90	$10.15	$9.50	$9.21	$0.00	$52.76
2	70.00	$27.89	$10.15	$9.50	$9.21	$0.00	$56.75
3	80.00	$31.87	$10.15	$9.50	$9.21	$0.00	$60.73
4	90.00	$35.86	$10.15	$9.50	$9.21	$0.00	$64.72

Apprentice: LABORER (HEAVY & HIGHWAY)

Effective Date: 12/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	60.00	$25.03	$9.90	$9.25	$9.21	$0.00	$53.39
2	70.00	$29.20	$9.90	$9.25	$9.21	$0.00	$57.56
3	80.00	$33.38	$9.90	$9.25	$9.21	$0.00	$61.74
4	90.00	$37.55	$9.90	$9.25	$9.21	$0.00	$65.91

Apprentice to Journeyworker Ratio: 1:5

LABORER: CARPENTER TENDER LABORERS LABORERS - ZONE 2	6/1/2025	$39.84	$10.15	$9.50	$9.11	$0.00	$68.60
	12/1/2025	$41.22	$10.15	$9.50	$9.11	$0.00	$69.98
	6/1/2026	$42.66	$10.15	$9.50	$9.11	$0.00	$71.42
	12/1/2026	$44.10	$10.15	$9.50	$9.11	$0.00	$72.86
	6/1/2027	$45.55	$10.15	$9.50	$9.11	$0.00	$74.31
	12/1/2027	$47.00	$10.15	$9.50	$9.11	$0.00	$75.76
	6/1/2028	$48.50	$10.15	$9.50	$9.11	$0.00	$77.26
	12/1/2028	$50.00	$10.15	$9.50	$9.11	$0.00	$78.76

For apprentice rates see "Apprentice- LABORER"

LABORER: CEMENT FINISHER TENDER LABORERS	6/1/2025	$39.84	$10.15	$9.50	$9.11	$0.00	$68.60
	12/1/2025	$41.22	$10.15	$9.50	$9.11	$0.00	$69.98

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
LABORERS - ZONE 2	6/1/2026	$42.66	$10.15	$9.50	$9.11	$0.00	$71.42
	12/1/2026	$44.10	$10.15	$9.50	$9.11	$0.00	$72.86
	6/1/2027	$45.55	$10.15	$9.50	$9.11	$0.00	$74.31
	12/1/2027	$47.00	$10.15	$9.50	$9.11	$0.00	$75.76
	6/1/2028	$48.50	$10.15	$9.50	$9.11	$0.00	$77.26
	12/1/2028	$50.00	$10.15	$9.50	$9.11	$0.00	$78.76
For apprentice rates see "Apprentice- LABORER"							
LABORER: HAZARDOUS WASTE/ASBESTOS REMOVER	6/2/2025	$39.93	$10.15	$9.50	$9.65	$0.00	$69.23
LABORERS	12/1/2025	$41.31	$10.15	$9.50	$9.65	$0.00	$70.61
LABORERS - ZONE 2	6/1/2026	$42.75	$10.15	$9.50	$9.65	$0.00	$72.05
	12/7/2026	$44.19	$10.15	$9.50	$9.65	$0.00	$73.49
	6/7/2027	$45.64	$10.15	$9.50	$9.65	$0.00	$74.94
	12/6/2027	$47.09	$10.15	$9.50	$9.65	$0.00	$76.39
	6/5/2028	$48.59	$10.15	$9.50	$9.65	$0.00	$77.89
	12/4/2028	$50.09	$10.15	$9.50	$9.65	$0.00	$79.39
For apprentice rates see "Apprentice- LABORER"							
LABORER: MASON TENDER	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
LABORERS	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
LABORERS - ZONE 2	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
LABORER: MASON TENDER (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
LABORERS	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
LABORER: MULTI-TRADE TENDER	6/1/2025	$39.84	$10.15	$9.50	$9.11	$0.00	$68.60
LABORERS	12/1/2025	$41.22	$10.15	$9.50	$9.11	$0.00	$69.98
LABORERS - ZONE 2	6/1/2026	$42.66	$10.15	$9.50	$9.11	$0.00	$71.42
	12/1/2026	$44.10	$10.15	$9.50	$9.11	$0.00	$72.86
	6/1/2027	$45.55	$10.15	$9.50	$9.11	$0.00	$74.31
	12/1/2027	$47.00	$10.15	$9.50	$9.11	$0.00	$75.76
	6/1/2028	$48.50	$10.15	$9.50	$9.11	$0.00	$77.26
	12/1/2028	$50.00	$10.15	$9.50	$9.11	$0.00	$78.76
For apprentice rates see "Apprentice- LABORER"							
LABORER: TREE REMOVER	6/1/2025	$39.84	$10.15	$9.50	$9.11	$0.00	$68.60
LABORERS	12/1/2025	$41.22	$10.15	$9.50	$9.11	$0.00	$69.98
LABORERS - ZONE 2	6/1/2026	$42.66	$10.15	$9.50	$9.11	$0.00	$71.42
	12/1/2026	$44.10	$10.15	$9.50	$9.11	$0.00	$72.86
	6/1/2027	$45.55	$10.15	$9.50	$9.11	$0.00	$74.31
	12/1/2027	$47.00	$10.15	$9.50	$9.11	$0.00	$75.76
	6/1/2028	$48.50	$10.15	$9.50	$9.11	$0.00	$77.26

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
	12/1/2028	$50.00	$10.15	$9.50	$9.11	$0.00	$78.76

This classification applies to the removal of standing trees, and the trimming and removal of branches and limbs when related to public works construction or site clearance incidental to construction . For apprentice rates see "Apprentice- LABORER"

LASER BEAM OPERATOR	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
LABORERS LABORERS - ZONE 2	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01

For apprentice rates see "Apprentice- LABORER"

LASER BEAM OPERATOR (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21

For apprentice rates see "Apprentice- LABORER (Heavy and Highway)

MARBLE & TILE FINISHERS	8/1/2025	$52.08	$11.49	$15.57	$6.05	$0.00	$85.19
BRICKLAYERS LOCAL 3 BRICKLAYERS LOCAL 3 - MARBLE & TILE	2/1/2026	$53.16	$11.49	$15.57	$6.05	$0.00	$86.27
	8/1/2026	$54.92	$11.49	$15.57	$6.05	$0.00	$88.03
	2/1/2027	$56.04	$11.49	$15.57	$6.05	$0.00	$89.15

Apprentice: MARBLE & TILE FINISHERS

Effective Date: 8/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$26.04	$11.49	$15.57	$6.05	$0.00	$59.15
2	60.00	$31.25	$11.49	$15.57	$6.05	$0.00	$64.36
3	70.00	$36.46	$11.49	$15.57	$6.05	$0.00	$69.57
4	80.00	$41.66	$11.49	$15.57	$6.05	$0.00	$74.77
5	90.00	$46.87	$11.49	$15.57	$6.05	$0.00	$79.98

Apprentice: MARBLE & TILE FINISHERS

Effective Date: 2/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$26.58	$11.49	$15.57	$6.05	$0.00	$59.69
2	60.00	$31.90	$11.49	$15.57	$6.05	$0.00	$65.01
3	70.00	$37.21	$11.49	$15.57	$6.05	$0.00	$70.32
4	80.00	$42.53	$11.49	$15.57	$6.05	$0.00	$75.64
5	90.00	$47.84	$11.49	$15.57	$6.05	$0.00	$80.95

Apprentice to Journeyworker Ratio: 1:5

MARBLE MASONS,TILELAYERS & TERRAZZO MECH	8/1/2025	$67.97	$11.49	$15.57	$7.99	$0.00	$103.02

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
BRICKLAYERS LOCAL 3	2/1/2026	$69.32	$11.49	$15.57	$7.99	$0.00	$104.37
BRICKLAYERS LOCAL 3 - MARBLE & TILE	8/1/2026	$71.52	$11.49	$15.57	$7.99	$0.00	$106.57
	2/1/2027	$72.92	$11.49	$15.57	$7.99	$0.00	$107.97

Apprentice: MARBLE MASONS,TILELAYERS & TERRAZZO MECH

Effective Date: 8/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$33.99	$11.49	$15.57	$7.99	$0.00	$69.04
2	60.00	$40.78	$11.49	$15.57	$7.99	$0.00	$75.83
3	70.00	$47.58	$11.49	$15.57	$7.99	$0.00	$82.63
4	80.00	$54.38	$11.49	$15.57	$7.99	$0.00	$89.43
5	90.00	$61.17	$11.49	$15.57	$7.99	$0.00	$96.22

Apprentice: MARBLE MASONS,TILELAYERS & TERRAZZO MECH

Effective Date: 2/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$34.66	$11.49	$15.57	$7.99	$0.00	$69.71
2	60.00	$41.59	$11.49	$15.57	$7.99	$0.00	$76.64
3	70.00	$48.52	$11.49	$15.57	$7.99	$0.00	$83.57
4	80.00	$55.46	$11.49	$15.57	$7.99	$0.00	$90.51
5	90.00	$62.39	$11.49	$15.57	$7.99	$0.00	$97.44

Apprentice to Journeyworker Ratio: 1:5

MECH. SWEEPER OPERATOR (ON CONST. SITES)	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
OPERATING ENGINEERS LOCAL 4	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MECHANICS MAINTENANCE	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
OPERATING ENGINEERS LOCAL 4	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89

For apprentice rates see "Apprentice- OPERATING ENGINEERS"

MILLWRIGHT (Zone 2)	1/6/2025	$45.03	$10.08	$11.47	$10.00	$0.00	$76.58
MILLWRIGHTS LOCAL 1121	1/5/2026	$47.36	$10.08	$11.47	$10.00	$0.00	$78.91
MILLWRIGHTS LOCAL 1121 - Zone 2							

Apprentice: MILLWRIGHT (Zone 2)

Effective Date: 1/6/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	55.00	$24.77	$10.08	$0.00	$5.50	$0.00	$40.35

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Apprentice: MILLWRIGHT (Zone 2)

Effective Date: 1/6/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
2	65.00	$29.27	$10.08	$0.00	$6.50	$0.00	$45.85
3	75.00	$33.77	$10.08	$11.47	$7.50	$0.00	$62.82
4	85.00	$38.28	$10.08	$11.47	$8.50	$0.00	$68.33

Apprentice: MILLWRIGHT (Zone 2)

Effective Date: 1/5/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	55.00	$26.05	$10.08	$0.00	$5.50	$0.00	$41.63
2	65.00	$30.78	$10.08	$0.00	$6.50	$0.00	$47.36
3	75.00	$35.52	$10.08	$11.47	$7.50	$0.00	$64.57
4	85.00	$40.26	$10.08	$11.47	$8.50	$0.00	$70.31

Apprentice Notes

Step 1&2 Appr. indentured after 1/6/2020 receive no pension,

Apprentice to Journeyworker Ratio: 1:4

MORTAR MIXER LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
OILER (OTHER THAN TRUCK CRANES,GRADALLS) OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$25.97	$15.30	$13.15	$3.25	$0.00	$57.67
	12/1/2025	$26.63	$15.30	$13.15	$3.25	$0.00	$58.33
	6/1/2026	$27.22	$15.30	$13.15	$3.25	$0.00	$58.92
	12/1/2026	$27.89	$15.30	$13.15	$3.25	$0.00	$59.59
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
OILER (TRUCK CRANES, GRADALLS) OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$31.80	$15.30	$13.15	$3.25	$0.00	$63.50
	12/1/2025	$32.60	$15.30	$13.15	$3.25	$0.00	$64.30
	6/1/2026	$33.32	$15.30	$13.15	$3.25	$0.00	$65.02
	12/1/2026	$34.12	$15.30	$13.15	$3.25	$0.00	$65.82
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
OTHER POWER DRIVEN EQUIPMENT - CLASS II OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
PAINTER (BRIDGES/TANKS) PAINTERS LOCAL 35 PAINTERS LOCAL 35 - ZONE 2	7/1/2025	$58.51	$10.30	$11.95	$12.50	$0.00	$93.26
	1/1/2026	$59.56	$10.35	$12.00	$12.50	$0.00	$94.41

Apprentice: PAINTER (BRIDGES/TANKS)

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$29.26	$10.30	$0.00	$0.00	$0.00	$39.56
2	55.00	$32.18	$10.30	$0.00	$6.88	$0.00	$49.36
3	60.00	$35.11	$10.30	$0.00	$7.50	$0.00	$52.91
4	65.00	$38.03	$10.30	$0.00	$8.13	$0.00	$56.46
5	70.00	$40.96	$10.30	$11.95	$8.75	$0.00	$71.96
6	75.00	$43.88	$10.30	$11.95	$9.38	$0.00	$75.51
7	80.00	$46.81	$10.30	$11.95	$10.00	$0.00	$79.06
8	90.00	$52.66	$10.30	$11.95	$11.25	$0.00	$86.16

Apprentice: PAINTER (BRIDGES/TANKS)

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$29.78	$10.35	$0.00	$0.00	$0.00	$40.13
2	55.00	$32.76	$10.35	$0.00	$6.93	$0.00	$50.04
3	60.00	$35.74	$10.35	$0.00	$7.56	$0.00	$53.65
4	65.00	$38.71	$10.35	$0.00	$8.19	$0.00	$57.25
5	70.00	$41.69	$10.35	$12.00	$8.82	$0.00	$72.86
6	75.00	$44.67	$10.35	$12.00	$9.45	$0.00	$76.47
7	80.00	$47.65	$10.35	$12.00	$10.08	$0.00	$80.08
8	90.00	$53.60	$10.35	$12.00	$11.34	$0.00	$87.29

Apprentice to Journeyworker Ratio: 1:1

PAINTER (SPRAY OR SANDBLAST, NEW) * * If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used. PAINTERS LOCAL 35 PAINTERS LOCAL 35 - ZONE 2	7/1/2025	$49.41	$10.30	$11.95	$12.50	$0.00	$84.16
	1/1/2026	$50.46	$10.35	$12.00	$12.60	$0.00	$85.41

Apprentice: PAINTER (SPRAY OR SANDBLAST, NEW) *

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$24.71	$10.30	$0.00	$0.00	$0.00	$35.01
2	55.00	$27.18	$10.30	$0.00	$6.88	$0.00	$44.36
3	60.00	$29.65	$10.30	$0.00	$7.50	$0.00	$47.45

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Apprentice: PAINTER (SPRAY OR SANDBLAST, NEW) *

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
4	65.00	$32.12	$10.30	$0.00	$8.13	$0.00	$50.55
5	70.00	$34.59	$10.30	$11.95	$8.75	$0.00	$65.59
6	75.00	$37.06	$10.30	$11.95	$9.38	$0.00	$68.69
7	80.00	$39.53	$10.30	$11.95	$10.00	$0.00	$71.78
8	90.00	$44.47	$10.30	$11.95	$11.25	$0.00	$77.97

Apprentice: PAINTER (SPRAY OR SANDBLAST, NEW) *

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$25.23	$10.35	$0.00	$0.00	$0.00	$35.58
2	55.00	$27.75	$10.35	$0.00	$6.93	$0.00	$45.03
3	60.00	$30.28	$10.35	$0.00	$7.56	$0.00	$48.19
4	65.00	$32.80	$10.35	$0.00	$8.19	$0.00	$51.34
5	70.00	$35.32	$10.35	$12.00	$8.82	$0.00	$66.49
6	75.00	$37.85	$10.35	$12.00	$9.45	$0.00	$69.65
7	80.00	$40.37	$10.35	$12.00	$10.08	$0.00	$72.80
8	90.00	$45.41	$10.35	$12.00	$11.34	$0.00	$79.10

Apprentice to Journeyworker Ratio: 1:1

PAINTER (SPRAY OR SANDBLAST, REPAINT) PAINTERS LOCAL 35 PAINTERS LOCAL 35 - ZONE 2	7/1/2025	$47.47	$10.30	$11.95	$12.50	$0.00	$82.22
	1/1/2026	$48.52	$10.35	$12.00	$12.60	$0.00	$83.47

Apprentice: PAINTER (SPRAY OR SANDBLAST, REPAINT)

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$23.74	$10.30	$0.00	$0.00	$0.00	$34.04
2	55.00	$26.11	$10.30	$0.00	$6.88	$0.00	$43.29
3	60.00	$28.48	$10.30	$0.00	$7.50	$0.00	$46.28
4	65.00	$30.86	$10.30	$0.00	$8.13	$0.00	$49.29
5	70.00	$33.23	$10.30	$11.95	$8.75	$0.00	$64.23
6	75.00	$35.60	$10.30	$11.95	$9.38	$0.00	$67.23
7	80.00	$37.98	$10.30	$11.95	$10.00	$0.00	$70.23
8	90.00	$42.72	$10.30	$11.95	$11.25	$0.00	$76.22

Apprentice: PAINTER (SPRAY OR SANDBLAST, REPAINT)

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
PAINTER / TAPER (BRUSH, NEW) *	7/1/2025	$48.01	$10.30	$11.95	$12.50	$0.00	$82.76
* If 30% or more of surfaces to be painted are new construction, NEW paint rate shall be used.	1/1/2026	$49.06	$10.35	$12.00	$12.60	$0.00	$84.01
PAINTERS LOCAL 35							
PAINTERS LOCAL 35 - ZONE 2							

Apprentice: PAINTER (SPRAY OR SANDBLAST, REPAINT)

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$24.26	$10.35	$0.00	$0.00	$0.00	$34.61
2	55.00	$26.69	$10.35	$0.00	$6.93	$0.00	$43.97
3	60.00	$29.11	$10.35	$0.00	$7.56	$0.00	$47.02
4	65.00	$31.54	$10.35	$0.00	$8.19	$0.00	$50.08
5	70.00	$33.96	$10.35	$12.00	$8.82	$0.00	$65.13
6	75.00	$36.39	$10.35	$12.00	$9.45	$0.00	$68.19
7	80.00	$38.82	$10.35	$12.00	$10.08	$0.00	$71.25
8	90.00	$43.67	$10.35	$12.00	$11.34	$0.00	$77.36

Apprentice to Journeyworker Ratio: 1:1

Apprentice: PAINTER / TAPER (BRUSH, NEW) *

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$24.01	$10.30	$0.00	$0.00	$0.00	$34.31
2	55.00	$26.41	$10.30	$0.00	$6.88	$0.00	$43.59
3	60.00	$28.81	$10.30	$0.00	$7.50	$0.00	$46.61
4	65.00	$31.21	$10.30	$0.00	$8.13	$0.00	$49.64
5	70.00	$33.61	$10.30	$11.95	$8.75	$0.00	$64.61
6	75.00	$36.01	$10.30	$11.95	$9.38	$0.00	$67.64
7	80.00	$38.41	$10.30	$11.95	$10.00	$0.00	$70.66
8	90.00	$43.21	$10.30	$11.95	$11.25	$0.00	$76.71

Apprentice: PAINTER / TAPER (BRUSH, NEW) *

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$24.53	$10.35	$0.00	$0.00	$0.00	$34.88
2	55.00	$26.98	$10.35	$0.00	$6.93	$0.00	$44.26
3	60.00	$29.44	$10.35	$0.00	$7.56	$0.00	$47.35
4	65.00	$31.89	$10.35	$0.00	$8.19	$0.00	$50.43
5	70.00	$34.34	$10.35	$12.00	$8.82	$0.00	$65.51
6	75.00	$36.80	$10.35	$12.00	$9.45	$0.00	$68.60
7	80.00	$39.25	$10.35	$12.00	$10.08	$0.00	$71.68
8	90.00	$44.15	$10.35	$12.00	$11.34	$0.00	$77.84

Apprentice to Journeyworker Ratio: 1:1

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
PAINTER / TAPER (BRUSH, REPAINT) PAINTERS LOCAL 35 PAINTERS LOCAL 35 - ZONE 2	7/1/2025	$46.07	$10.30	$11.95	$12.50	$0.00	$80.82
	1/1/2026	$47.12	$10.35	$12.00	$12.60	$0.00	$82.07

Apprentice: PAINTER / TAPER (BRUSH, REPAINT)

Effective Date: 7/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$23.04	$10.30	$0.00	$0.00	$0.00	$33.34
2	55.00	$25.34	$10.30	$0.00	$6.88	$0.00	$42.52
3	60.00	$27.64	$10.30	$0.00	$7.50	$0.00	$45.44
4	65.00	$29.95	$10.30	$0.00	$8.13	$0.00	$48.38
5	70.00	$32.25	$10.30	$11.95	$8.75	$0.00	$63.25
6	75.00	$34.55	$10.30	$11.95	$9.38	$0.00	$66.18
7	80.00	$36.86	$10.30	$11.95	$10.00	$0.00	$69.11
8	90.00	$41.46	$10.30	$11.95	$11.25	$0.00	$74.96

Apprentice: PAINTER / TAPER (BRUSH, REPAINT)

Effective Date: 1/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$23.56	$10.35	$0.00	$0.00	$0.00	$33.91
2	55.00	$25.92	$10.35	$0.00	$6.93	$0.00	$43.20
3	60.00	$28.27	$10.35	$0.00	$7.56	$0.00	$46.18
4	65.00	$30.63	$10.35	$0.00	$8.19	$0.00	$49.17
5	70.00	$32.98	$10.35	$12.00	$8.82	$0.00	$64.15
6	75.00	$35.34	$10.35	$12.00	$9.45	$0.00	$67.14
7	80.00	$37.70	$10.35	$12.00	$10.08	$0.00	$70.13
8	90.00	$42.41	$10.35	$12.00	$11.34	$0.00	$76.10

Apprentice to Journeyworker Ratio: 1:1

PAINTER TRAFFIC MARKINGS (HEAVY/HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$39.84	$10.15	$9.50	$9.21	$0.00	$68.70
	12/1/2025	$41.22	$10.15	$9.50	$9.21	$0.00	$70.08
	6/1/2026	$42.66	$10.15	$9.50	$9.21	$0.00	$71.52
	12/1/2026	$44.10	$10.15	$9.50	$9.21	$0.00	$72.96
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)							
PANEL & PICKUP TRUCKS DRIVER TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$40.78	$15.57	$20.17	$0.00	$0.00	$76.52
	12/1/2025	$40.78	$15.57	$21.78	$0.00	$0.00	$78.13
	1/1/2026	$40.78	$16.17	$21.78	$0.00	$0.00	$78.73
	6/1/2026	$41.78	$16.17	$21.78	$0.00	$0.00	$79.73
	12/1/2026	$41.78	$16.17	$23.52	$0.00	$0.00	$81.47
	1/1/2027	$41.78	$16.77	$23.52	$0.00	$0.00	$82.07
PIER AND DOCK CONSTRUCTOR (UNDERPINNING AND DECK) PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2)	8/1/2024	$51.97	$10.08	$11.62	$12.67	$0.00	$86.34

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
For apprentice rates see "Apprentice- PILE DRIVER"							
PILE DRIVER PILE DRIVER LOCAL 56 PILE DRIVER LOCAL 56 (ZONE 2)	8/1/2024	$51.97	$10.08	$11.62	$12.67	$0.00	$86.34

Apprentice: PILE DRIVER

Effective Date: 8/1/2024

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	45.00	$23.39	$10.08	$0.00	$2.53	$0.00	$36.00
2	55.00	$28.58	$10.08	$0.00	$5.07	$0.00	$43.73
3	70.00	$36.38	$10.08	$11.62	$7.60	$0.00	$65.68
4	80.00	$41.58	$10.08	$11.62	$10.14	$0.00	$73.42

Apprentice to Journeyworker Ratio: 1:5

PIPELAYER LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
PIPELAYER (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
PLUMBER & PIPEFITTER PLUMBERS & PIPEFITTERS LOCAL 51 PLUMBERS & PIPEFITTERS LOCAL 51	8/25/2025	$55.24	$10.80	$16.80	$4.60	$0.00	$87.44

Apprentice: PLUMBER & PIPEFITTER

Effective Date: 8/25/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	40.00	$22.10	$10.15	$2.50	$0.00	$0.00	$34.75
2	50.00	$27.62	$10.15	$2.50	$0.00	$0.00	$40.27
3	60.00	$33.14	$10.15	$8.40	$0.50	$0.00	$52.19
4	70.00	$38.67	$10.15	$13.44	$0.80	$0.00	$63.06
5	80.00	$44.19	$10.15	$16.80	$1.00	$0.00	$72.14

Apprentice to Journeyworker Ratio: 1:3

PNEUMATIC CONTROLS (TEMP.)	8/25/2025	$55.24	$10.80	$16.80	$4.60	$0.00	$87.44

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
PLUMBERS & PIPEFITTERS LOCAL 51 PLUMBERS & PIPEFITTERS LOCAL 51							
For apprentice rates see "Apprentice- PIPEFITTER" or "PLUMBER/PIPEFITTER"							
PNEUMATIC DRILL/TOOL OPERATOR LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
PNEUMATIC DRILL/TOOL OPERATOR (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
POWDERMAN & BLASTER LABORERS LABORERS - ZONE 2	6/1/2025	$40.84	$10.15	$9.50	$9.11	$0.00	$69.60
	12/1/2025	$42.22	$10.15	$9.50	$9.11	$0.00	$70.98
	6/1/2026	$43.66	$10.15	$9.50	$9.11	$0.00	$72.42
	12/1/2026	$45.10	$10.15	$9.50	$9.11	$0.00	$73.86
	6/1/2027	$46.55	$10.15	$9.50	$9.11	$0.00	$75.31
	12/1/2027	$48.00	$10.15	$9.50	$9.11	$0.00	$76.76
	6/1/2028	$49.50	$10.15	$9.50	$9.11	$0.00	$78.26
	12/1/2028	$51.00	$10.15	$9.50	$9.11	$0.00	$79.76
For apprentice rates see "Apprentice- LABORER"							
POWDERMAN & BLASTER (HEAVY & HIGHWAY) LABORERS LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2025	$40.84	$9.90	$9.50	$9.21	$0.00	$69.45
	12/1/2025	$42.22	$9.90	$9.50	$9.21	$0.00	$70.83
	6/1/2026	$43.66	$9.90	$9.50	$9.21	$0.00	$72.27
	12/1/2026	$45.10	$9.90	$9.50	$9.21	$0.00	$73.71
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							
POWER SHOVEL/DERRICK/TRENCHING MACHINE OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$58.33	$15.55	$13.25	$3.25	$0.00	$90.38
	12/1/2025	$59.78	$15.55	$13.25	$3.25	$0.00	$91.83
	6/1/2026	$61.08	$15.55	$13.25	$3.25	$0.00	$93.13
	12/1/2026	$62.53	$15.55	$13.25	$3.25	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
PUMP OPERATOR (CONCRETE) OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
PUMP OPERATOR (DEWATERING, OTHER) OPERATING ENGINEERS LOCAL 4	6/1/2025	$37.52	$15.55	$13.25	$3.25	$0.00	$69.57
	12/1/2025	$38.47	$15.55	$13.25	$3.25	$0.00	$70.52

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
OPERATING ENGINEERS LOCAL 4	6/1/2026	$39.33	$15.55	$13.25	$3.25	$0.00	$71.38
	12/1/2026	$40.28	$15.55	$13.25	$3.25	$0.00	$72.33
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
READY-MIX CONCRETE DRIVER TEAMSTERS 653 TEAMSTERS 653 - Southeastern Concrete (Weymouth)	8/1/2023	$25.00	$13.91	$6.90	$0.00	$0.00	$45.81
RECLAIMERS OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
RIDE-ON MOTORIZED BUGGY OPERATOR LABORERS LABORERS - ZONE 2	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
ROLLER/SPREADER/MULCHING MACHINE OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg) ROOFERS LOCAL 33 ROOFERS LOCAL 33	8/1/2025	$53.53	$13.28	$12.67	$9.03	$0.00	$88.51
	2/1/2026	$54.78	$13.28	$12.67	$9.03	$0.00	$89.76

Apprentice: ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg)

Effective Date: 8/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$26.77	$13.28	$6.52	$9.03	$0.00	$55.60
2	60.00	$32.12	$13.28	$12.67	$9.03	$0.00	$67.10
3	65.00	$34.79	$13.28	$12.67	$9.03	$0.00	$69.77
4	75.00	$40.15	$13.28	$12.67	$9.03	$0.00	$75.13
5	85.00	$45.50	$13.28	$12.67	$9.03	$0.00	$80.48

Apprentice: ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg)

Effective Date: 2/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
ROOFER SLATE / TILE / PRECAST CONCRETE ROOFERS LOCAL 33 ROOFERS LOCAL 33	8/1/2025	$53.78	$13.28	$12.67	$9.03	$0.00	$88.76
	2/1/2026	$55.03	$13.28	$12.67	$9.03	$0.00	$90.01

For apprentice rates see "Apprentice- ROOFER"

Apprentice: ROOFER (Inc.Roofer Waterproofng &Roofer Damproofg)

Effective Date: 2/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$27.39	$13.28	$6.52	$9.03	$0.00	$56.22
2	60.00	$32.87	$13.28	$12.67	$9.03	$0.00	$67.85
3	65.00	$35.61	$13.28	$12.67	$9.03	$0.00	$70.59
4	75.00	$41.09	$13.28	$12.67	$9.03	$0.00	$76.07
5	85.00	$46.56	$13.28	$12.67	$9.03	$0.00	$81.54

Apprentice Notes

** 1:5, 2:6-10, the 1:10; Reroofing: 1:4, then 1:1

Apprentice to Journeyworker Ratio: 1:5

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
SHEETMETAL WORKER SHEETMETAL WORKERS LOCAL 17 SHEETMETAL WORKERS LOCAL 17 - B	10/1/2025	$44.05	$14.91	$13.35	$6.15	$2.24	$80.70
	4/1/2026	$45.55	$14.91	$13.35	$6.15	$2.24	$82.20

Apprentice: SHEETMETAL WORKER

Effective Date: 10/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	40.00	$17.62	$14.91	$4.27	$0.00	$1.09	$37.89
2	45.00	$19.82	$14.91	$4.80	$0.00	$1.17	$40.70
3	50.00	$22.03	$14.91	$12.28	$0.00	$1.45	$50.67
4	55.00	$24.23	$14.91	$12.28	$0.00	$1.52	$52.94
5	60.00	$26.43	$14.91	$12.28	$3.69	$1.64	$58.95
6	65.00	$28.63	$14.91	$12.28	$4.00	$1.71	$61.53
7	70.00	$30.84	$14.91	$12.28	$4.31	$1.78	$64.12
8	75.00	$33.04	$14.91	$12.28	$4.61	$1.86	$66.70
9	80.00	$35.24	$14.91	$12.28	$4.92	$1.93	$69.28
10	85.00	$37.44	$14.91	$12.28	$5.23	$2.00	$71.86

Apprentice: SHEETMETAL WORKER

Effective Date: 4/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	40.00	$18.22	$14.91	$4.27	$0.00	$1.09	$38.49
2	45.00	$20.50	$14.91	$4.80	$0.00	$1.17	$41.38
3	50.00	$22.78	$14.91	$12.28	$0.00	$1.45	$51.42
4	55.00	$25.05	$14.91	$12.28	$0.00	$1.52	$53.76

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
Apprentice: SHEETMETAL WORKER							
Effective Date: 4/1/2026							
Step / Percent		**Apprentice Base Wage**					
5 / 60.00		$27.33	$14.91	$12.28	$3.69	$1.64	$59.85
6 / 65.00		$29.61	$14.91	$12.28	$4.00	$1.71	$62.51
7 / 70.00		$31.89	$14.91	$12.28	$4.31	$1.78	$65.17
8 / 75.00		$34.16	$14.91	$12.28	$4.61	$1.86	$67.82
9 / 80.00		$36.44	$14.91	$12.28	$4.92	$1.93	$70.48
10 / 85.00		$38.72	$14.91	$12.28	$5.23	$2.00	$73.14
Apprentice to Journeyworker Ratio: 1:4							
SPECIALIZED EARTH MOVING EQUIP < 35 TONS TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$41.24	$15.57	$20.17	$0.00	$0.00	$76.98
	12/1/2025	$41.24	$15.57	$21.78	$0.00	$0.00	$78.59
	1/1/2026	$41.24	$16.17	$21.78	$0.00	$0.00	$79.19
	6/1/2026	$42.24	$16.17	$21.78	$0.00	$0.00	$80.19
	12/1/2026	$42.24	$16.17	$23.52	$0.00	$0.00	$81.93
	1/1/2027	$42.24	$16.77	$23.52	$0.00	$0.00	$82.53
SPECIALIZED EARTH MOVING EQUIP > 35 TONS TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$41.53	$15.57	$20.17	$0.00	$0.00	$77.27
	12/1/2025	$41.53	$15.57	$21.78	$0.00	$0.00	$78.88
	1/1/2026	$41.53	$16.17	$21.78	$0.00	$0.00	$79.48
	6/1/2026	$42.53	$16.17	$21.78	$0.00	$0.00	$80.48
	12/1/2026	$42.53	$16.17	$23.52	$0.00	$0.00	$82.22
	1/1/2027	$42.53	$16.77	$23.52	$0.00	$0.00	$82.82
SPRINKLER FITTER SPRINKLER FITTERS LOCAL 550 SPRINKLER FITTERS LOCAL 550 - (Section B) Zone 2	10/1/2025	$64.85	$12.25	$7.40	$19.50	$0.00	$104.00
	1/1/2026	$64.85	$13.45	$7.45	$18.25	$0.00	$104.00
Apprentice: SPRINKLER FITTER							
Effective Date: 10/1/2025							
Step / Percent		**Apprentice Base Wage**					
1 / 0.00		$22.70	$12.25	$14.22	$19.50	$0.00	$68.67
2 / 0.00		$25.94	$12.25	$15.20	$19.50	$0.00	$72.89
3 / 0.00		$29.18	$12.25	$16.18	$19.50	$0.00	$77.11
4 / 0.00		$32.43	$12.25	$17.15	$19.50	$0.00	$81.33
5 / 0.00		$35.67	$12.25	$18.12	$19.50	$0.00	$85.54
6 / 0.00		$38.91	$12.25	$19.10	$19.50	$0.00	$89.76
7 / 0.00		$42.15	$12.25	$20.08	$19.50	$0.00	$93.98
8 / 0.00		$45.40	$12.25	$21.05	$19.50	$0.00	$98.20
9 / 0.00		$48.64	$12.25	$22.02	$19.50	$0.00	$102.41
10 / 0.00		$51.88	$12.25	$23.00	$19.50	$0.00	$106.63

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
Apprentice: SPRINKLER FITTER							
Effective Date: 1/1/2026							
Step / Percent / Apprentice Base Wage							
1 / 0.00		$22.70	$13.45	$13.84	$18.25	$0.00	$68.24
2 / 0.00		$25.94	$13.45	$14.75	$18.25	$0.00	$72.39
3 / 0.00		$29.18	$13.45	$15.67	$18.25	$0.00	$76.55
4 / 0.00		$32.43	$13.45	$16.57	$18.25	$0.00	$80.70
5 / 0.00		$35.67	$13.45	$17.49	$18.25	$0.00	$84.86
6 / 0.00		$38.91	$13.45	$18.40	$18.25	$0.00	$89.01
7 / 0.00		$42.15	$13.45	$19.32	$18.25	$0.00	$93.17
8 / 0.00		$45.40	$13.45	$20.22	$18.25	$0.00	$97.32
9 / 0.00		$48.64	$13.45	$21.15	$18.25	$0.00	$101.49
10 / 0.00		$51.88	$13.45	$22.05	$18.25	$0.00	$105.63
Apprentice Notes							
Apprentice entered prior 9/30/10:							
Apprentice to Journeyworker Ratio: 1:3							
STEAM BOILER OPERATOR	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
OPERATING ENGINEERS LOCAL 4	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
TAMPERS, SELF-PROPELLED OR TRACTOR DRAWN	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
OPERATING ENGINEERS LOCAL 4	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
TELECOMMUNICATION TECHNICIAN	9/1/2025	$42.52	$12.00	$12.05	$3.25	$0.00	$69.82
ELECTRICIANS LOCAL 223	9/1/2026	$44.41	$12.25	$12.59	$3.50	$0.00	$72.75
ELECTRICIANS LOCAL 223	9/1/2027	$46.51	$12.50	$13.18	$3.75	$0.00	$75.94
TERRAZZO FINISHERS	8/1/2025	$66.89	$11.49	$15.57	$8.02	$0.00	$101.97
BRICKLAYERS LOCAL 3	2/1/2026	$68.24	$11.49	$15.57	$8.02	$0.00	$103.32
BRICKLAYERS LOCAL 3 - MARBLE & TILE	8/1/2026	$70.44	$11.49	$15.57	$8.02	$0.00	$105.52
	2/1/2027	$71.84	$11.49	$15.57	$8.02	$0.00	$106.92
Apprentice: TERRAZZO FINISHERS							
Effective Date: 8/1/2025							
Step / Percent / Apprentice Base Wage							
1 / 50.00		$33.45	$11.49	$15.57	$8.02	$0.00	$68.53

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate

Apprentice: TERRAZZO FINISHERS

Effective Date: 8/1/2025

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
2	60.00	$40.13	$11.49	$15.57	$8.02	$0.00	$75.21
3	70.00	$46.82	$11.49	$15.57	$8.02	$0.00	$81.90
4	80.00	$53.51	$11.49	$15.57	$8.02	$0.00	$88.59
5	90.00	$60.20	$11.49	$15.57	$8.02	$0.00	$95.28

Apprentice: TERRAZZO FINISHERS

Effective Date: 2/1/2026

Step	Percent	Apprentice Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
1	50.00	$34.12	$11.49	$15.57	$8.02	$0.00	$69.20
2	60.00	$40.94	$11.49	$15.57	$8.02	$0.00	$76.02
3	70.00	$47.77	$11.49	$15.57	$8.02	$0.00	$82.85
4	80.00	$54.59	$11.49	$15.57	$8.02	$0.00	$89.67
5	90.00	$61.42	$11.49	$15.57	$8.02	$0.00	$96.50

Apprentice to Journeyworker Ratio: 1:5

TEST BORING DRILLER LABORERS LABORERS - FOUNDATION AND MARINE	6/1/2025	$51.20	$10.15	$9.50	$9.80	$0.00	$80.65
	12/1/2025	$52.70	$10.15	$9.50	$9.80	$0.00	$82.15
	6/1/2026	$54.25	$10.15	$9.50	$9.80	$0.00	$83.70
	12/1/2026	$55.75	$10.15	$9.50	$9.80	$0.00	$85.20
For apprentice rates see "Apprentice- LABORER"							
TEST BORING DRILLER HELPER LABORERS LABORERS - FOUNDATION AND MARINE	6/1/2025	$47.32	$10.15	$9.50	$9.80	$0.00	$76.77
	12/1/2025	$48.82	$10.15	$9.50	$9.80	$0.00	$78.27
	6/1/2026	$50.37	$10.15	$9.50	$9.80	$0.00	$79.82
	12/1/2026	$51.87	$10.15	$9.50	$9.80	$0.00	$81.32
For apprentice rates see "Apprentice- LABORER"							
TEST BORING LABORER LABORERS LABORERS - FOUNDATION AND MARINE	6/1/2025	$47.20	$10.15	$9.50	$9.80	$0.00	$76.65
	12/1/2025	$48.70	$10.15	$9.50	$9.80	$0.00	$78.15
	6/1/2026	$50.25	$10.15	$9.50	$9.80	$0.00	$79.70
	12/1/2026	$51.75	$10.15	$9.50	$9.80	$0.00	$81.20
For apprentice rates see "Apprentice- LABORER"							
TRACTORS/PORTABLE STEAM GENERATORS OPERATING ENGINEERS LOCAL 4 OPERATING ENGINEERS LOCAL 4	6/1/2025	$57.68	$15.55	$13.25	$3.25	$0.00	$89.73
	12/1/2025	$59.12	$15.55	$13.25	$3.25	$0.00	$91.17
	6/1/2026	$60.40	$15.55	$13.25	$3.25	$0.00	$92.45
	12/1/2026	$61.84	$15.55	$13.25	$3.25	$0.00	$93.89
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
TRAILERS FOR EARTH MOVING EQUIPMENT TEAMSTERS JOINT COUNCIL NO. 10 TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	6/1/2025	$41.82	$15.57	$20.17	$0.00	$0.00	$77.56
	12/1/2025	$41.82	$15.57	$21.78	$0.00	$0.00	$79.17
	1/1/2026	$41.82	$16.17	$21.78	$0.00	$0.00	$79.77

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
	6/1/2026	$42.82	$16.17	$21.78	$0.00	$0.00	$80.77
	12/1/2026	$42.82	$16.17	$23.52	$0.00	$0.00	$82.51
	1/1/2027	$42.82	$16.77	$23.52	$0.00	$0.00	$83.11
TUNNEL WORK - COMPRESSED AIR	6/1/2025	$59.43	$10.15	$9.50	$10.25	$0.00	$89.33
LABORERS	12/1/2025	$60.93	$10.15	$9.50	$10.25	$0.00	$90.83
LABORERS (COMPRESSED AIR)	6/1/2026	$62.48	$10.15	$9.50	$10.25	$0.00	$92.38
	12/1/2026	$63.98	$10.15	$9.50	$10.25	$0.00	$93.88
For apprentice rates see "Apprentice- LABORER"							
TUNNEL WORK - COMPRESSED AIR (HAZ. WASTE)	6/1/2025	$61.43	$10.15	$9.50	$10.25	$0.00	$91.33
LABORERS	12/1/2025	$62.93	$10.15	$9.50	$10.25	$0.00	$92.83
LABORERS (COMPRESSED AIR)	6/1/2026	$64.48	$10.15	$9.50	$10.25	$0.00	$94.38
	12/1/2026	$65.98	$10.15	$9.50	$10.25	$0.00	$95.88
For apprentice rates see "Apprentice- LABORER"							
TUNNEL WORK - FREE AIR	6/1/2025	$51.50	$10.15	$9.50	$10.25	$0.00	$81.40
LABORERS	12/1/2025	$53.00	$10.15	$9.50	$10.25	$0.00	$82.90
LABORERS (FREE AIR TUNNEL)	6/1/2026	$54.55	$10.15	$9.50	$10.25	$0.00	$84.45
	12/1/2026	$56.05	$10.15	$9.50	$10.25	$0.00	$85.95
For apprentice rates see "Apprentice- LABORER"							
TUNNEL WORK - FREE AIR (HAZ. WASTE)	6/1/2025	$53.50	$10.15	$9.50	$10.25	$0.00	$83.40
LABORERS	12/1/2025	$55.00	$10.15	$9.50	$10.25	$0.00	$84.90
LABORERS (FREE AIR TUNNEL)	6/1/2026	$56.55	$10.15	$9.50	$10.25	$0.00	$86.45
	12/1/2026	$58.05	$10.15	$9.50	$10.25	$0.00	$87.95
For apprentice rates see "Apprentice- LABORER"							
VAC-HAUL	6/1/2025	$41.24	$15.57	$20.17	$0.00	$0.00	$76.98
TEAMSTERS JOINT COUNCIL NO. 10	12/1/2025	$41.24	$15.57	$21.78	$0.00	$0.00	$78.59
TEAMSTERS JOINT COUNCIL NO. 10 ZONE B	1/1/2026	$41.24	$16.17	$21.78	$0.00	$0.00	$79.19
	6/1/2026	$42.24	$16.17	$21.78	$0.00	$0.00	$80.19
	12/1/2026	$42.24	$16.17	$23.52	$0.00	$0.00	$81.93
	1/1/2027	$42.24	$16.77	$23.52	$0.00	$0.00	$82.53
WAGON DRILL OPERATOR	6/1/2025	$40.09	$10.15	$9.50	$9.11	$0.00	$68.85
LABORERS	12/1/2025	$41.47	$10.15	$9.50	$9.11	$0.00	$70.23
LABORERS - ZONE 2	6/1/2026	$42.91	$10.15	$9.50	$9.11	$0.00	$71.67
	12/1/2026	$44.35	$10.15	$9.50	$9.11	$0.00	$73.11
	6/1/2027	$45.80	$10.15	$9.50	$9.11	$0.00	$74.56
	12/1/2027	$47.25	$10.15	$9.50	$9.11	$0.00	$76.01
	6/1/2028	$48.75	$10.15	$9.50	$9.11	$0.00	$77.51
	12/1/2028	$50.25	$10.15	$9.50	$9.11	$0.00	$79.01
For apprentice rates see "Apprentice- LABORER"							
WAGON DRILL OPERATOR (HEAVY & HIGHWAY)	6/1/2025	$40.09	$10.15	$9.50	$9.21	$0.00	$68.95
LABORERS	12/1/2025	$41.47	$10.15	$9.50	$9.21	$0.00	$70.33
LABORERS - ZONE 2 (HEAVY & HIGHWAY)	6/1/2026	$42.91	$10.15	$9.50	$9.21	$0.00	$71.77
	12/1/2026	$44.35	$10.15	$9.50	$9.21	$0.00	$73.21
For apprentice rates see "Apprentice- LABORER (Heavy and Highway)"							

Construction

Classification	Effective Date	Base Wage	Health	Pension	Annuity	Supplemental Unemployment	Total Rate
WASTE WATER PUMP OPERATOR	6/1/2025	$58.33	$15.55	$13.25	$3.25	$0.00	$90.38
OPERATING ENGINEERS LOCAL 4	12/1/2025	$59.78	$15.55	$13.25	$3.25	$0.00	$91.83
OPERATING ENGINEERS LOCAL 4	6/1/2026	$61.08	$15.55	$13.25	$3.25	$0.00	$93.13
	12/1/2026	$62.53	$15.55	$13.25	$3.25	$0.00	$94.58
For apprentice rates see "Apprentice- OPERATING ENGINEERS"							
WATER METER INSTALLER	8/25/2025	$55.24	$10.80	$16.80	$4.60	$0.00	$87.44
PLUMBERS & PIPEFITTERS LOCAL 51							
PLUMBERS & PIPEFITTERS LOCAL 51							
For apprentice rates see "Apprentice- PLUMBER/PIPEFITTER" or "PLUMBER/GASFITTER"							

Additional Apprentice Information

All apprentices must be registered with the Division of Apprenticeship Training(DAS) in accordance with M.G.L.c. 23, §§ 11E-11L. Minimum wage rates for apprentices employed on public works projects are listed above as a percentage of the hourly prevailing wage rate established by the Commissioner under the provisions of M.G.L.c. 149, §§ 26-27D.

Apprentice ratios are established by DAS pursuant to M.G.L.c. 23, §§ 11E-11L. Ratios are expressed as the allowable number of apprentices to journeymen or fraction thereof, unless otherwise specified. The ratios listed herein have been taken from relevant private collective bargaining agreements(CBAs) and are provided for illustrative purposes only. They have not been independently verified as being accurate or continuing to be accurate.

Parties having questions regarding what ratio to use should contact DAS.

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APPENDIX H

PRICE ADJUSTMENTS FOR CERTAIN MATERIALS IN CONSTRUCTION PROJECTS
MGL CHAPTER 30, SECTION 38A

On November 20, 2013, the Massachusetts Legislature passed a bill (Chapter 150 of the Acts of 2013) requiring that water and sewer projects bid under MGL Chapter 30 Section 39M include price adjustment clauses for **fuel** (both diesel and gasoline)**, liquid asphalt** and **portland cement** contained in cast in place concrete for all projects that are advertised for bid after January 1, 2014.

The inclusion of these clauses in the construction contract is the responsibility of the awarding authority, and as such, MassDEP does not dictate what language should be used in the contract. MassDEP will, however, review the contracts to verify that price adjustment clauses have been included.

Awarding Authorities may find value from researching the *price adjustment* information on the Massachusetts Department of Transportation (MassDOT) website at https://www.mass.gov/massdot-contract-price-adjustments

MassDOT requires the use of price adjustment clauses in all of its contracts, and since 2008 has been requiring cities and towns utilizing Chapter 90 road construction funds to also include price adjustment clauses. Because of this, many cities and towns may already have drafted appropriate price adjustment language. This language would be suitable for use in SRF funded contracts. The MassDOT website has extensive information on price adjustments and required contract language for MassDOT contracts.

Attached below is the new Chapter 30, Section 38A language and the contract language that MassDOT uses in its construction contracts. The MassDOT contract language is presented as a possible starting point for borrowers that have not drafted price adjustment clauses. The LGU should consult with their legal and contract staff as appropriate in developing the price adjustment clauses.

Chapter 150 of the Acts of 2013
An Act Relative to Price Adjustment for Certain Materials in Construction Projects

Whereas, the deferred operation of this act would tend to defeat its purpose, which is to establish forthwith certain price adjustments, therefore it is hereby declared to be an emergency law, necessary for the immediate preservation of the public convenience.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same as follows:

SECTION 1. Chapter 30 of the General Laws is hereby amended by inserting after section 38 the following section:-

Section 38A. Contracts for road and bridge projects awarded as a result of a proposal or invitation for bids under section 39M shall include a price adjustment clause for each of the following materials: fuel, both diesel and gasoline; asphalt; concrete; and steel. Contracts for water and sewer projects awarded as a result of a proposal or invitation for bids under said section 39M shall include a price adjustment clause for fuel, both diesel and gasoline; liquid asphalt; and

portland cement contained in cast-in-place concrete. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provide for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 per cent.

SECTION 2. Section 1 shall apply to projects which are advertised for bid after January 1, 2014.

Approved, November 25, 2013.

MassDOT Price Adjustment Clauses

DOCUMENT 00811
SPECIAL PROVISIONS
MONTHLY PRICE ADJUSTMENT FOR HOT MIX ASPHALT (HMA) MIXTURES
ENGLISH UNITS
Revised: 02/02/2009

This provision applies to all projects using greater than 100 tons of hot mix asphalt (HMA) mixtures containing liquid asphalt cement as stipulated in the Notice to Contractors section of the bid documents.

The Price Adjustment will be based on the variance in price for the liquid asphalt component only from the Base Price to the Period Price. It shall not include transportation or other charges. This Price Adjustment will occur on a monthly basis.

Base Price
The Base Price of liquid asphalt on a project as listed in the Notice to Contractors section of the bid documents is a fixed price determined at the time of bid by the Department by using the same method as for the determination of the Period Price detailed below.

Period Price
Please note that, starting December 15, 2008, two sets of period prices will be posted each month on the MassHighway website at https://www.mass.gov/orgs/highway-division. They will be labeled “New Asphalt Period Price Method” and “Old Asphalt Period Price Method”.

New Asphalt Period Price Method
The “New Asphalt Period Price Method” is for contracts bid after December 15, 2008 and will show the Period Price of liquid asphalt for each monthly period as determined by MassHighway using the average selling price per standard ton of PG64-28 paving grade (primary binder classification) asphalt, FOB manufacturer's terminal, as listed under the "East Coast Market - New England, Boston, Massachusetts area" section of the Poten & Partners, Inc. "Asphalt Weekly Monitor". This average selling price is listed in the issue having a publication date of the second Friday of the month and will be posted as the Period Price for that month. MassHighway will post this Period Price on this website within two (2) business days following their receipt of the relevant issue of the "Asphalt Weekly Monitor". Poten and Partners has granted MassHighway the right to publish this specific asphalt price information sourced from the Asphalt Weekly Monitor.

Old Asphalt Period Price Method
The "Old Asphalt Period Price Method" Period Price will be for contracts bid on or before December 15, 2008 and will contain liquid asphalt prices as determined by the old or previous method. These prices will continue to be posted on MassHighway's website until all contracts using the "Old Asphalt Period Price Method" Period Price have been closed.

New and Old Asphalt Period Price Methods
The paragraphs below apply to both the New and the Old Asphalt Period Price Methods.
The Contract Price of the hot mix asphalt mixture will be paid under the respective item in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the work has been performed, using the monthly period price for the month during which the work was performed.

The Price Adjustment applies only to the actual virgin liquid asphalt content in the mixture placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M3.11.03.

The Price Adjustment will be a separate payment item. It will be determined by multiplying the number of tons of hot mix asphalt mixtures placed during each monthly period times the liquid asphalt content percentage times the variance in price between Base Price and Period Price of liquid asphalt.

This Price Adjustment will be paid only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.

No Price Adjustment will be allowed beyond the Completion Date of this Contract, unless there is a Department approved extension of time.

******** END OF DOCUMENT ********

DOCUMENT 00812
SPECIAL PROVISIONS
MONTHLY PRICE ADJUSTMENT FOR DIESEL FUEL AND GASOLINE – ENGLISH UNITS
Revised: 01/26/2009

This monthly fuel price adjustment is inserted in this contract because the national and worldwide energy situation has made the future cost of fuel unpredictable. This adjustment will provide for either additional compensation to the Contractor or repayment to the Commonwealth, depending on an increase or decrease in the average price of diesel fuel or gasoline.

This adjustment will be based on fuel usage factors for various items of work developed by the Highway Research Board in Circular 158, dated July 1974. These factors will be multiplied by the quantities of work done in each item during each monthly period and further multiplied by the variance in price from the Base Price to the Period Price.

The Base Price of Diesel Fuel and Gasoline will be the price as indicated in the Department's web site (https://www.mass.gov/orgs/highway-division) for the month in which the contract was bid, which includes State Tax.

The Period Price will be the average of prices charged to the State, including State Tax for the bulk purchases made\ during each month.

This adjustment will be effected only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.

No adjustment will be paid for work done beyond the extended completion date of any contract.

Any adjustment (increase or decrease) to estimated quantities made to each item at the time of final payment will have the fuel price adjustment figured at the average period price for the entire term of the project for the difference of quantity.

The fuel price adjustment will apply only to the following items of work at the fuel factors shown:

ITEMS COVERED	**FUEL FACTORS**	
	Diesel	**Gasoline**
Excavation: and Borrow Work: Items 120, 120.1, 121, 123, 124, 125, 127, 129.3, 140, 140.1, 141, 142, 143, 144., 150, 150.1, 151 and 151.1 (Both Factors used)	0.29 Gallons / CY	0.15 Gallons / CY
Surfacing Work: All Items containing Hot Mix Asphalt	2.90 Gallons / Ton	Does Not Apply

******** END OF DOCUMENT ********

DOCUMENT 00814
SPECIAL PROVISIONS
PRICE ADJUSTMENT FOR PORTLAND CEMENT CONCRETE MIXES
January 12, 2009

This provision applies to all projects using greater than 100 Cubic Yards (76 Cubic Meters) of Portland cement concrete containing Portland cement as stipulated in the Notice to Contractors section of the Bid Documents. This Price Adjustment will occur on a monthly basis.

The Price Adjustment will be based on the variance in price for the Portland cement component only from the Base Price to the Period Price. It shall not include transportation or other charges.

The Base Price of Portland cement on a project is a fixed price determined at the time of bid by the
Department by using the same method as for the determination of the Period Price (see below) and found in the Notice to Contractors.

The Period Price of Portland cement will be determined by using the latest published price, in dollars per ton (U.S.), for Portland cement (Type I) quoted for Boston, U.S.A. in the **Construction Economics** section of *ENR Engineering News-Record* magazine or at the ENR website http://www.enr.com under **Construction Economics**. The Period Price will be posted on the MassHighway website the Wednesday immediately following the publishing of the monthly price in ENR, which is normally the first week of the month.

The Contract Price of the Portland cement concrete mix will be paid under the respective item in the Contract. The price adjustment, as herein provided, upwards or downwards, will be made after the work has been performed, using the monthly period price for the month during which the work was performed.

The price adjustment applies only to the actual Portland cement content in the mix placed on the job in accordance with the Standard Specifications for Highways and Bridges, Division III, Section M4.02.01.

No adjustments will be made for any cement replacement materials such as fly ash or ground granulated blast furnace slag.

The Price Adjustment will be a separate payment item. It will be determined by multiplying the number of cubic yards of Portland cement concrete placed during each monthly period times the Portland cement content percentage times the variance in price between the Base Price and Period Price of Portland cement.

This Price Adjustment will be paid only if the variance from the Base Price is 5% or more for a monthly period. The complete adjustment will be paid in all cases with no deduction of the 5% from either upward or downward adjustments.

No Price Adjustment will be allowed beyond the Completion Date of this Contract, unless there is a Department-approved extension of time.

****
END OF DOCUMENT

APPENDIX B
DIESEL RETROFIT PROGRAM

The Department of Environmental Protection ("DEP") has developed the Diesel Retrofit Program in response to increasing public health concerns with the emissions from diesel engines and vehicles.

Diesel Construction Equipment Standard

All diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") must have the following pollution control device installed unless exempt as provided below:

1. Emission control technology verified by U.S. Environmental Protection Agency ("EPA") or the California Air Resources Board ("CARB") for use with non-road engines;
2. Emission control technology verified by EPA or CARB for use with on-road engines provided that such equipment is operated with diesel fuel that has no more than 15 parts per million sulfur content (i.e. Ultra Low Sulfur Diesel fuel); or
3. Emission control technology certified by the manufacturer that such technology meets or exceeds the emission reductions provided by on-road or off-road emission control technology verified by EPA or CARB, i.e. that a Diesel Oxidation Catalyst is achieving the following minimum emission reductions: particulate matter 20%; carbon monoxide 40%; volatile organic compounds 50%; or a Diesel Particulate Filter is achieving a minimum of 85% emission reductions for particulate matter.

Emission control devices, such as oxidation catalysts or particulate filters, shall be installed on the exhaust system side of the Diesel Construction Equipment. The Contractor shall be responsible to insure that the emissions control technology is operated, maintained, and serviced as recommended by the manufacturer.

For the latest up-to-date list of EPA verified-technologies, see:
https://www.epa.gov/verified-diesel-tech
For the latest up-to-date list of CARB verified technologies, see:
http://www.arb.ca.gov/diesel/verdev/vt/cvt.htm

Exemptions

The following Diesel Construction Equipment shall be exempt from the standard above. The Contractor shall include such Diesel Construction Equipment in the required recordkeeping:

1. Diesel Construction Equipment not owned by the Contractor and used in the performance of the work under this Contract for 30 calendar days (cumulative days but not necessarily consecutive) or less;
2. Unless otherwise exempt, additional Diesel Construction Equipment originally not anticipated to be used under the Contract or used as permanent replacement after the work under the Contract has commenced, for 15 calendars days from the date such Diesel Construction Equipment is brought on site;

3. Diesel Construction Equipment with an engine that meets the EPA particulate matter (PM) Tier emission standards in effect at the start of the Contract for non-road diesel engines for the applicable engine power group (e.g., as of January 1, 2009, a piece of Diesel Construction Equipment with a Tier 3 engine is exempt from meeting the standard until the piece of Diesel Construction Equipment is available with a Tier 4 engine) provided that if such emissions standards are superseded during the Contract then such Diesel Construction Equipment must be retrofitted in accordance with the standards above prior to the end of the Contract;
4. A large crane (e.g. a sky crane or link belt crane which is responsible for critical lift operations) if such device would adversely affect the operation of the crane provided the Contractor submits to the municipality's project engineer written technical justification documenting the adverse impact on operation; and
5. Diesel Construction Equipment that the project engineer has determined is necessary to control a compelling emergency including but not limited to, the need for rescue vehicles or other equipment to prevent harm to human beings or additional equipment required to address a catastrophic emergency such as structure collapse or imminent collapse. After the compelling emergency is controlled, such non-compliant equipment must be removed from the Contract site and may not be used in further performance of the work under this Contract. Meeting Contract deadlines is not a compelling emergency.

Contractor Certification

Each bidder shall submit as part of its bid, the Statement of Intent to Comply. Within 10 days of being notified that it has been awarded a contract, the bidder and each of its Contractors and Subcontractors shall submit a Diesel Retrofit Program Contractor Certification. Each such Certification shall contain the following information for each piece of Diesel Construction Equipment:

1. Contractor or Subcontractor name;
2. Equipment type, make, model;
3. Vehicle Identification Number or VIN;
4. Engine model and year of manufacture;
5. Engine HP rating;
6. Emission Control Device (ECD) type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
7. ECD make, model, and manufacturer;
8. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
9. ECD installation date;
10. Type of fuel to be used; and
11. Whether the equipment is owned or rented.

Recordkeeping

Each Contractor and Subcontractor shall maintain detailed records of all Diesel Construction Equipment used under the Contract, including the dates and duration times the Diesel Construction Equipment is

used at the Contract site. Records shall be available for inspection by DEP. Each Contractor and Subcontractor shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site.

For Diesel Construction Equipment that has an emissions control device with a manufacturer's certification, the Contractor shall maintain records of all supporting emissions test data and test procedures. If upon review the emissions reductions are not supported by the test data and test procedures, then the emissions control device may need to be replaced with a compliant retrofit device.

Project Regulatory Agreement

The following language shall be included section 4 (Covenants of the Borrower) of the municipality's Project Regulatory Agreement if it receives funds from the State Revolving Fund:

> The Borrower shall require each Contractor and Subcontractor to submit the Diesel Retrofit Program Contractor Certification to DEP and the Borrower prior to commencing work on the Project. The Borrower shall not allow any Contractor or Subcontractor to commence work at the Project site prior to submitting such Certification.

STATEMENT OF INTENT TO COMPLY

This form must be signed and submitted by the bidder as part of the bid.

Local Governmental Unit _____ **SRF Project No.** _____

Contract No. _____ **Contact Title** _____

Bidder _____

The undersigned, on behalf of the above-named Bidder, agrees that, if awarded the Contract:

1. **the Bidder shall comply with the Massachusetts Department of Environmental Protection's ("MassDEP") Diesel Retrofit Program by ensuring that all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard;**
2. **the Bidder shall require all Subcontractors to comply with MassDEP's Diesel Retrofit Program by ensuring all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract are equipped or retrofitted with a pollution control device in accordance with the Diesel Retrofit Program Standard; and**

3. **The Bidder shall submit and shall require each Subcontractor to submit a Diesel Retrofit Program Contractor Certification (form attached) with a Diesel Retrofit List to MassDEP Municipal Services and the Bidder within 10 days of the bidder being notified that it has been awarded the Contract. The Bidder shall require each Subcontractor to update such Certification and List within 2 days of using additional Diesel Construction Equipment on the project under the Contract.**

_____

(Signature of Bidder's Authorized Representative) **(Date)**

APPENDIX B (cont.)

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

Each Contractor and its Subcontractor(s) must sign and email this form to the DEP DMS project engineer, within 10 days after the contractor is awarded.

Local Governmental Unit _____ **SRF Project No.** _____

Contract No. _____ **Contact Title** _____

Contractor _____

I, _____, an authorized signatory for _____, whose principal place of business is at _____ do hereby certify that any and all diesel powered non-road construction equipment and vehicles greater than 50 brake horsepower which will be used in the performance of the work under the Contract (hereinafter "Diesel Construction Equipment") have pollution control devices, such as oxidation catalysts or particulate filters, installed on the exhaust system side of the diesel combustion engine equipment in accordance with the Diesel Retrofit Program Standard.

I am submitting on behalf of _____ a list of all said Diesel Construction Equipment, labeled "Diesel Retrofit List," that will be used in connection with this Contract by _____. I hereby certify that the information on the attached Diesel Retrofit List is correct and accurate as of the date of signature. The List includes the following information for each piece of Diesel Construction Equipment:

1. Equipment type, make, model;
2. Vehicle Identification Number or VIN;
3. Engine model and year of manufacture;
4. Engine HP rating;
5. Emission Control Device ("ECD") type (Diesel Oxidation Catalyst or Diesel Particulate Filter);
6. ECD make, model, and manufacturer;
7. ECD EPA or CARB Verification Number or manufacturer's certification that the DOC or DPF meets or exceeds emission reductions provided by similar emission control technology verified by EPA or CARB;
8. ECD installation date;
9. Type of fuel to be used; and
10. Whether the equipment is owned or rented.

DIESEL RETROFIT PROGRAM CONTRACTOR CERTIFICATION

_____shall notify DEP within 48 hours of any new Diesel Construction Equipment brought onto the Contract site. _____shall maintain detailed records of all Diesel Construction Equipment used at the Contract site, including the dates and duration times the Diesel Construction Equipment is used at the Contract site. _____ shall make such records available for inspection by DEP. _____shall ensure that the emissions control technology for each piece of Diesel Construction Equipment is operated, maintained, and serviced as recommended by the manufacturer. _____ shall retrofit prior to the end of the Contract any Diesel Construction Equipment no longer exempt from meeting the Diesel Construction Equipment Standard under exemption 3 (because it had an engine that met the EPA particulate matter (PM) Tier emission standards currently in effect at the start of the Contract for non-road diesel engines for the applicable engine power group and such emissions standards were superseded during the Contract).

I acknowledge that this certificate is being furnished as a requirement under this Contract and is subject to applicable State and federal laws, both criminal and civil. Signed under pains and penalty of perjury on this date _____.

Signature_____

Name: _____

Title: _____

APPENDIX F

DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER RESOURCES
DIVISION OF MUNICIPAL SERVICES POLICIES

The Division of Municipal Services (DMS) has established the following policies for all Division financially-assisted projects.

POLICY MEMORANDUM NO. PM-1 EASEMENTS AND RIGHTS OF WAY

Prior to the approval of financial assistance for construction, the owner shall obtain and shall thereafter retain, a fee simple or such estate or interest in the site of construction and rights of access as will assure undisturbed use and possession for the purpose of construction and operation for the estimated life of the project. The Division may refuse to approve financial assistance until it has received from the owner sufficient assurances that such interests have been obtained. Unless the Division otherwise notifies the owner, the certificate (under pains and penalties of perjury) of the owner's legal representative shall constitute such sufficient assurance.

Additional cost which result from interruptions of construction or extensions of contract time caused by the owner's failure to obtain the necessary interests in land shall be ineligible for financial assistance, and all such additional costs shall be borne by the owner.

POLICY MEMORANDUM NO. PM-2 PERMITS

The owner shall be responsible for identifying and obtaining all federal, state, local and railroad permits required by the nature and location of construction, including but not limited to building construction permits and permits for street and highway cuts and openings, and all such permits shall be listed in a separate permits section of the contract documents. To the extent possible, such permits shall be obtained by the owner prior to the solicitation of bids for construction, and copies of all permits so obtained shall be included in the said permits section. The status of the application for each permit, including the permit conditions, and costs, not obtained prior to the solicitation of bids shall also be indicated in the contract documents permits section. The Division may refuse to approve financial assistance for construction unless and until it has received from the owner sufficient assurances that all necessary permits have been or will be obtained prior to the commencement of construction.

The contractor shall be responsible for obtaining all permits required of his equipment, work force, or particular operations (such as blasting) in the performance of the contract and not otherwise specified in the two preceding paragraphs as to be obtained by the owner. These permit fees shall be paid by the contractor.

The owner shall be responsible for the payment of all other permit fees required by the construction.

The following permits shall not be eligible for financial participation by the Department of Environmental Protection (DEP).

- Permits and insurance for construction in railroads' rights of way;
- Building permits;
- Permits for opening public streets and other public or municipal rights of way;
- Permits for the use of explosives;
- Permits for the disposal of waste materials;
- Permits and fees for connecting to municipal utilities.

Permits required by extraordinary circumstances and not specifically excluded from eligibility above may be eligible for DEP participation. For such permits to be so eligible, the owner or his representative must notify the DEP project engineer in advance of obtaining such permit and receive from the engineer specific agreement that such permit will be eligible for DEP participation. Eligibility for such participation will not be made retroactively.

Additional costs which result from interruptions of construction or extensions of contract time resulting from the owner's or the contractor's failure to obtain the necessary permits may be ineligible for participation.

POLICY MEMORANDUM NO. PM-3 **FIELD CONTROLS**

The Owner shall be responsible for indicating on the contract drawings all easement limits and all property and other control lines for locating the principal component parts of the work together with those elevations and bench marks used in the design of the work, all hereinafter referred to as "field controls". Where easement and property limits have not previously been established in the field, the owner shall be responsible for establishment of such limits. From the information provided by the Owner, unless otherwise specified, the Contractor shall develop and make all layouts required for construction, such as slope stakes, batter boards, stakes for pipe locations and other working points, lines, elevations and cut sheets.

Whenever he has reason to believe that an error exists or whenever he is otherwise unable to locate the field controls, the contractor shall promptly notify the owner and the owner's engineer of such error with appropriate documentation.

POLICY MEMORANDUM NO. PM-4 **RECORD DRAWINGS**

The Owner shall be responsible for the preparation of all record drawings required by this contract. This responsibility may be delegated to the Owner's representative. The responsibility for preparation of record drawings shall not be delegated or transferred to the contractor. They may use the contractor's and sub-contractor's certified AS BUILT drawings along with their own marked up set in the preparation of the Record Drawings.

Division approved contract drawings shall be revised upon completion of the contract to reflect any changes made and/or final quantities, as appropriate.

POLICY MEMORANDUM NO. PM-5 **PLAN SCALE**

Unless otherwise approved in advance by the Division, the horizontal scale for construction plans for non-structural facilities shall be 1" = 40'. A larger horizontal scale shall be used where appropriate to show sufficient detail to construct the project. The vertical scale for construction plans for non-structural facilities shall be 1" = 4'. Based on the best information available at the time of their preparation, the location of underground utilities and support structures for overhead utilities shall be shown on the plans.

Unless otherwise exempted in advance by the Division, construction plans shall be updated whenever the date of the advertisement for bids for the construction of such facilities is more than one year after the date of approval by the Division or EPA; and in the case of approval by both such agencies, the later approval date shall be used in determining the need for update.

The consulting engineer shall receive adequate compensation for updating plans and specifications, and such additional cost shall be eligible for assistance to the extent not otherwise prohibited by USEPA and Division regulations and program guidance.

All revision, or review without need for revision, shall be noted and dated on the plans prior to advertisement of the project for bid.

POLICY MEMORANDUM NO. PM-6 **BORINGS LOGS**

All soil borings shall be taken as close as practicable to the construction line, and the location of all such borings shall be clearly indicated on the contract drawings. The plan view shall show the location and boring number of each boring. The profile view shall show the location, elevation, and depth of each soil boring, the location of each change in soil stratum, the groundwater level, and the average of blow counts at each five foot interval. As a minimum, boring logs to be submitted with the plans and specifications shall show the name of the company taking the borings, the soil classification, the number of blows per foot of penetration, the groundwater elevation, and the date on which the borings were taken.

As part of the submission of plans and specification for approval, the owner's representative shall include written justification for the lesser frequency and depth of borings where their interval is more than approximately 300' or their depth is less than 50% below depth of pipe invert.

POLICY MEMORANDUM NO. PM-7 **BREAKDOWN OF BID ITEMS**

The following items shall, where applicable, be listed separately in the bid documents.

1. Mobilization

2. Pavement
   a. Municipal
      i. temporary
      ii. permanent
   b. State
      i. temporary
      ii. permanent

3. Concrete cradle or encasement (to be identified where applicable)

4. Rock-Excavation

5. Wood or steel sheeting left in place

6. Excavation of unsuitable materials below grade.

7. Select and/or borrow material

8. Dewatering

9. Special Dewatering (coffer dam)

Mobilization costs are the costs of initiating the contract, exclusive of the cost of materials. Payment for mobilization shall be a lump sum at the price bid for this item in the proposal and shall be payable when the contractor is operational on the site. For purposes of this policy, "operational" shall mean the substantial commencement of work on site.

The lump sum price bid for mobilization shall not exceed five per centum (5%) of the total amount of the bid.

POLICY MEMORANDUM NO. PM-8 **PAVEMENT**

All roads and trenches therein shall be refilled and repaved in accordance with specifications provided by the owner in the contract documents. Please note that this policy may be excludable on federally assisted projects where bid alternative items may be required (i.e. trench width vs. full width pavement). You are advised to seek project specific clarification.

Loan eligibility shall be limited to the following:

A. Where the depth of the pipe invert is 0 to 8', the maximum pavement widths which shall be eligible for financial assistance are as follows:

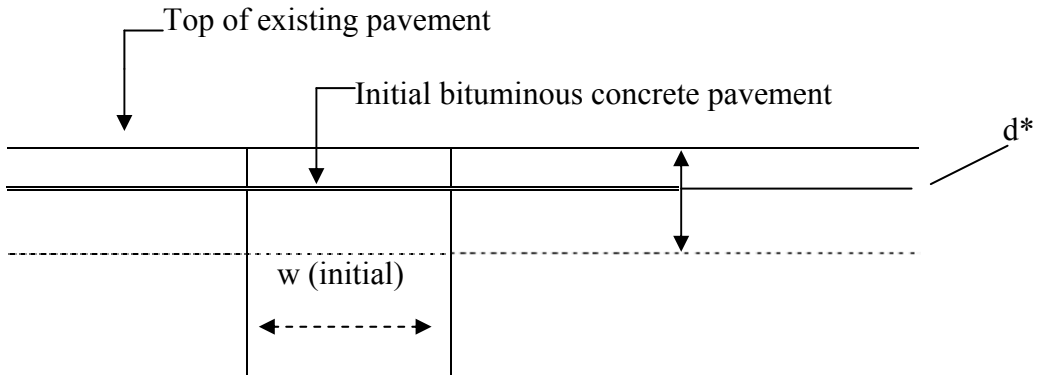
Nominal Pipe Diameter	Maximum Eligible Widths	
	Initial Pavement	Permanent Trench
0-24"	6'-6"	8'-6"

Where the nominal pipe diameter is greater than 24" the maximum eligible width for initial re-paving shall be the nominal diameter of the pipe plus four (4) feet, and for permanent trench re-paving the maximum eligible width shall be the nominal pipe diameter plus six (6) feet.

B. For each additional four (4) feet (or fraction thereof) of pipe invert depth, add three feet to the eligible width limits stated in paragraph A.

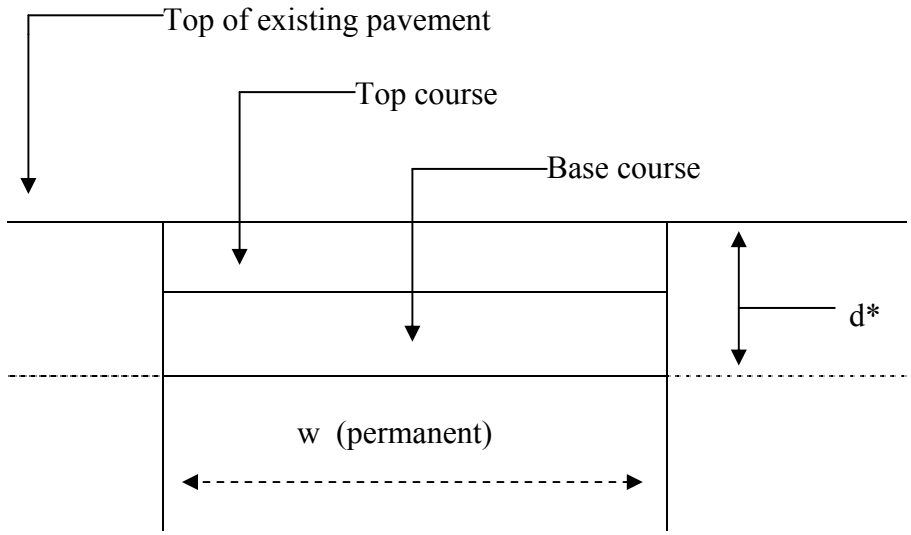
At the design phase of a project the owner has the option to elect either Initial Pavement with Option I (Permanent Trench replacement) or Initial with Option II (curb to curb over initial)

Initial Pavement



d*= depth of existing pavement to a maximum of 3 inches (see general notes #3)
w = maximum eligible Initial pavement width as described in paragraphs "A" & "B" on page DEP-DMS-CG's-P4.

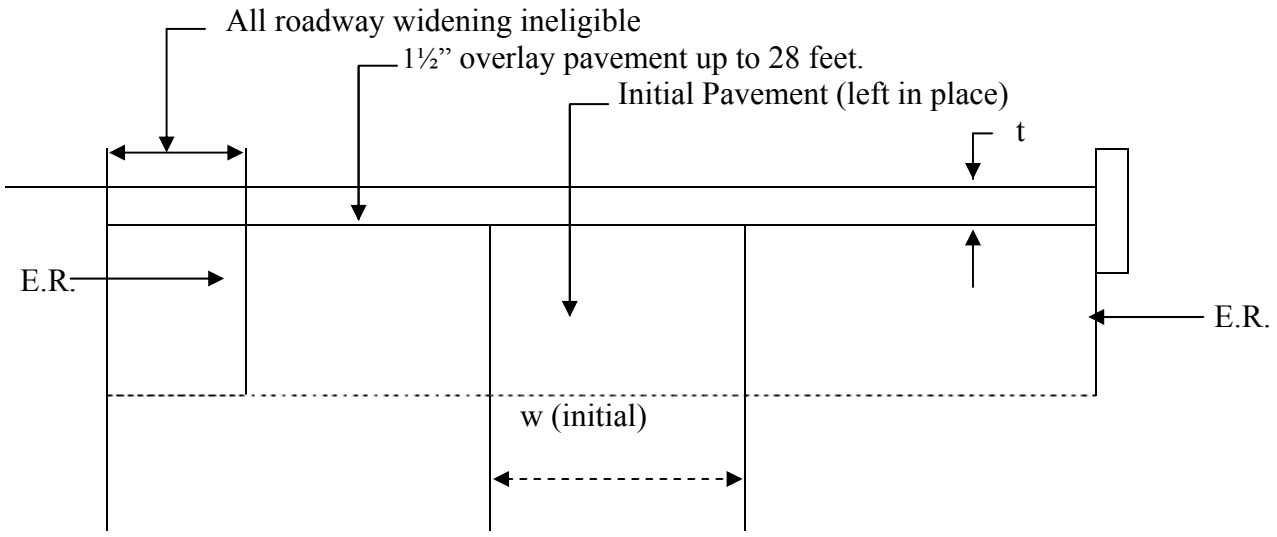
OPTION I Permanent Trench Pavement



d*= depth of existing pavement trench to a maximum of 3 inches (see general notes #3)
w = maximum eligible permanent pavement width as described in paragraphs "A" & "B". equals initial width plus 2 feet and includes:

- Cutting edges for the permanent trench
- Removal of initial patch plus two feet of existing pavement
- Fine grading/compacting gravel
- Placement of Permanent Trench pavement in two courses.

OPTION II Curb to Curb Pavement (overlay pavement for roadways up to 28 feet)



E.R.= edge of existing paved roadway
t = one and one half inch (1½") overlay of bituminous concrete pavement

GENERAL NOTES:

1. Repavement of settled areas and crown restoration within the trench limits shall be the responsibility of the contractor.
2. Leveling outside the trench limits shall be the responsibility of the owner.
3. Sewer trench re-fill and pavement re-paving on public ways under the jurisdiction of the Massachusetts Department of Public Works, the Metropolitan District Commission, or other such agency shall be in accordance with permit(s) issued therefore by that Department or Commission, as the case may be.
4. The Division will consider requests for increase in the participating pay limits defined in paragraphs A and B, when such increases are, in the Division's opinion, reasonable. Such requests should be documented in writing and submitted to the Division in a timely manner.
5. Projects which deviate from the above options are required to seek Division review and approval.

POLICY MEMORANDUM NO. PM-9 **PIPE TESTING**

Monthly payment estimates shall be prepared in accordance with contract documents. All pipe shall be tested in accordance with the contract documents and sound engineering practice. If, after 60 days following submission of a monthly payment estimate for pipe items, the pipe for which payment is requested has not been successfully tested, the owner may withhold up to 10% of the amount requested for such pipe items until the pipe has been so tested. However, in the case of a major (pipe diameter 24 inches or greater) interceptor pipe installation, sums retained by the owner pursuant to this policy memorandum shall not exceed two per centum (2%) of the costs of such pipe items.

POLICY MEMORANDUM NO. PM-10 **CHANGE ORDERS**

Executed change orders submitted to the Division for review and processing for financial assistance must be prepared on the attached Change Order Forms (PM-10, Attachment 1, pages A-1 & A-2) with a duplicate copy, calculation sheet(s) (PM-10, Attachment 2), and all other supporting documentation necessary for evaluation. Failure to comply with these instructions will result in delays in processing the change order and/or limited financial assistance.

M.G.L. c.44, s.31C requires that the auditor, accountant, or other municipal officer having similar duties must certify that adequate funding in an amount sufficient to cover the total cost of the change order has been made. Change orders will not be processed or approved until this certification is made on the face of the Change Order Form (PM-10 Attachment 1).

Payment of Change Orders:

Payment of all change orders shall be in accordance with the relevant provisions of Massachusetts General laws, Chapter 30, Section 39G for non-building construction and Section 39K for building construction.

Payment of change orders shall be made in accordance with one of the following three methods:

A. Existing unit prices as set forth in the contract; or
B. Agreed upon lump sum or unit prices; or
C. Time and materials

A. Payment for work for which there is a unit price in the contract:

Where the contract contains a unit price for work and the Engineer orders a change for work of the same kind as other work contained in the contract and is performed under similar physical conditions, the contractor may accept full and final payment at the contract unit price(s) for the acceptable quantities.

B. Payment for work or materials for which no price is contained in the contract:

If the Engineer directs, the contractor shall submit promptly in writing to the Engineer and offer to do the required work on a lump sum or unit price basis, as specified by the Engineer. The stated price, either lump sum or unit price, shall be divided so as to show that it is the sum of:

(1) The estimated cost of labor, plus
(2) Direct Labor Cost, plus
(3) Material and Freight Costs, plus
(4) Equipment Costs, plus
(5) An amount not to exceed 20% of the sum of items (1) through (4) for overhead and profit, plus (if applicable),
(6) In the case of work done by a subcontractor an amount not to exceed 7 ½ %, for the general contractor of the sum of items (1) through (4) for his overhead and profit, less, if applicable,
(7) Credits for work deleted from the contract.

C. Payment for work on a time and materials basis:

Unless an agreed lump sum and/or unit price is obtained from above and is so stated in the change price, the contractor shall accept as full payment for which no other agreement is contained in contract, and amount equal to:

(1) The estimated cost of Labor, plus
(2) Direct Labor Cost, plus
(3) Material and Freight Costs, plus
(4) Equipment Costs, plus
(5) An amount not to exceed 20% of the sum of items (1) through (4) for overhead and profit, plus (if applicable),
(6) In the case of work done by a subcontractor an amount not to exceed 7 ½ %, for the general contractor of the sum of items (1) through (4) for his overhead and profit, less, if applicable,
(7) Credits for work deleted from the contract.

Explanation of items (1) through (7) as outlined in "B" and "C":

(1) Labor – Only those workers employed on the project who are doing the extra work, including the foreman in charge, are allowable. General foremen, superintendents, or other supervisory personnel are considered to be included in the overhead markup as provided in items (5) and/or (6). Hourly labor rates in excess of those as listed in the contract wage rates (Federal or State, whichever applies) require documentation. As a minimum, an explanation and the appropriate copy of the certified payroll are required.

(2) Direct Labor Costs - These costs are limited to those which are required in the contract document. Coverage in excess of the contract provisions, secured by the contractor/subcontractor(s) at his option, are ineligible for financial assistance. The following list of typical direct labor charges is provided for your assistance and is in no way intended to be complete or all encompassing:

- Workman's Compensation
- Federal/State: Social Security Tax and Unemployment Tax;
- Health, Welfare and Pension Benefits; (this cost is included in the wage rates appearing in the Mass. Wage Rates of the contract specifications)
- Liability Insurance: Bodily Injury; Excess Umbrella; Property damage; Public Liability
- Blasters Insurance
- Builders Risk Insurance
- Experience Modification Insurance
- Surcharges

If applied to any required direct labor costs.

Following the Notice of Intent to Award, the Owner shall require the Low Bidder to submit the percentage to be used for the Direct Labor Cost markup, along with the breakdown of how it is calculated (this number shall be required and submitted to MassDEP before and Authorization to Award is issued by DMS). This documented direct labor cost may be adjusted upon the submission of new documentation which demonstrates both how and why it has changed.

(3) Material and Freight – Only those materials required as a result of the change order and reasonable freight charges for delivery of same are allowable.

(4) Equipment – Only the equipment required as a result of the change order is allowable. Equipment rental rates shall be governed by the current Nielson/Dataquest Rental Rate bluebook for Construction Equipment (the "Bluebook"). In determining the rental rate the following shall apply:

(a) For equipment already on the project – the monthly prorated rental rate by the hourly use shall be applicable;
(b) For equipment not on the project the daily rate, the weekly rate, or monthly rate will prevail, whichever will prove to be most cost effective. Small tools and manual equipment are examples of costs not allowable under this item. These costs are considered to be included in the overhead markup as provided in items (5) and/or (6) (1 month (normal use) = 176 hours)

(5) & (6) Overhead and Profit – All other costs not previously mentioned are considered to be included in this item, be it for the general contractor or subcontractor(s).

(7) Credits – Work deleted, material and equipment removed from the contractor, stored and/or returned shall be credited to the cost of the change order, less costs.

The Contractor shall furnish itemized statements of the cost of the work ordered and shall give the Engineer access to all accounts, bills and vouchers relating thereto; and unless the Contractor shall furnish such itemized statements, and access to all accounts, bills and vouchers, he shall not be entitled to payment for any items of extra work for which such information is sought by the Engineer. Deviations from any of the above will be reviewed for financial assistance on a case-by-case basis.

The change order will be prepared in such manner as to clearly separate Eligible and Ineligible Costs.

CHANGE ORDER FORM

SRF Number _____
Public Entity _____
Contract Number _____
Change Order Number _____

Contract Amount (As Bid) $ _____

Net Change in Contract Price (this change order) $ _____

Total Adjusted Contract Price (including this and all other change orders) $ _____

This change order extends the time to complete the work by _____ calendar days.

The extended completion date is _____

This change order checked by _____ _____
(Chief) Resident Engineer Date

This change order is requested by: _____

This change order is recommended by: _____

_____ _____ _____
Consultant Engineer P.E. Number Date

The undersigned agree to the terms of the change order.

_____ _____
Contractor Date

_____ _____
Owner Date

Certification of Appropriation under M.G.L. c.44, §31C: Adequate funding in an amount sufficient to cover the total cost of this change order is available.

By: _____ _____
Certification Officer (Auditor, accountant, treasurer) Date

Do not write below: this space reserved for STATE AGENCY APPROVAL

DEP/DMS

CHANGE ORDER FORM (Continued)

Public Entity _____

SRF No: _____ Contract No. _____ Change Order No. _____

Contract Title: _____

Owner's Name: _____

Owner's Address: _____

Contractor's Name: _____

Contractor's Address: _____

Description of Change

Reason for Change

CALCULATION SHEET

(1) Labor

Foreman	10 hrs @ $10.00/hr.	$ 100.00	
Engineer	10 hrs @ 8.50/hr	85.00	
Operator	10 hrs @ 9.50/hr	95.00	
Laborers	24 hrs @ 7.00/hr	168.00	
			$448.00

(2) Direct Labor Cost (use the agreed upon Direct Labor Cost)

*	(30)% of $448	
*	(Used for example purposes only)	134.00

(3) Materials & Freight

150 l.f. of 12" pipe @ $2.00/l.f.	$ 300.00	
15 v.f. precast SMH	1,700.00	
Freight (slip # _____ Enclosed)	25.00	
		2,025.00

(4) Equipment

1 Backhoe 10 hrs @ $80.00/hr	$ 800.00	
1 Truck-crane 10 hrs @ $100.00/hr	1,000.00	
		1,800.00
Total (Items 1 through 4)		4,407.00

(5) 20% markup for Overhead, Profit

20% of $4,407	881.00

(6) 7 ½% markup for general contractor (if subcontractor is involved)

7 ½% of $4,407	331.00

(7) Credits (deductibles)		- 323.00
Total Cost	$	5,296.00

Reminder: Provide support documentation as necessary i.e. vouchers, correspondence, Calculation, photographs, reports …….

EXAMPLE

POLICY MEMORANDUM NO. PM-11 **UTILITY RELOCATION**

The construction of treatment facilities, sewers, pumping stations, force mains and appurtenant work can cause the relocation of utilities. Costly relocation can sometimes be minimized by early communication and cooperation of the representatives of the municipality (owner) and the utilities.

Every possible effort should be made by the owner and each utility to establish the location of existing utilities in the vicinity of the proposed construction. The owner or its consulting engineer should make every reasonable effort to design the proposed construction so that relocation of existing utilities is minimized whenever possible. If the proposed construction is in an area of many existing utilities or in an otherwise critical area, the utilities are encouraged to mark the location of their existing utilities at the site during the design phase of the project.

During the design phase of the project, the municipality should provide timely notice to all utilities known or thought to have facilities in or proximate to the site of such future construction.

POLICY MEMORANDUM NO. PM-12 **REFUNDABLE DEPOSITS FOR PLANS AND SPECIFICATIONS**

For each set of project plans and specifications provided, the owner may require a deposit in form of cash or other appropriate security, in an amount sufficient to cover the costs of production of such plans and specifications.

Upon return of the plans and specifications to the owner within a reasonable time and in good condition, such deposit shall be refunded.

Actual mailing costs, if any, shall be borne by the party requesting such plans and specifications.

POLICY MEMORANDUM NO. PM-13 **BID OPENING PROCEDURES**

As a minimum, bid documents shall be reviewed/inspected for conformance to the following bid opening procedure in the order presented below. Failure to comply with any of these steps shall render the bid non-responsive and upon determination of such non-responsiveness, such bid shall be rejected immediately, set aside, and shall receive no further consideration.

Bid Opening Procedure

Step #1. Timeliness – The bid must be filed at the place and within the time specified therefore in the invitation to bid, and no bid shall be accepted after such time. The time at which a bid is filed should be time/date stamped or otherwise prominently noted on the bid;

Step #2. Bid Security – Properly executed bid security, in the amount and terms specified in the invitation to bid (equal to 5% of Base Bid or Highest Possible Amount considering all alternatives) shall be placed in a seal envelope and attached to the outside of the envelope containing the bid at the time of its submission;

A. Bid Bond

The Bid bond must be dated On or Before the Bid Date;
Issued by a Bonding Company Licensed in Massachusetts;
Accompanied by a Current Power of Attorney;
Signed by Surety;

B. Check

The Check must be a Certified, Cashiers or Bank Treasurer's;
Dated On or Before the Bid Date;

Step #3. Bid Signature – The bid and all accompanying documents so required shall be signed by the bidder or its authorized representative before submission;

Step #4. Addenda – All addenda shall be sent certified mail, return receipt requested, by the owner to all individuals and organizations which have received plans and specifications and shall be mailed not later than five days prior to the date established for submission of bids. All bidders shall include with their bids written acknowledgement of receipt of all addenda, which acknowledgement may be on a form provided therefore by the owner.

Alternates – Any Alternates shall be acknowledged.

Step #5. Written Dollar Amounts – The total dollar amount of each bid shall be read, and the three lowest bids shall be selected for further consideration. The remaining bids shall then be set aside. The three apparent low bids shall be read to determine whether the unit price for each line item of each bid has been written therein in words. If it has not, such bid shall be rejected and shall receive no further consideration. ***Bid amounts shall be consistent (words vs. numbers) and if words and numbers differ, the words govern.*** This procedure shall then be repeated with the next apparent low bid until three are acceptable which have all the unit prices written in words, at which time the lowest bid shall be announced as the apparent low bidder, and the bid opening procedure shall be closed.

The Division recommends that this policy memorandum be included in all contract specifications and that the owner's evaluator(s) use the attached form (PM-13 Attachment 1) for bid opening procedures.

The Contractor's Bid Opening Checklist also attached hereto, is for use by each contractor to assure that his bid conforms with this policy memorandum. It is recommended that the checklist (PM-13 Attachment 2) be included in information for bidders, or at the end of the bid proposal, or in some other prominent part of the bid specifications

PM-13 Attachment 1

FORM FOR BID OPENING PROCEDURES

(to be completed by the owner's evaluator(s))

CONTRACT NO.: _____ DATE: _____

CONTRACT NAME: _____ BID OPENING TIME: _____

All non-responsive bids shall be rejected forthwith by the awarding authority upon determination of such bids' non-responsiveness at the time bids are opened and read. Failure to comply with any one of the requirements shall render the bid non-responsive, and upon determination of such non-responsiveness such bid shall be rejected and receive no further consideration.

A = Acceptable N-R = Non-Responsive (explain reasons on supplemental sheet & attach)

BIDDER		1. TIMELINESS	2. BID SECURITY	3. SIGNATURE	4. ADDENDA ALTERNATIVES	5. WRITTEN DOLLAR AMOUNTS	COMPLIANCE (CIRCLE ONE)	
1							YES	NO
2							YES	NO
3							YES	NO
4							YES	NO
5							YES	NO
6							YES	NO
7							YES	NO
8							YES	NO
9							YES	NO
10							YES	NO
11							YES	NO
12							YES	NO

Evaluator(s) _____

_____

_____

BID OPENING PROCEDURES
CONTRACTORS CHECKLIST

CONTRACT NO.: _____ BIDDER: _____ DATE: _____

All non-responsive bids shall be rejected forthwith by the awarding authority upon determination of such bids' non-responsiveness at the time bids are opened and read. Failure to comply with one or more of the following requirements shall render the bid non-responsive, and upon determination of such non-responsiveness such bid shall be rejected and receive no further consideration.

ITEM	REQUIREMENTS	COMPLIANCE (CIRCLE 1)		REASONS FOR REJECTION
1. Timeliness	Bid filed w/in time specified	Yes	No; Rejected	
2. Bid Security	Appropriate and properly Executed security w/bid.	Yes	No; Rejected	
3. Signature	Bid signed by authorized Representative	Yes	No; Rejected	
4. Addenda	All addenda acknowledge Any alternative	Yes	No; Rejected	
5. Dollar Amount	Dollar amount in words Specified for each line item in bid	Yes	No; Rejected	

POLICY MEMORANDUM NO. PM-14 **PAYMENT FOR ROCK EXCAVATION**

There shall be in the contract documents a separate pay item for rock excavation. For such purposes, "rock" shall mean igneous, sedimentary, metamorphic, and conglomerate rock, which for excavation must be drilled, blasted, broken, or ripped by power tools. Boulders and concrete structures one cubic yard or greater, however removed, are included within this definition of rock for payment purposes. At the option of the owner or his representative a separate pay item for boulders, concrete structures, or concrete road base may be used.

Depth From Ground Surface To Invert Pipe	Pay Width (Nominal Pipe Diameter)	
	0-24"	Over 24"
* 0 – 12'	5'0"	D+3'0"
* Over 12' – 20'	7'0"	D+5'

Engineer's plans and specifications shall establish pay limits below pipe and structures.

- See PM-14 Attachment 1 (typical cross section)

Payment width for depths over twenty feet (20') shall be determined on a case-by-case basis consistent with the foregoing chart.

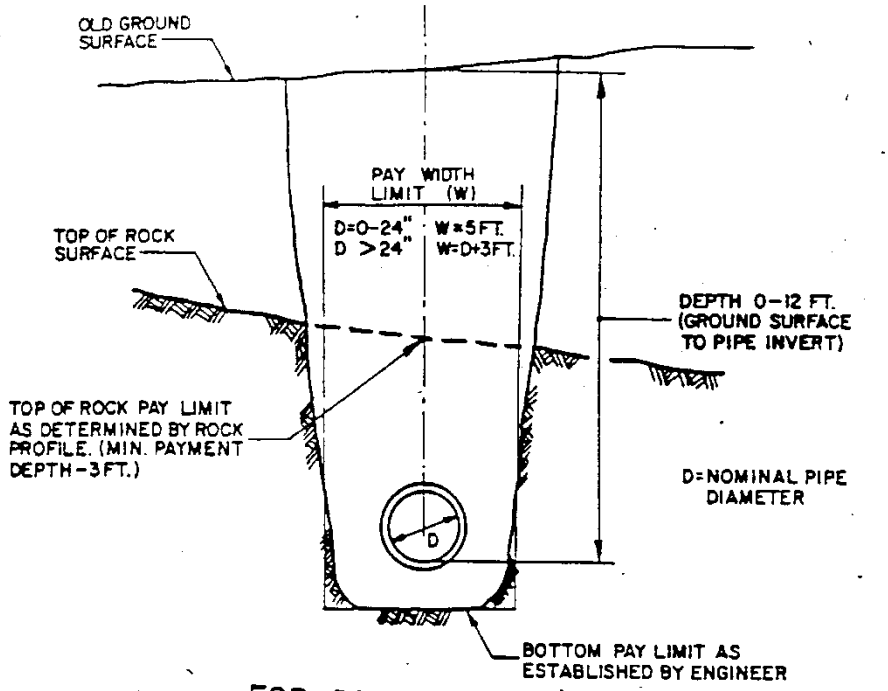
The pay limit for rock removal outside proposed manholes shall commence one foot (1') outside the widest dimension of the structure of shall be the maximum connecting trench width, whichever is greater.

Payment depth for rock which is encountered in a trench shall be no less than three feet (3') when removal can be accomplished only by drilling and blasting or by use of jack (air or hydraulic) hammers.

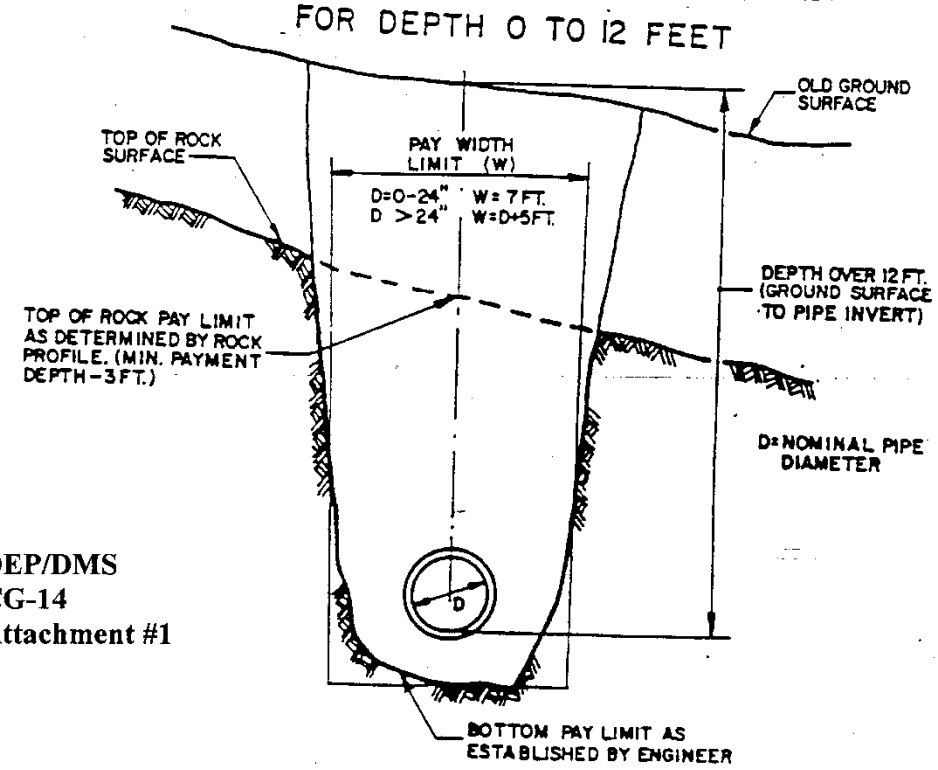
Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.

Boulders encountered within the pay limits of excavation, whose volume is one cubic yard or greater, part of which extends outside said limits shall be paid in accordance with the actual volume excavated.

CG-14 ROCK EXCAVATION



FOR DEPTH 0 TO 12 FEET



FOR DEPTH OVER 12 FEET AND UP TO 20 FEET

DEP/DMS
CG-14
Attachment #1

POLICY MEMORANDUM NO. PM-15 **TRAFFIC POLICE**

The reasonable costs for police details required for traffic control on a construction project which receives financial assistance shall be considered as an eligible administrative cost. A police detail item shall not be included as a bid item in the contract documents.

"Police" as used in this memorandum includes local, county, capital, state, regular and auxiliary police.

Owner's Responsibility

It shall be the owner's responsibility to submit in writing the hourly rate of pay to be established for detailed traffic police and each change in rate during the course of the project. It is the owner's responsibility to arrange, document and pay for such police details. The owner or its representative shall meet with the police chief or other officer in charge of police detail duty to review contract needs. The owner shall maintain a daily record of the following:

a. Officer's name
b. Hours worked
c. Location of assignment
d. Hourly rate

POLICY MEMORANDUM NO. PM-16 **DOCUMENTATION REQUIRED TO SUBSTANTIATE CONTRACT QUANITITES**

Unit	Documentation required
Acres (A)	Location, station, offset and calculations. Location = Street right-of-way, etc; Station = Point on Baseline; Offset = Distance left or right of Baseline
Cubic Yard (C.Y.)	Location, stations, widths, depths, calculations and Cross sections as necessary
Each (Ea.)	Location, station, and offset.
Gallon (Gal.)	Location, stations, calculations (if appropriate) and delivery slips.
Hour (Hr.)	Hours and location.
Linear Feet (L.F.)	Location, stations, and offsets.
Month (Mo.)	Location, period of time and calculations if applicable.

1000 Foot Board Measure (MFBM)	Location, stations, offset, elevations, grade, and calculations. Attach invoices where applicable.
Pound (Lb.)	Locations, stations, and calculations (if applicable). Attach Delivery weight slips.
Square Feet (S.F.)	Locations, stations and calculations
Square Yard (S.Y.)	Locations, stations and calculations
Ton	Locations, stations and calculations (if applicable). Attach Delivery weight slips.
Vertical Feet (V.F.)	Locations, stations, elevations, and offsets.

Note:

1. All of the above, that apply must be submitted with a final payment request or change order as applicable.
2. Where in place measurement is not possible or practical, delivery slips may be used to substantiate quantities.
3. Change orders – See PM-10 in which some of the above may be applicable in justifying materials, equipment and labor.
4. When necessary, itemized quantities must be separated into eligible and non-eligible units with separate calculations to justify eligible costs.
5. Overruns and underruns of any specific item shall be explained with an appropriate sentence or paragraph.
6. On all quantities, units of payment shall be maintained at the project site and shall be updated daily so that upon field inspection by the C.O.E., EPA or DMS, the quantities paid to date can be substantiated.
7. In the case of unforeseen conditions, photos should be submitted with the applicable item in addition to the recommended documentation.
8. Documentation of units of payment shall be clearly legible and cross referenced to the applicable sheets of the record drawings.
9. For record drawings policy, please see PM-4.

DMS Policies 1 through 16 Approved By:

Steven J. McCurdy
Division of Municipal Services

DWS POLICY 88-02
DEPARTMENT OF ENVIRONMENTAL PROTECTION
POLICY FOR REVIEW OF SEWER LINE/WATER SUPPLY PROTECTION

The Department of Environmental Protection seeks to protect existing and potential water supplies from the potentially negative effects of leaking sewer lines through the adoption of a Department policy on this subject.

The following restrictions will apply to new sewer construction statewide:

Gravel Packed Wells

~ Within the 400 foot radius protective distance around gravel packed wells, all sewer lines and appurtenances are prohibited, unless they are necessary to eliminate existing and/or potential sources of pollution to the well.

Tubular Wells

~ Within the 250 foot radius protective distance around tubular wells, all sewer lines and appurtenances are prohibited, unless they are necessary to eliminate existing and/or potential sources of pollution to the well.

Gravel Packed and Tubular Wells

~ Within a minimum radius of 2,640 feet or unless otherwise documented by an appropriate study specifically defining the area of influence and approved by the Division of Water Supply, all sewer lines and appurtenances will be designed and constructed for maximum water tightness.

○ Force Mains or Pressure Sewers: shall be tested at 150% above maximum operating pressure or 150 p.s.i. whichever is greater. Testing shall conform to the requirements of the American Water works Association (AWWA) standard c 600.

○ Gravity Sewers: shall be tested by approved methods which will achieve test results for infiltration or exfiltration of less than 100 gallons/inch diameter/mile/24 hours.

○ Manholes: shall be installed with watertight covers with locking or bolted and gasketed assembles. Testing for infiltration/exfiltration shall conform to the same standards as the maximum allowed for pipes in the manhole as required for gravity sewers, indicated above.

○ Satisfactory test results for Force Mains, Manholes and Gravity Sewers shall be performed prior to the expiration of the contractor's one year guarantee period.

○ All pumping stations within this zone shall have standby power high water alarms telemetered to an appropriated location that is manned at all times. An emergency contingency plan must be developed by the owner and approved by the BWR.

○ A minimum of Class B bedding as defined by WPCF-MOP9 must be used for all piping.

○ Service connections (laterals and house connections) shall be rigidly inspected by the appropriate municipal official. Certified inspection reports shall be submitted to the BWR.

Bedrock Wells

The above requirements are the same for bedrock wells, with the Department reserving the right to require more stringent controls on a case-by-case basis.

Surface Water Supplies

~ Within 100 feet of all surface water supplies and tributaries all sewer lines and appurtenances are prohibited except as required to cross tributaries or to eliminate existing or potential pollution to the water supply. In the latter case, watertight construction methods shall be use.

~ Tributary stream crossings shall employ watertight construction methods of sewer lines and manholes. Watertight construction must extend 100 feet to either side of the stream.

~ Within 1,000 feet of surface water supplies and tributaries, all pumping stations shall have standby power and high water alarms telemetered to an appropriate location that is manned at all times. An emergency contingency plan must be developed by the owner of the wastewater treatment facility and submitted to the BWR for approval.

~ Beyond 1,000 feet and within the watershed of surface water supplies the Department may in specific circumstances after review, require additional controls.

Potential Public Water Supplies

The above requirements also apply to potential public water supplies.

Baseline Date Requirements

Two (2) copies of an appropriately scaled map(s) shall be submitted to the Department which details the proposed sewers and/or appurtenances and also includes the following:

(1) the location of all nearby existing or potential surface water supplies, tributaries thereto, and watershed boundaries;

(2) the location of existing and potential public and municipal potable groundwater supply wells.

The Department reserves the right to impose more restrictive measures than those contained in this policy as deemed appropriate.

Definitions

- Appurtenances – all attachments to sewer lines necessary for the transport and operation and maintenance of sewer lines, including manholes, pumping station, siphons, etc.

- Area of influence – that area of an aquifer which contributes water to a well under the most severe recharge and pumping condition that can be realistically anticipated (i.e. pumping at the safe yield of the well for 180 days without any natural recharge occurring). It is bounded by the groundwater divides which result from pumping the well and by the contact of the edge of the aquifer with less permeable materials such as till and bedrock. At some locations, streams and lakes may form recharge boundaries.

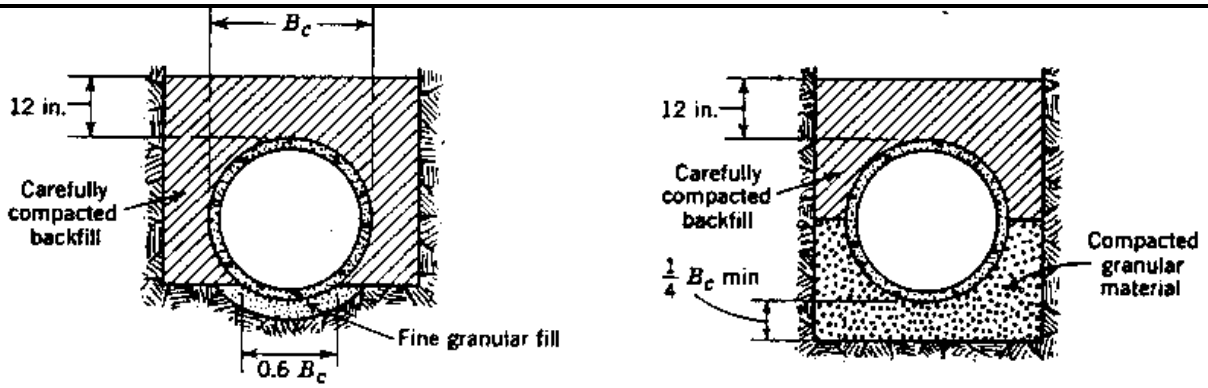
- Potential public water supply – areas designated by communities for water supply purposes where land has been set aside and Department approved pump tests conducted and surface water supplies as defined below.

- Surface Water Supply – Waters classified as Class A by the DWPC.

- Public Water Supply Systems – as defined in 310 CMR 22.02 (DEP Drinking Water Regulations).

- Class B Bedding – as defined in WPCF Manual of Practice No. 9.

APPROVED: (Signature on File)



Shaped bottom with tamped backfill, load factor 1.9

Compacted granular bedding, load factor 1.9

Class B---First-Class Bedding – Class B bedding may be achieved by either of two construction methods:

a. Shaped Bottom with Tamped Backfill. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with a radius at least 2 in. (5 cm) greater than the radius to the outside of the pipe and with a width sufficient to allow six-tenths of the width of the pipe barrel to be bedded in fine granular fill placed in the shaped excavation. Carefully compacted backfill shall be placed at the sides of the pipe to a thickness of at least 12 in. (30 cm) above the top of the pipe. Shaped trench bottoms are difficult to achieve under current construction conditions.

b. Compacted Granular Bedding with Tamped Backfill. The pipe shall be bedded in compacted granular material placed on a flat trench bottom. The granular bedding shall have a minimum thickness of one-fourth the outside pipe diameter and shall extend halfway up the pipe barrel at the sides. The remainder of the side fills and a minimum depth of 12 in. (30 cm) over the top of the pipe shall be filled with carefully compacted material.

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Work under Owner’s separate contracts.
6. Future work not part of this Project.
7. Contractor’s use of site and premises.
8. Coordination with occupants.
9. Work restrictions.
10. Specification and Drawing conventions.
11. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 “Execution” for coordination of Owner-installed products.

1.3 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: Wastewater Collection and Water Resource Recovery Facilities; Phase 1 – Contract No. 6.

1. Project Location: Town of Yarmouth, MA.

B. Owner: Town of Yarmouth, MA.

1. Owner's Representative: Jeffrey Colby, P.E., DPW Director.

C. Engineer: CDM Smith, 3 Davol Square, Building A, Suite A425, Providence, RI 02903.

1. Engineer's Representative: Jesse Herman (hermanjd@cdmsmith.com).

D. Owner’s Project Manager: Wright-Pierce.

1. Owner’s Project Manager Representative: Louis Ragozzino (louis.ragozzino@wright-pierce.com).
2. Owner’s Project Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Contractor, according to a separate contract between Owner and Owner’s Project Manager.

E. Project Coordinator for Multiple Contracts: Owner shall serve as Project coordinator.

1.5 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work included in the Base Bid of the Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. All work required to furnish and install 10,000 linear feet of 8-inch to 24-inch polyvinyl chloride (PVC) gravity sewer pipe; 3,000 linear feet of 8-inch and 12-inch PVC force main pipe; two submersible wastewater pumping stations (PS1 and PS2); manholes; sewer service connections and appurtenances; approximately 7,200 linear feet of 6-inch to 16-inch Class 52 ductile iron (DI) water main, including water service connections, fitting, valves, hydrants, connection to the existing water system, cutting, capping and abandoning existing water mains; earthwork; dewater and drainage; paving; restoration; all miscellaneous work and cleanup as specified; and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract; however, several separate contracts will be constructed adjacent to this contract, Contract No. 6. See “1.7 Work Under Owner’s Separate Contracts”.

1.6 WORK PERFORMED BY OWNER

A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

1.7 WORK UNDER OWNER’S SEPARATE CONTRACTS

A. Work with Separate Contractors: Cooperate fully with Owner’s separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner’s separate contracts, especially with regard to schedule, and traffic control/detour routes.

B. Concurrent Work: Owner has/will award separate contracts for the following construction operations at adjacent Project sites. Those operations will be conducted simultaneously with Work under this Contract.

1. Phase 1 – Contract No. 1: Water Resource Recovery Facility (WRRF): To construct the Owner's WRRF at 99 Buck Island Road.
2. Phase 1 – Contract No. 2: To construct approximately 22,800 linear feet of 8- to 30-inch polyvinyl chloride (PVC) gravity and ductile iron (DI) sewer pipe; 8,400 linear feet of 14-inch high-density polyethylene (HDPE) force main pipe; one submersible wastewater pumping station (PS4); manholes; sewer service connections and appurtenances; approximately 10,000 linear feet of 6-in to 12-in Class 52 DI water main, including water service connections, fittings, valves, hydrants; and initial paving. The limit of work under Contract No. 2 extends along Route 28 and Old Main Street between Long Pond Drive and a few hundred feet from the intersection of Route 28 and North Main Street (start of Contract No. 4). Contract No. 2 will be occurring at the same time as Contract No. 6.
3. Phase 1 – Contract No. 3: To construct approximately 16,100 linear feet of 8-inch to 18-inch diameter gravity sewer main, 4,600 linear feet of 6-inch HDPE force main, and one wastewater pumping station (PS5) including access manholes, sewer service connections, approximately 6,500 linear feet of 6-inch to 12-inch water main including water service connections, fitting, valves, hydrants, and initial paving. The limit of work for Contract No. 3 extends along Route 28 from Parkers River to the intersection of Route 28 and Willow Street. Contract No. 3 also includes work along South Shore Drive and Seaview Avenue. Contract No. 3 will be occurring at the same time as Contract No. 6.
4. Phase 1 – Contract No. 4: To construct approximately 2,600 linear feet of 8-inch to 30-inch diameter gravity sewer main, including access manholes, sewer service connections, and initial paving. The work under Contract No. 4 is located along Route 28 from the limit of Contract No. 2 to approximately the Bass River, Old Main Street from the limit of Contract No. 2 to the Route 28 intersection, and a portion of North Main Street and Station Avenue. Work on Contract No. 4 has been completed.
5. Phase 1 – Contract No 5: To construct gravity sewer main along Route 28, between Higgins Crowell Road and Parkers River, and to construct one submersible wastewater pumping station (PS3). Contract No. 5 will be occurring at the same time as, and directly adjacent to, Contract No. 6.

C. Future Work Not Part of this Contract: The Contract Documents include requirements that will allow Owner to carry out future work following completion of this Project; provide for the following future work:

1. Future phases of the Owner's wastewater program will expand the sewer collection system upstream of the portion of the system installed under this Contract.

1.8 CONTRACTOR'S USE OF SITE AND PREMISES

A. General: Contractor shall have use of Project site for construction operations during construction period as approved by Owner. Contractor's use of Project site is limited by Owner's right to perform work, retain other contractors on portions of Project and retain normal operations at site.

B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

C. Limits on Use of Site: Limit use of Project site to Work in areas indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways and Entrances: Keep driveways parking lots, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, users of the site, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.9 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to between 7:00 a.m. to 4:00 p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.

1. Weekend Hours: Not permitted, unless approved by Owner and authorities having jurisdiction.
2. Early Morning Hours: Not permitted, unless approved by Owner and authorities having jurisdiction.
3. Hours for Utility Shutdowns: Not permitted, unless approved by Owner and authorities having jurisdiction.
4. Should Contractor’s working hours extend outside normal working hours (7:00 a.m. to 4:00 p.m.), any and all costs for weekend, Holiday, and/or on-site overtime services for Owner personnel incurred by the Owner will be the sole obligation of the Contractor. When Owner personnel are required by the Contractor’s operations to work between 6:00 a.m. and 7:00 a.m. or between 4:00 p.m. and 5:00 p.m. on normal working days, the Contractor shall pay a minimum of 1 hour of Owner personnel’s time. When Owner personnel are required by the Contractor’s operations to work between 5:00 p.m. and 6:00 a.m. on normal working days, the Contractor shall pay a minimum of 3 hours of Owner’s personnel’s time.

C. Work of any kind will not be allowed along Route 28 between Memorial Day and Labor Day. MassDOT may further restrict work during the winter period.

D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.
3. Provide written notification of any planned water shutdowns to all impacted properties no less than 48 hours prior to the shutdown.

E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

F. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.10 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

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SECTION 012001 - PRICE AND PAYMENT

PART 1 - GENERAL

1.1 SEWER PIPE AND APPURTENANCES (Items 1a thru 1l, 29a thru 29j and 54a thru 54k)

A. Measurement

1. Gravity sewer, pressure sewer and force main pipe of the type, size, and depth specified on the Bid Form (Items 1a thru 1h, 29a thru 29f, 54a thru 54g, and 54l) will be measured in place on a linear foot basis. Measurement for payment does not signify that the pipe is accepted.
2. Measurement of pipe for length will be along the horizontal centerline of the pipe with no deduction for fittings and will be to the center of manholes. Measurement for depth will be from the original ground surface, as determined by the Engineer, to the invert of the pipe. Measurement will be to the nearest tenth of a foot.
3. 6-in PVC and DI service connections (Items 1i, 29g and 54h) will be measured along the horizontal centerline of the pipe from either the face of the wye branch or tee, or from the centerline of the chimney to the end of the pipe as laid.
4. Wye branch and tee connections (Items 1j, 29h and 54i) will be measured as the number actually installed and accepted in the locations designated by the Engineer.
5. Internal drop manhole connections (Items 1k, 29i and 54j) will be measured in vertical feet from the upper invert of the drop to the lower invert of the drop, as shown on the Drawings, but will not be less than 3 feet for each drop connection.
6. Chimneys (Items 1l, 29j and 54k) will be measured in vertical feet from the centerline of the sewer to the centerline of the service bell, as shown on the Drawings, but will not be less than 3 feet for each chimney.
7. 1.5-in pressure sewer service connections (Item 54m) will be measured along the horizontal centerline of the pipe from the face of the tee to the end of the pipe as laid.
8. Pressure sewer cleanout/flushing connections (Item 54n) will be measured as the number actually installed and accepted in the locations as shown on the Drawings and as designated by the Engineer.
9. 2-in pressure sewer ball valves (Item 54o) will be measured as the number actually installed and accepted in the locations as shown on the Drawings and as designated by the Engineer.

B. Payment

1. Payment for furnishing and installing sewer and force main pipe will be made for the respective quantities as determined above at the unit price bid under Items 1a thru 1h, 29a thru 29f, 54a thru 54g, and 54l in the Bid Form. This price and payment shall be full compensation for saw cutting and removing existing pavement, temporary trench support, including driving and removing sheeting and bracing; trench excavation (except rock and boulder excavation); removal, handling and disposal of excess excavated material; backfilling and compaction, installation of geotechnical instrumentation and performing all required monitoring, loaming and seeding or sodding, installing impervious dams, filter fabric, restoring the trench surface to grade, all restoration required within the trench limits, protection or temporary removal and replacement of existing utilities,

furnishing screened gravel bedding for pipe (and select common fill for DI pipe), furnishing, laying, jointing, cleaning, and testing the pipe, restrained joints, mechanical joints where required, fittings; Protecto 401 lining for DI pipe; and all incidental work, environmental protection, and all else incidental thereto, for which separate payment is not provided under other items in the Bid Form.

2. Payment will be made for pipe only when it is installed in the ground, and no so-called proportional payment shall be made for pipe on the site but not yet installed.
3. Payment for furnishing and installing 6-in service connections will be made for the quantity as determined above at the unit price bid for Items 1i, 29g and 54h in the Bid Form. This price and payment shall be full compensation for saw cutting and removing the existing pavement or concrete sidewalk, furnishing and installing the service connection pipe together with all fittings required, jointing, bedding, testing, excavation (except rock and boulder excavation), driving and removing sheeting and bracing, temporary trench support, removal, handling and disposal of excess excavated material; backfilling, compaction, temporarily plugging open ends, or providing a permanent plug on future service connections, bracing the plug, restoring trench surface to grade, loaming and seeding, furnishing and installing a wood marker at the end of pipe, replacement of any curbing removed or disturbed within trench limits, replacing concrete sidewalk where required, all restoration required within trench limits, protection or temporary removal and replacement of existing utilities, furnishing screened gravel bedding for pipe (and select common fill for DI pipe), Protecto 401 lining for DI pipe, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form. Payment for Items 1i, 29g and 54h shall include service connections installed for vacant lots, when directed by the Engineer.
4. Payment for furnishing and installing wye branches on PVC sewers and tees on DI sewers will be made for the quantity as determined above at the unit price bid for each under Items 1j, 29h and 54i in the Bid Form, which price and payment shall be full compensation for the additional cost over and above that of sewer pipe for furnishing and installing the fittings, PVC/DI adaptors, plugs or caps, cutting the sewer pipe, if necessary, screened gravel bedding and all else incidental thereto, for which separate payment is not provided under other items in the Bid Form. Payment under Items 1j, 29h and 54i shall include wye branches or tees installed for vacant lots, when directed by the Engineer.
5. Payment for furnishing and installing internal drop manhole connections will be made for the quantity in vertical feet as determined above at the unit price bid for Items 1k, 29i and 54j in the Bid Form. This price and payment shall be full compensation for furnishing and installing the PVC drop pipe, tees, bowls, all necessary fittings and braces, cutting into manhole wall and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
6. Payment for furnishing and installing chimneys will be made for the quantity in vertical feet as determined above at the unit price bid for Items 1l, 29j and 54k in the Bid Form. This price and payment shall be full compensation for furnishing and installing the pipe, fittings, sonotube and stone, end stopper, PVC/DI adapters and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
7. Payment for furnishing and installing 1.5-in pressure sewer service connections will be made for the quantity as determined above at the unit price bid for Item 54m in the Bid Form. This price and payment shall be full compensation for saw cutting and removing the existing pavement or concrete sidewalk, furnishing and installing the service connection pipe together with check valve, ball valve, curb stop box, and all fittings required, jointing, bedding, testing, excavation (except rock and boulder excavation), driving and removing sheeting and bracing, temporary trench support, removing,

handling and disposing of excess excavated material, backfilling, compaction, temporarily plugging open ends, or providing a permanent plug on future service connections, bracing the plug, restoring trench surface to grade, loaming and seeding, furnishing and installing a wood marker at the end of pipe, replacement of any curbing removed or disturbed within trench limits, replacing concrete sidewalk where required, all restoration required within trench limits, protection or temporary removal and replacement of existing utilities, furnishing screened gravel bedding for pipe, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form. Payment for Item 54m shall include service connections installed for vacant lots, when directed by the Engineer.

8. Payment for furnishing and installing pressure sewer cleanout/flushing structures will be made for the quantity as determined above at the unit price bid for Item 54n in the Bid Form. The price and payment shall be full compensation for connection to the low pressure sewer, valves, fittings, wye branches, clean-out assemblies, valve boxes, structures, excavation (excluding rock and boulder); furnishing, installing and removing sheeting and bracing; temporary excavation support; backfilling and compaction; screened gravel subbase; and all else incidental thereto, for which separate payment is not provided under other items in the Bid Form.
9. Payment for furnishing and installing 2-in pressure sewer ball valves will be made for the quantity as determined above at the unit price bid for Item 54o in the Bid Form. Price and payment shall be full compensation for installing the valves at the locations directed by the Engineer, including cutting valves into the new low pressure sewer, placing screened gravel where required, setting, jointing, providing screened gravel drainage pocket, testing, and all work required for or incidental to the satisfactory completion of the items for which separate payment is not provided under other items in the Bid Form.
10. As specified in Supplementary Conditions Paragraph 15.01. a percentage of the payment due for furnishing and installing pipeline may be retained on the partial payment requests until the pipeline is tested as specified herein.

1.2 PRECAST CONCRETE SEWER MANHOLES AND STRUCTURES (Items 2a thru 2d, 30a and 30b, and 55a and 55b)

A. Measurement

1. Measurement for payment of precast concrete sewer manholes and appurtenances (Items 2a and 2b, 30a and 30b, and 55a and 55b) will be measured in vertical feet from the invert of the lowest pipe in the manhole to the top of the manhole frame.
2. Automatic air release valve manholes (Item 2c) will be measured as the number actually installed and accepted in the locations shown on the Drawings or as designated by the Engineer.
3. Force main cleanout manholes (Item 2d) will be measured as the number of each actually furnished and installed in the completed project.

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B. Payment

1. Payment for furnishing and installing concrete sewer manholes will be made for the quantity as above determined at the unit price bid for Items 2a and 2b, 30a and 30b, and 55a and 55b in the Bid Form. This price and payment shall be full compensation for saw cutting existing pavement, all excavation (excluding rock and boulder); furnishing, installing and removing sheeting and bracing; temporary excavation support; removal, handling and disposal of excess excavated material; backfilling and compaction; furnishing and installing precast concrete manhole bases and sections; furnishing and installing cast in-place bases where shown on the Drawings or as directed by the Engineer; pipe connections; manhole rungs; frames and covers, including watertight covers where called for on the Drawings; one time sewer manhole tag fee for "SEWER" cover; intermediate landings where shown on the Drawings or where required; furnishing and installing cushions/gaskets for manhole covers; epoxy lining where indicated on the Drawings; screened gravel subbase; all forms, reinforcing, concrete and masonry materials; bricks, concrete grade rings, brick channels and shelves; flexible pipe repair couplings; and all else incidental thereto, for which separate payment is not provided under other items in the Bid Form.
2. Payment for the automatic air release/vacuum valve manholes at the locations shown on the Drawings will be made for the quantity as determined above at the unit price bid for each under Item 2c in the Bid Form, which price and payment shall be full compensation for furnishing all labor, equipment and materials required to install the valve manholes along the force mains complete in place as shown on the Drawings and specified herein. Payment shall include furnishing and installing the air release/vacuum valve and all required piping, fittings and appurtenances, 12-in DI force main piping and fittings, 12-in PVC mechanical joint adapters and stainless steel stiffeners, precast concrete manhole including saw cutting existing pavement, all excavation (except rock and boulder), temporary excavation support, removal, handling and disposal of excess excavated material, backfilling, precast sections and bases, pipe connections, manhole rungs, frames and covers, screened gravel subbase, all forms, reinforcing, concrete and masonry materials, extra costs associated with installing the force main through the precast concrete manhole, 2-in PVC vent pipe, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
3. Payment for furnishing and installing force main cleanout manholes will be made for the quantity as above determined at the unit price bid for Item 2d in the Bid Form, respectively, which price and payment shall be full compensation for installing the cleanouts complete in place as shown on the Drawings, including all piping including 12-in DI force main piping and fittings, 12-in PVC mechanical joint adapters and stainless steel stiffeners, precast concrete manholes including saw cutting existing pavement, all excavation (except rock and boulder), temporary excavation support, removal, handling and disposal of excess excavated material, backfilling, precast sections and bases, manhole rungs, frame and covers, screened gravel subbase, all forms, reinforcing, concrete and masonry materials, extra costs associated with installing the force main through the precast concrete manhole, tees, blind flanges, solid sleeves, flexible couplings, plug valve, quick connect fitting and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

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1.3 DRAIN PIPE AND APPURTENANCES (Items 3a, 31a and 56a)

A. Measurement

1. Drain pipe replacements (Item 3a, 31a and 56a) will be measured in linear feet between the cut ends of the existing pipe where ordered by the Engineer. Replacements may be ordered by the Engineer to address conflicts with new sewers and/or laterals. The pipe size ranges from 8-in to 12-in and will be replaced with approved similar/like materials, PVC drain pipe, or as directed by the Engineer. Approved couplings/adaptors shall be used to connect new pipe to existing pipe. Concrete/brick collars will not be permitted. No compensation will be made for replacement of lines damaged or broken by the Contractor's operations.

B. Payment

1. Payment for the drain pipe replacements, when ordered by the Engineer, will be made for the quantity as determined above at the unit price bid for Items 3a, 31a and 56a in the Bid Form, which price and payment shall be full compensation for saw cutting existing pavement, excavation, temporary trench support, cutting the existing drain pipe, replacing the pipe with similar/like materials or PVC drain pipe and appropriate couplings or adaptors to the existing drain, backfilling and compaction, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

1.4 WATER MAINS AND APPURTENANCES FOR MISCELLANEOUS WATER MAIN REPLACEMENTS (Items 3b thru 3d, 31b and 31c, and 56b and 56c)

A. Measurement

1. Miscellaneous water main replacements (Items 3b and 3c, 31b and 31c, and 56b and 56c) will be measured in linear feet between the cut ends of the existing pipe where ordered by the Engineer. Replacements may be ordered by the Engineer to address conflicts with new sewers and/or service laterals or where the existing main is within the sewer trench paving limits, or as directed by the Engineer. No compensation will be made for replacement of lines damaged or broken by the Contractor's operations.
2. Temporary service pipe actually furnished, installed and removed by the Contractor of the size specified in the Bid Form (Items 3d) in the areas of miscellaneous water main replacements will be measured along the centerline of the pipe, including fittings, hydrants and valves. Tap holes and smaller pipes which are provided for temporary service connections, house connections, or other purposes will not be measured for payment. Pipe not ordered installed by the Engineer, but employed by the Contractor solely for his own convenience and use, will not be measured for payment.

B. Payment

1. Payment for water main replacements, when ordered by the Engineer, will be made for the quantity as determined above at the established unit price for Items 3b, 31b, and 56b in the Bid Form, which price and payment shall be full compensation for saw cutting the existing pavement, excavation (except rock and boulder), isolating the existing water

main, cutting the main (if not AC pipe), removal and disposal of the existing main (if not AC water main) and excess excavated material, replacing the main with solid sleeved DI couplings at each end, a bell and spigot joint at the trench centerline, including restrained joints as required, cleaning, testing, chlorinating and sampling the line and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

2. Payment for miscellaneous water main replacements will also be made for the quantities as determined above at the unit price bid for Items 3c, 31c and 56c in the Bid Form. This price and payment shall be full compensation for any additional costs associated with miscellaneous water main replacements, as described above, over and above the unit price established for Items 3b, 31b and 56b in the Bid Form.
3. Payment for furnishing, installing, maintaining and removing temporary service pipe, service connections, and fire services of the size required will be made for the quantity as determined above, at the applicable price per linear foot and per each bid in the Bid Form under Item 3d. Price and payment shall be full compensation for furnishing all labor, equipment and materials for developing and submitting a plan for the proposed layout and sizing of the temporary service pipe and connections to the existing distribution system; installing the pipe, for all excavation including saw cutting and removing existing pavements, backfilling, protecting the temporary pipe, initial and permanent trench width paving where the temporary pipe and services cross the street or driveways, furnishing and installing tap holes and connecting temporary service pipes to existing hydrants or providing temporary hydrants and other facilities required in connection with the temporary service piping, chlorinating temporary pipe, installing and removing temporary water service to all residences, fire protection, restoring lawns, restoring sidewalks and other surfaces in private or public property disturbed by the Contractor's operations, all as specified.
4. Temporary services and bypass piping shall be as specified in Section 015000 “Temporary Facilities and Controls” and price and payment made under Item 3d shall include all labor, materials, equipment and incidentals to meet all requirements as specified in Section 015000 “Temporary Facilities and Controls” and other sections.
5. The Contractor is required to submit a daily log as specified in Section 015000 “Temporary Facilities and Controls” of all building addresses where temporary service connections have been installed and removed. No payment will be made under Item 3d until the Contractor has submitted to the Engineer all required and acceptable temporary service connection installation and removal logs as specified in Section 015000 “Temporary Facilities and Controls.” This requirement is so that the Owner can have a record of when existing service connections are on temporary bypass pipe and not metered.
6. The Contractor shall notify the Owner and local Fire Department of all existing hydrants taken out of service. All out-of-service hydrants shall be covered with bags that are clearly labeled “Out of Service” or “Not in Service”. No payment will be made under Items 3d until the Contractor makes all proper notifications as described above to notify the Owner and local Fire Department as to which hydrants have been taken out of service. No payment will be made under this Item until the Contractor confirms with the local Fire Department that the temporary hydrants are compatible with equipment used by the Fire Department.

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1.5 SUBMERSIBLE PUMPING STATIONS PS1 AND PS2 (Items 4a and 4b, and 57a and 57b)

A. Measurement

1. Measurement for payment for furnishing and installing the PS2 submersible pumping station (Item 4a) and PS1 submersible pumping station (Item 57a) shall be on a lump sum basis.

B. Payment

1. Payment for the PS2 and PS1 submersible pumping stations will be made at the lump sum price bid under Items 4a and 57a, respectively, in the Bid Form, which price and payment shall be full compensation for furnishing all labor, equipment and materials required to construct the completely equipped submersible pumping station as shown on the Drawings and specified herein. Payment shall include site preparation, clearing and grubbing, installation of geotechnical instrumentation and performing all required monitoring, excavation (except rock and boulder), sheeting and bracing, filter fabric on the excavation subgrade, removal, backfilling, furnishing, placing, compacting and grading backfill material to the final elevations shown on the Drawings and as directed by the Engineer, furnishing and installing the precast concrete wet well, valve vault structure, meter vault structure including meter, fittings and appurtenances, reinforced concrete foundation/pad including steel reinforcing, precast concrete electrical superstructure/building, all electrical work, plumbing, instrumentation, HVAC, framing, siding, roofing, doors and louvers, painting, gas and water service connections, underground electrical conduit, emergency generator and all other appurtenances as specified, motors, pumps, pump frames, including additional spare pumps as specified, braces and lifting mechanisms including hoists, all related piping, valves, air release/vacuum valves including all appurtenances, fittings, vents, conduits, wiring, float switches, pump controls, control panel, alarm system, miscellaneous concrete, furnishing and installing hydrants, furnishing spare parts, shop testing, field testing as required, providing manufacturer's representative services, providing protection from flotation, connecting force main and sewers at the pumping station; design and installation of soil vapor barrier system beneath PS2 including all piping, materials and appurtenances; on site drainage system at PS2 site including drain manholes, hooded catch basins, stormwater infiltration unit, concrete modular subsurface infiltration system, connecting to existing drainage system, and all associated piping and appurtenances; temporary leaching pit at PS2 including connecting existing 2-in pressure line to provide sewer service during construction, removing the leaching pit and connecting the existing 2-in pressure line to manhole S8-1 after construction is completed and PS2 is operational, coordinating with the property owner to maintain uninterrupted sewer service during construction; steel bollards, loaming and seeding, trees and plantings, crushed stone, gravel infiltration trenches, driveway paving, concrete pads and walkways, grading, fencing, site restoration, coordination with electric and gas companies, and all work or equipment required for or incidental to the satisfactory completion of this item that is not paid for under other items in the Bid Form.
2. Payment for Items 4b and 57b shall be full reimbursement for the actual invoiced cost by the electric and gas companies. Contractor shall coordinate installations.

1.6 TEST PITS (Items 5, 28, 32, 53, 58, and 78)

A. Measurement

1. Test pits (Items 5, 28, 32, 53, 58, and 78) when ordered by the Engineer to determine utility locations or for other purposes will be measured in cubic yards in accordance with the following established volume rates:

Test Pit Depth	Cu. Yds per vert. Ft.
0 to 8 ft	1.5
Over 8 ft	2.0

B. Payment

1. Payment for test pits will be made for the quantity as determined above at the unit price bid for Items 5, 28, 32, 53, 58, and 78 in the Bid Form. This price and payment shall be full compensation for saw cutting and removing existing pavement, excavation (including hand excavation), exposing and obtaining both top and bottom elevations of existing utilities and/or structures, backfilling, compaction, restoring trench surface to grade, temporary pavement and all incidental work required to complete the test pits for which separate payment is not provided under other items in the Bid Form.

1.7 ROCK AND BOULDER EXCAVATION (Items 6a and 6b, 33a and 33b, and 59a and 59b)

A. Measurement

1. When rock is encountered, the material shall be uncovered and the Engineer notified. The Engineer will then take cross sections of the rock surface. If the Contractor fails to uncover the ledge, notify the Engineer and allow ample time for cross sectioning the undisturbed material, the Contractor shall have no right-of-claim to any classification other than that allowed by the Engineer. Removal of old concrete foundations, if any, shall be classified as rock.
2. Measurement of rock excavation in pipe trenches will extend to the width as specified in the DEP Policy Memorandum No. PM-14 which is appended to the Supplementary Conditions. The limits are as follows:

Depth from Ground Surface to Invert of Pipe	Pay Width (Nominal Pipe Diameter)	
	0 to 24-in	over 24-in
0 to 12-ft	5-ft-0-in	D + 3-ft-0-in
12-ft to 20-ft	7-ft-0-in	D + 5-ft-0-in
20-ft to 24-ft	8-ft-0-in	D + 5-ft-0-in

a. Measured widths for depths over 24-ft shall be determined case-by-case consistent with the foregoing chart.

b. Payment depth for rock which is encountered in a trench shall be no less than three feet when removal can be accomplished only by drilling and blasting or by use of jack (air or hydraulic) hammers.
c. Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.

3. Measurement for depth shall be from the top of the rock formation to the normal depth of the pipe as shown on the Drawings.
4. The pay limit for rock and boulder removal for manholes and structures shall commence one foot outside the widest dimension of the structure or shall be the maximum connecting trench width, whichever is greater. No allowance will be made for overbreakage.
5. Boulders and concrete structures exceeding 1 cu yd in volume when encountered in excavation will be measured for payment. Removal of boulders of whatever size will not be paid for when encountered in borrow areas.
6. The quantity of rock and boulder excavation to be paid for shall be the number of cubic yards of rock or boulders measured in place within the limits herein specified.

B. Payment

1. Payment for rock and boulder excavation will be made for the quantities as determined above at the unit price established for Items 6a, 33a, and 59a in the Bid Form. This price and payment shall be full compensation for excavation and disposal of rock and boulder as specified, backfilling and providing borrow for any deficiency of trench backfill and all work incidental thereto, for which payment is not provided under other items in the Bid Form.
2. Payment for rock and boulder excavation will also be made for the quantities as determined above at the unit price bid for Items 6b, 33b, and 59b in the Bid Form. This price and payment shall be full compensation for any additional costs associated with rock and boulder excavation over and above the unit price established for Items 6a, 33a, and 59a in the Bid Form.
3. No payment will be made under Items 7a thru 7d, 25a thru 25d, 34a thru 34d, 50a thru 50d, 60a thru 60d, and 75a thru 75d for refill material to replace any deficiency of backfill material.

1.8 GRANULAR FILL MATERIALS (Items 7a thru 7d, 25a thru 25d, 34a thru 34d, 50a thru 50d, 60a thru 60d, and 75a thru 75d)

A. Measurement

1. Bank run gravel/gravel borrow and dense graded crushed stone (Items 7a, 7d, 25a, 25d, 34a, 34d, 50a, 50d, 60a, 60d, 75a, and 75d), when its use is approved and when furnished, placed and compacted for pavement subbase, gravel roads and for miscellaneous uses will be measured in cubic yards at actual in-place dimensions as determined by the Engineer. When used for pavement subbase, the widths for payment shall not exceed those defined for initial trench pavement. No allowance will be made for loss from consolidation of material. Truck measurement will not be permitted. Excavated material which is used as pavement subbase will not be measured for payment.
2. Screened gravel (Items 7b, 25b, 34b, 50b, 60b, and 75b) used in conjunction with utility and drain crossings and at other locations when its use is ordered by the Engineer will be

measured in cubic yards at actual in-place dimensions as determined by the Engineer. When used in trenches the payment limits shall not exceed the trench widths defined for rock. No allowance will be made for loss from consolidation of material. Truck measurement will not be permitted.

3. Common fill (Items 7c, 25c, 34c, 50c, 60c, and 75c), when its use is required and approved and when furnished, placed, and compacted for trench backfill and miscellaneous uses, will be measured in cubic yards at actual in-place dimensions as determined by the Engineer. When used in trenches, the payment limits shall not exceed the trench widths defined for rock. No allowance will be made for loss from consolidation of material. Truck measurement will not be permitted. No additional payment will be made under this item for use of excavated material and any surplus material generated from the construction of this project.

B. Payment

1. Payment for furnishing and placing bank run gravel/gravel borrow, screened gravel, common fill and dense graded crushed stone will be made for the quantities determined above at the respective prices bid for Items 7a thru 7d, 25a thru 25d, 34a thru 34d, 50a thru 50d, 60a thru 60d, and 75a thru 75d in the Bid Form. This price and payment shall be full compensation for performing laboratory testing as specified, furnishing, hauling, placing, compacting the material, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
2. Payment for screened gravel used in pipe bedding and encasement for DI and PVC pipe will be included with the respective pipe items.
3. Payment for screened gravel used in subbase for manholes will be included under Items 2, 30 and 55.
4. Payment for common fill materials to refill rock and boulder excavation will be included under Items 6, 33, and 59.

1.9 EARTH EXCAVATION AND REFILL BELOW NORMAL GRADE (Items 7e, 25e, 35, 50e, 60e, and 75e)

A. Measurement

1. Measurement of earth excavation and refill below normal grade (Items 7e, 25e, 35, 50e, 60e, and 75e) will extend only downward from the dimensions defining normal grade on the Drawings to a depth determined by the Engineer and for a width as defined above for rock excavation or as approved by the Engineer. Normal grade is defined as the bottom of the pipe trench.
2. If the trench bottom is below normal grade through error by the Contractor or if improper drainage softens the subgrade and additional excavation in the trench is required before laying the pipe, such removal and replacement of material will not be measured for payment.
3. No allowance will be made for shrinkage or compaction of gravel in place. Measurement by truck count will not be permitted.
4. Furnishing and placing screened gravel in accordance with the Specifications to replace excavation below normal grade is included in this work and will not be measured for payment under Items 7b, 25b, 34b, 50b, 60b, or 75b.

B. Payment

1. Payment for earth excavation and refill below normal grade will be made for the quantity as above determined at the price per cubic yard bid for Items 7e, 25e, 35, 50e, 60e, and 75e in the Bid Form which price and payment shall be full compensation for excavation and disposal of all materials below normal grade, furnishing, placing and compacting screened gravel and all other work incidental thereto for which separate payment is not provided under other items in the Bid Form.
2. No payment will be made under Items 7a thru 7d, 25a thru 25d, 34a thru 34d, 50a thru 50d, 60a thru 60d, or 75a thru 75d for refill below normal grade.

1.10 MCP-related soil handling/disposal items (Items 8a thru 8e)

A. Measurement

1. Measurement for management of excavated material identified as uncontaminated material in accordance with 310 CMR 40.000 for management or reuse at a <RCS 1 facility (Item 8a), shall be based on the weight of the material computed to the nearest tenth of a ton. Disposal of materials identified as uncontaminated materials and meeting the facility maximum contaminant levels shall be by management or reuse at a < RCS-1 facility.
2. Measurement for management of excavated material identified as contaminated material in accordance with 310 CMR 40.000 for disposal or reuse at in-state unlined landfills (Item 8b), shall be based on the weight of the material computed to the nearest tenth of a ton. Disposal of these materials identified as contaminated materials and exceeding the 310 CMR 40.000 RCS-1 standards but meeting COMM-97-001 standards for unlined landfills shall be by disposal or reuse at an in-state unlined landfill.
3. Measurement for management of excavated material identified as contaminated material in accordance with 310 CMR 40.000 for disposal or reuse at in-state lined landfills (Item 8c), shall be based on the weight of the material computed to the nearest tenth of a ton. Disposal of these materials identified as contaminated materials and exceeding the 310 CMR 40.000 RCS-1 standards but meeting COMM-97-001 standards for lined landfills shall be by disposal or reuse at an in-state lined landfill.
4. Measurement for management of excavated material identified as contaminated material in accordance with 310 CMR 40.000 for disposal at an out-of-state facility (Item 8d), shall be based on the weight of the material computed to the nearest tenth of a ton. Disposal of these materials, identified as contaminated materials and exceeding the standards for reuse at Massachusetts landfills (COMM-97-001) and meeting the facility maximum contaminant levels shall be at an out-of-state facility.
5. Measurement for management of excavated material identified as hazardous waste in accordance with the Resource Conservation and Recovery Act (RCRA), specifically 40 CFR Parts 260–272 for disposal at a hazardous waste disposal facility (Item 8e), shall be based on the weight of the material computed to the nearest tenth of a ton. Disposal of these materials, identified as hazardous waste and meeting the facility maximum contaminant levels shall be at an out-of-state facility.
6. Stockpiled urban fill shall be reused in the work to the maximum extent possible.

B. Payment

1. Payment for uncontaminated material management and reuse at an in-state <RCS-1 facility will be made for the quantity as determined above at the unit price bid for Item 8a in the Bid Form based on certified facility weight slips. This price and payment shall be

full compensation for all labor, materials, equipment and supervision necessary for stockpiling, sampling, testing, loading, transportation and reuse of excess excavated material at a DEP-approved <RCS-1 Massachusetts facility, preparation of shipping documentation and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

2. Payment for contaminated material management and disposal at an in-state unlined landfill will be made for the quantity as determined above at the unit price bid for Item 8b in the Bid Form based on certified facility weight slips. This price and payment shall be full compensation for all labor, materials, equipment and supervision necessary for stockpiling, sampling, testing, loading, transportation and disposal of excess excavated material at a DEP-approved in-state unlined landfill, preparation of shipping documentation, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
3. Payment for contaminated material management and disposal at an in-state lined landfill will be made for the quantity as determined above at the unit price bid for Item 8c in the Bid form based on certified facility weight slips. This price and payment shall be full compensation for all labor, materials, equipment and supervision necessary for excavation, stockpiling, sampling, testing, loading, transportation and disposal of excess excavated material at an approved in-state lined landfill, preparation of shipping documentation and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
4. Payment for contaminated material management and disposal at an out-of-state facility will be made for the quantity as determined above at the unit price bid for Item 8d in the Bid form based on certified facility weight slips. This price and payment shall be full compensation for all labor, materials, equipment and supervision necessary for excavation, stockpiling, sampling, testing, loading, transportation and disposal of excess excavated material at an approved out-of-state facility, preparation of shipping documentation and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
5. Payment for contaminated material management and disposal as hazardous waste will be made for the quantity as determined above at the unit price bid for Item 8e in the Bid form based on certified facility weight slips. This price and payment shall be full compensation for all labor, materials, equipment and supervision necessary for excavation, stockpiling, sampling, testing, loading, transportation and disposal of excess excavated material at an approved hazardous facility, preparation of shipping documentation and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

1.11 PAVEMENT REPLACEMENT (Items 9a thru 9c, 26a thru 26c, 36a thru 36c, 51a thru 51c, 61a thru 61c, and 76a thru 76c)

A. Measurement

1. Measurement for initial trench-width pavement in Town streets and Route 28, 4-in thick hot mix asphalt (HMA) bituminous binder course (Items 9a, 26a, 36a, 51a, 61a and 76a) and 3-in thick HMA bituminous binder course (Items 9b, 26b, 36b, 51b, 61b, and 76b), respectively, will be in square yards as actually placed, but not exceeding the limits given below:

Depth to	Initial Trench

Pipe Invert	Pavement Width (feet)
0-8	6.5
8-12	9.5
12-16	12.5
16-20	15.5
20-24	18.5
24-30	22

2. Measurement for permanent trench-width plus 2-feet pavement in Route 28, 10-inch thick (6-inch thick HMA Superpave base course; 2.25-inch thick HMA Superpave intermediate course and 1.75-inch thick HMA Superpave surface course), or thickness of existing pavement if greater than 10 inches (Items 9c, 26c, 36c, 51c, 61c, and 76c), will be in square yards as actually placed at the total pavement thickness of 10 inches.
3. Measurements shall be horizontally centered along the center of the pipe.

B. Payment

1. Payment for 4-in thick HMA binder course initial trench-width pavement in Town streets and 3-in thick HMA initial trench-width plus 1-foot in Route 28, complete in place and approved by the Engineer, will be made for the quantity determined above at the unit price bid for Items 9a, 9b, 26a, 26b, 36a, 36b, 51a, 51b, 61a, 61b, 76a and 76b, respectively, in the Bid Form. This price and payment shall be full compensation for a second cutting of the entire trench, cleaning and priming the edges of the existing pavement with tack coat, cleaning and preparing the surface of the gravel base, furnishing, placing and maintaining the initial pavement including removing and repaving areas where the trench has settled more than 1½ inches, applying temporary pavement markings where required, including labor, materials, and all else incidental thereto for which payment is not provided under other items in the Bid Form.
2. Payment for permanent trench-width plus 2-feet pavement in Route 28, including 6-in thick HMA Superpave base or intermediate course, 2.25-in thick HMA Superpave intermediate course and 1.75-in thick HMA Superpave surface course, will be made for the quantity as above determined at the unit price bid for Items 9c, 26c, 36c, 51c, 61c, and 76c in the Bid Form, which price and payment shall be full compensation for removal of initial trench pavement; saw cutting 1-foot on both sides of initial paving (trench plus 2 feet); reshaping and removing, replacing and rolling gravel subbase to a minimum 7.5 inches below existing pavement (or match existing pavement thickness, whichever is greater); resetting all castings; priming the edges of pavement and tack coat; furnishing, placing and compacting HMA courses, and applying bitumen tack coat, hot poured rubberized asphalt sealer; calcium chloride for dust control; water for dust control; infra-red pavement repairs; applying permanent pavement thermoplastic markings; and performing all finishing work and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
3. Payment under Items 9a thru 9c, 26a thru 26c, 36a thru 36c, 51a thru 51c, 61a thru 61c, and 76a thru 76c shall include all costs of furnishing, storing and applying calcium chloride as required for dust control.
4. If the thickness of pavement or subbase ordered placed by the Engineer is greater than that specified, payment will be prorated on the basis of the thickness of material actually ordered placed. No payment will be made for any additional pavement or sub-base not specifically ordered in writing by the Engineer.

5. Payment under Items 9a thru 9c, 26a thru 26c, 36a thru 36c, 51a thru 51c, 61a thru 61c, and 76a thru 76c shall include remarking the pavement after both initial and final paving.

1.12 TRAFFIC MANAGEMENT (Items 10, 37, and 62)

A. Measurement

1. Measurement for all work required to coordinate traffic control systems, and to comply with the traffic management plans (Items 10, 37, and 62), shall be on a lump sum basis.

B. Payment

1. Payment of the lump sum price bid for traffic management (Items 10, 37, and 62) shall be full compensation for all labor, materials, equipment and incidentals required to prepare, submit, revise and implement Traffic Management Plans are specified; furnish, install, maintain and remove all temporary traffic management and control devices, including signs, barrels, lights, barriers, and boards as shown on the Drawings and as specified herein, complying with all requirements included in the MassDOT Highway Access permit for work in Route 28 including submitting weekly Work Requests to MassDOT via SHAPS, coordinate with Work by Others, and all incidental work for which separate payment is not provided under other items in the Bid Form.

1.13 SEDIMENTATION AND EROSION CONTROL (Items 11, 38 and 63)

A. Measurement for payment of sedimentation and erosion control (Items 11, 38 and 63) shall be on a lump sum basis.

B. Payment

1. Payment of the lump sum price bid for Items 11, 38 and 63 shall fully compensate the Contractor for sedimentation and erosion control. This price and payment shall be full compensation to furnish, install, maintain and remove sedimentation and erosion control measures as shown on the Drawings, specified herein, required by the Conservation Commission, or directed by the Owner or Engineer.

1.14 DEWATERING AND DRAINAGE (Items 12, 39 and 64)

A. Measurement

1. Measurement for payment for dewatering and drainage (Items 12, 39 and 64) shall be on a lump sum basis.

B. Payment

1. Payment of the lump sum price bid for Items 12, 39 and 64 in the Bid Form shall be full compensation for all labor, equipment, materials and incidentals necessary to handle groundwater and surface water to preserve the bearing capacity of the subgrade soils and allow construction to proceed "in-the-dry" as specified in Section 312319 “Dewatering” including but not limited to preparing and submitting a dewatering plan to the Engineer,

obtaining all required permits including any required sampling, sinking well points and/or deep wells, furnishing, installing and maintaining pumping systems including all pumps, piping, casing and other appurtenances, filter sand required for underdrains or pumping systems, handling, removing and discharging dewatering discharge including any permitting required, erosion and sediment control, furnishing, installing, maintaining and removing observation wells, and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

2. Note that existing drainage systems may not adequate capacity to accommodate discharge from dewatering systems. Contractor shall make all investigations necessary to make this determination an develop and implement appropriate strategies for proper handling and disposal of discharge from dewatering systems including any permitting required, all at no additional cost to the Owner.

1.15 MISCELLANEOUS CONCRETE (Items 13, 27, 40, 52, 65 and 77)

A. Measurement

1. Measurement for payment for concrete furnished and installed (Items 13, 27, 40, 52, 65 and 77) shall be the actual number of cubic yards placed or as determined by the Engineer.
2. Concrete placed for miscellaneous purposes where approved by the Engineer will be measured in cubic yards.

B. Payment

1. Payment for miscellaneous concrete will be made for the quantity as determined above at the unit price bid for Items 13, 27, 40, 52, 65 and 77 in the Bid Form and shall be full compensation for furnishing and placing the concrete including form work, reinforcing, and other materials required, complete as shown on the Drawings and as specified herein.

1.16 STREET SWEEPER AND MESSAGE BOARDS (Items 14a and 14b, 41 and 66)

A. Measurement

1. Measurement for payment for providing an industrial street sweeper (Items 14a, 41 and 66) shall be on an hourly basis for the time ordered in writing by the Engineer or the Owner.
2. Normal daily cleanup work is included in Section 017300 “Execution” and will not be measured for payment under this item.
3. Measurement for payment for the cost of two (2) trailer-mounted electronic message boards (Item 14b) shall be on a monthly basis for the number of months the boards are ordered in writing by the Engineer. Additional trailer-mounted electronic message boards that may be required shall be prorated accordingly to the unit bid price.

B. Payment

1. Payment for the street sweeper will be made for the quantities as determined above at the unit price bid for Items 14a, 41 and 66 in the Bid Form. This price and payment shall be

full compensation for furnishing all labor and equipment and refill water required to sweep clean all pavement areas required in addition to normal cleanup, which is included under other items.

2. Payment shall be for an operator and a three-wheel, 5.75-cubic yard double gutter broom street sweeper equal to Model Vanguard V3000SP Johnston Sweeper Co., Pomona, California.
3. Payment for Item 14b in the Bid Form shall be made for the quantities as determined above for costs associated with providing two (2) trailer-mounted, solar powered, programmable message boards for traffic control. Payment shall be full compensation for delivery, setup, maintenance, relocating and reprogramming as necessary for traffic control during the construction period.

1.17 ENGINEER'S FIELD OFFICE (Item 15)

A. Measurement

1. Measurement for payment for the Engineer's field office (Item 15) shall be on a monthly basis for the duration of construction under this Contract, including final paving.

B. Payment

1. Payment for the Engineer's field office will be made for the quantity as determined above at the unit price bid for Item 15 in the Bid Form, which price and payment shall be full compensation for furnishing all labor, materials, and equipment associated with furnishing, installing, maintaining, and removing the Engineer's field office at a location to be determined as directed by the Engineer and as specified in Section 015000 "Temporary Facilities and Controls", including but not limited to preparing the site as needed, including cutting trees, clearing, grubbing, placing compost socks, grading, placing crushed stone parking area and bituminous parking areas and driveway aprons; mobilizing the trailer to the site; providing all necessary power, telephone, potable water service and sanitary service connection or holding tank, Wi-Fi/internet service and plumbing; insurance, maintenance, cleaning, snow removal, office furniture, equipment, and supplies; all monthly utility costs; removing the trailer and restoring the site, including removing the crushed stone and bituminous paving, grading, loaming and seeding, as directed by the Engineer; and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.
2. Connection fees and user charges for Town water will be waived for the Engineer's field office.
3. Contractor's field office shall be paid for under Items 16, 42 and 67.

1.18 MISCELLANEOUS WORK AND CLEANUP (Items 16, 42 and 67)

A. Measurement

1. Miscellaneous work and cleanup shall be measured on a lump sum basis.

B. Payment

1. Payment of the lump sum price bid in the Bid Form for Items 16, 42 and 67 Miscellaneous Work and Cleanup, shall be full compensation for furnishing all labor, materials, and equipment required to do all related work of this Contract as specified, or as shown on the Drawings and any other miscellaneous work not specifically included for payment under any other item in the Bid Form, but obviously necessary to complete the Contract including miscellaneous work specified in section 017300 "Execution." Partial payments shall be based on the breakdown of the schedule of values.

1.19 MOBILIZATION (Item 17)

A. Measurement

1. Measurement for payment of mobilization costs shall be on a lump sum basis but the cost shall not exceed 5 percent of the Eligible (Part A) Bid Price, excluding this item.

B. Payment

1. Payment of the lump sum price bid in the Bid Form for Item 17 shall be full compensation for all costs associated with initiating the Contract, exclusive of the cost of materials. Payment shall include compensation for all insurance, bonds, site preparation, and in general the costs associated with establishing the work on site to assure that it is proceeding in a continuous manner.
2. No additional payment will be made for mobilization beyond the lump sum price bid in the Bid Form for Item 17 for award of additive alternates.

1.20 DUCTILE IRON WATER MAIN AND FITTINGS (Items 18a thru 18c, 19a thru 19e, 43a thru 43c, 44a thru 44c, 68a thru 68d and 69a thru 69e)

A. Measurement

1. Ductile iron water main replacement (or parallel construction and abandonment of existing water main where indicated on the Drawings) of the size and type specified on the Bid Form (Items 18a thru 18c, 43a thru 43c, and 68a thru 68d) will be measured in place on a linear foot basis. Measurement for payment does not signify that the water main is accepted. Measurement for length of ductile iron water main will be along the horizontal centerline of the pipe, with no deductions for valves or fittings. Measurement will be to the nearest tenth of a foot.
2. Ductile iron fittings (tees, bends, crosses, reducers, caps/plugs, etc.) installed in the completed project (Items 19a, 44a and 69a) shall be measured by the pound, excluding cement lining, based on tabular weights obtained from the current ANSI Standards. The weight of the fittings shall not include the weight of glands, bolts, nuts, gaskets or accessories.
3. Couplings (Items 19b thru 19e, 44b thru 44c, and 69b thru 69e) will be measured as the actual number of each size of coupling installed in the completed project and accepted by the Engineer.

B. Payment

1. Payment for furnishing and installing ductile iron pipe of the class and size specified will be made for the respective quantities as above determined, at the price per linear foot bid under Items 18a thru 18c, 43a thru 43c, and 68a thru 68d in the Bid Form. Such price and payment shall be full compensation for saw cutting existing pavement; trench excavation of all material of every description and of whatever substance encountered (excluding rock and boulder excavation and excavation below normal grade); sheeting and bracing; excavation support and protection; dewatering and drainage; disposal of excess excavated and unacceptable material; furnishing and installing tap holes for dewatering or air release and pumping equipment for dewatering, if necessary; removal or abandonment of existing water main including filling of existing gate valves; removal and disposal of all asbestos cement (AC) water mains in accordance with all applicable federal, state, and local regulations; supporting existing utility lines in the trench; furnishing, laying and jointing the new ductile iron pipe including all restrained joints and concrete thrust blocks required; furnish and install exterior bitumastic coating, furnishing and installing pipe insultation where new water main and fittings have less than 4 feet of cover; concrete encasement of water mains, where indicated on the Drawings and as necessary; furnishing and installing backfill material as shown on the Drawings including screened gravel for pipe bedding and common fill from excavated trench (excluding CDF); backfilling; compaction; storing and applying calcium chloride as required for dust control over trenches; restoring the trench surface to grade (excluding loaming and seeding and pavement); restoring all physical features to grade; all restoration required within the trench limits including removing and resetting of any curbing removed or disturbed within trench limits, replacing landscape islands; cleaning, flushing, chlorinating, dechlorinating and testing the pipe, including water quality sampling and testing, and all else incidental thereto for which separate payment is not provided under other Items in the Bid Form.
2. Payment for furnishing and installing fittings based on weights as herein specified will be made for the quantity determined above at the unit price bid under Items 19a, 44a and 69a in the Bid Form. Payment shall not include weight of glands, bolts, nuts, gaskets or accessories. Price and payment shall be full compensation for furnishing and installing the fitting with cement lining, glands, bolts, nuts, gaskets, jointing and all work required for, or incidental to the satisfactory completion of the Item for which payment is not provided under other items in the Bid Form.
3. Payment for furnishing and installing couplings of the required size will be made for the respective quantities determined above at the applicable unit price bid under Items 19b thru 19e, 44b thru 44c, and 69b thru 69e in the Bid Form. Price and payment shall be full compensation for furnishing and installing the couplings, glands, gaskets, bolts, nuts, jointing, retainer gland fitting for the couplings (if noted), denso protective wrapping, connection to existing 2-inch water main via coupling with tapped threaded connection; and all work required for or incidental to the satisfactory completion of the Item for which payment is not provided under other items in the Bid Form.
4. Payment for test pits to determine the depth, dimensions and measurements of existing water mains and for fabrication and ordering of new materials will be made under Item 28, 53 and 78 in the Bid Form.
5. Payment for Rock and Boulder Excavation, Excavation Below Normal Grade and Paving will be made under the respective Bid Items in the Bid Form. Loaming and Seeding will be paid for under Miscellaneous Work and Cleanup.

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1.21 VALVES AND HYDRANTS (Items 20a thru 20c, 21a thru 21d, 22a and 22b, 45a thru 45c, 46a and 46b, 47, 70a thru 70c, 71a thru 71c, and 72)

A. Measurement

1. Gate valves (Items 20a thru 20c, 45a thru 45c, and 70a thru 70d), tapping sleeve and valves (Items 21a and 21b, 46a and 46b, and 71a and 71b), and insertion valves (Items 21c and 21d, and 71c) shall be measured as the number of valves actually installed in the completed project and accepted by the Engineer.
2. Hydrants (Items 22a, 47 and 72) shall be measured as the actual number of new hydrant assemblies installed and accepted by the Engineer.
3. Measurement for the existing hydrants removed, delivered, and stacked at Yarmouth's Water Department yard (Item 22b) will be made at the lump sum price bid in the Bid Form.

B. Payment

1. Payment for furnishing and installing gate valves, tapping sleeve and valves, and insertion valves will be made for the quantity as determined above at the unit price per each bid under Items 20a thru 20c, 21a thru 21d, 45a thru 45c, 46a and 46b, 70a thru 70d, and 71a thru 71c respectively, in the Bid Form. Such price and payment shall be full compensation for all labor, materials and equipment required for furnishing and installing gate valves, tapping sleeve and valves, insertion valves, or manual air release valve assemblies with boxes, extension stems, restraints and covers as specified; cutting existing pavement; all excavation (excluding rock and boulder excavation and excavation below normal grade); excavation support and protection; dewatering and drainage; furnishing and installing backfill material as shown on the Drawings including screened gravel for bedding and common fill from excavated trench (excluding CDF); setting, jointing, tapping; furnishing and installing restrained joints and fittings as required; backfilling and compaction; cleaning; on site testing; chlorinating; and all work required for or incidental to the satisfactory completion of the Item for which separate payment is not provided under other items in the Bid Form.
2. Payment for furnishing and installing insertion valves will also include abandoning existing gate valves, where shown on the Drawings. Price and Payment shall include confirming existing valves to be abandoned are in the open position; cutting existing pavement; all excavation (excluding rock and boulder excavation and excavation below normal grade); excavation support and protection; dewatering and drainage; furnishing and installing backfill material as shown on the Drawings including screened gravel for bedding and common fill from excavated trench (excluding CDF); and removing and disposing of existing valve extension and box.
3. Payment for furnishing and installing hydrants will be made for the quantity as determined above at the unit price per each bid under Items 22a, 47 and 72 in the Bid Form. Such price and payment shall be full compensation for all labor, materials and equipment required for all work as specified and as shown on the Drawings for furnishing and installing hydrants including cutting existing pavement; all excavation (excluding rock and boulder excavation and excavation below normal grade); excavation support and protection; dewatering and drainage; installation of the main line tee of the size required with anchoring branch, gate valve, new pipe, fittings, connections, hydrant, concrete thrust blocks for main line tee and hydrant; furnishing and installing restrained joints and fittings; furnishing and installing concrete thrust blocks; placing screened gravel, screened gravel drainage pocket and crushed stone; cleaning; testing;

chlorinating; painting; restoring physical features to their original condition, removing and resetting granite curbing, disposal of excavated materials, and all other work required to complete the installation for which separate payment is not provided under other items in the Bid Form.

4. Payment for removing, delivering, and stacking at the Town of Yarmouth Water Department yard (99 Buck Island Road) all removed hydrants, inclusive of existing hydrants removed as part of awarded Bid Add Alternate(s), will be made at the lump sum price bid under Item 22b in the Bid Form. This price will be full compensation for all work required for or incidental to the removing, delivering, and stacking of existing hydrants, including excavation, cutting and capping the existing water main, restoring the surface of the roadway, delivering the materials to the Water Department yard, and stacking/placing at a designated location as required by the Water Department, to remain property of the Town of Yarmouth.
5. Payment for Rock and Boulder Excavation, Excavation Below Normal Grade and Paving will be made under the respective Bid Items in the Bid Form. Payment for Loaming and Seeding will be made under Miscellaneous Work and Cleanup.

1.22 SERVICE CONNECTIONS (Items 23a and 23b, 24a and 24b, 48a and 48b, 49a and 49b, 73a and 73b, and 74a and 74b)

A. Measurement

1. Plastic tubing for water service connections installed in streets and sidewalk areas of the size and type specified on the Bid Form (Items 23a and 23b, 48a and 48b, and 73a and 73b) will be measured as the actual number of linear feet of each size of tubing installed in the completed project measured from the centerline of the water main to the end of the new service line installed at the property line. Measurement will be along the centerline of the service pipe without deduction for valves and fittings.
2. Corporation cocks and curb stops of the size and type specified on the Bid Form (Items 24a and 24b, 49a and 49b, and 74a and 74b) will be measured as the actual number of sets of curb stops with boxes and corporation cocks installed in the completed project and accepted by the Engineer.

B. Payment

1. Payment for furnishing and installing plastic tubing service connections of the required size will be made for the quantity as determined above at the applicable unit price bid under Items 23a and 23b, 48a and 48b, and 73a and 73b of the Bid Form. Price and payment shall be full compensation for all work of furnishing and installing the tubing and all required adapters, reducers, fittings and appurtenances required for executing such connections, chlorinating, trench excavation (excluding rock and boulder excavation), dewatering and drainage, furnishing and installing backfill material as shown on the Drawings including screened gravel for service bedding and common fill from excavated trench (excluding CDF), connection to existing house service connection at the property line, backfilling and compaction, all restoration required within the trench limits including removing and resetting of any granite curbing and brick or concrete sidewalks/driveways removed or disturbed within trench limits, furnishing, storing and applying calcium chloride as required for dust control over trenches, restoring physical features to their original condition, loaming and seeding, disposal of excavated materials,

and all work required for or incidental to the satisfactory completion of the Item for which payment is not provided under other items in the Bid Form.

2. Payment for furnishing and installing curb stops with boxes and corporation cocks of the required size will be made for the quantity as determined above at the applicable unit price bid under Items 24a and 24b, 49a and 49b, and 74a and 74b of the Bid Form. Price and payment shall be full compensation for all work of furnishing and installing the curb stops with boxes and corporation cocks, all excavation (excluding rock and boulder excavation), backfilling and compaction, setting boxes and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

1.23 EXTRA WORK

A. Extra work, if any, will be performed in accordance with Article 11 of the General Conditions and will be paid for in accordance with the provisions of Article 13 of the General Conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012001

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SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 013100 “Project Management and Coordination” for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Engineer will issue Field Orders authorizing minor changes in the Work, not involving adjustment to the Contract Price or the Contract Time, on EJCDC Form C-942 or other form acceptable to Owner.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Price or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Requests For Proposal (RFP) issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of RFP, submit a quotation estimating adjustments to the Contract Price and the Contract Time necessary to execute the change.

    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

e. Quotation Form: Use forms acceptable to Engineer.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Price and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in paragraph 7.05 of the General Conditions if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Engineer.

1.5 ADMINISTRATIVE CHANGE ORDERS

A. Unit-Price Adjustment: See Paragraph 13.03 of the General Conditions for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Change Order Request, Engineer will issue a Change Order for signatures of Owner and Contractor on form contained in DEP Policy Memorandum No. PM-10, which is included in Part 2 of the Supplementary Conditions.

1.7 WORK CHANGE DIRECTIVE

A. Work Change Directive: Engineer may issue a Work Change Directive on form acceptable to Owner and Engineer. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Price or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

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SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project management software directory, and in prominent location in each built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination of Multiple Contracts: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

E. Coordination with Local Agencies

1. Provide the Owner and Engineer with a list of after-hours telephone numbers by which appropriate Contractor personnel may be contacted in the event of an emergency.
2. Provide the local Police Department, Fire Department, School Department, Conservation Commission and the Public Works Department with the following information.

    a. List of streets and intersections where work will be in progress to be supplied at intervals as required by the Engineer.
    b. Areas where approved detours are in effect.
    c. Immediate notification of any drain, gas or water main breaks.

3. Reimburse the Owner for the actual cost of the services of DPW Personnel required during other than regular working hours. The emergency contact number for the DPW during non-business hours is (508) 771-7921
4. Maintain pavement as specified and provide the Public Works Department with an address where the Contractor may be reached when not at the site. Upon notification by the Owner or Engineer, promptly make such repairs as necessary to paved surfaces.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

    a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
    b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
    c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

    a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
    b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
    c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
    d. Location of pull boxes and junction boxes, dimensioned from column center lines.

8. Fire-Protection System: Show the following:

    a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Engineer will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are

Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make suitable modifications and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

C. Coordination Drawing Process: Prepare coordination drawings in the following manner:

1. Schedule submittal and review of Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Engineer to review and resolve conflicts on the coordination drawings.

D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. File Preparation Format: DWG, Version , operating in Microsoft Windows operating system.
3. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
4. Engineer will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    b. Digital Data Software Program: Drawings are available in Auto CADD Civil 3D 2021.
    c. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner’s Project number.
4. Name of Engineer.
5. Engineer’s Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.

1. Attachments shall be electronic files in PDF format.

D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.

d. Requests for coordination information already indicated in the Contract Documents.
e. Requests for adjustments in the Contract Time or the Contract Sum.
f. Requests for interpretation of Engineer's actions on submittals.
g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 5 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Use software log that is part of web-based Project management software. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer.
4. RFI description.
5. Date the RFI was submitted.
6. Date Engineer's response was received.
7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Engineer's Digital Data Files: Digital data files of Engineer's CAD drawings will be provided by Engineer for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.
2. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Digital Drawing Software Program: Contract Drawings are available in Auto CADD Civil 3D 2021 and PDF.
4. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Engineer.

a. Subcontractors, and other parties granted access by Contractor to Engineer's digital data files shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Engineer.

1.9 WEB-BASED PROJECT MANAGEMENT SOFTWARE PACKAGE

A. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion. General Contractor shall be responsible for the full cost for the project team including costs for Owner, Engineer, Contractor, subcontractors and suppliers.

1. Web-based Project management software includes, at a minimum, the following features:

   a. Compilation of Project data, including Contractor, subcontractors, Engineer, Engineer's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
   b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
   c. Document workflow planning, allowing customization of workflow between project entities.
   d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
   e. Track status of each Project communication in real time, and log time and date when responses are provided.
   f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
   g. Processing and tracking of payment applications.
   h. Processing and tracking of contract modifications.
   i. Creating and distributing meeting minutes.
   j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
   k. Management of construction progress photographs.
   l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to seven Project management software user licenses for use of Owner, Owner's Project Manager, Engineer, and Engineer's consultants. Provide eight hours of software training at Engineer's office for web-based Project software users.
3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Engineer. Provide data in locked format to prevent further changes.
4. Provide one of the following web-based Project software packages under their current published licensing agreements:

   a. Trimble; Unity Construct/e-Builder.
   b. Procore Technologies, Inc.
   c. Oracle; Submittal Exchange.
   d. Or equal.

B. PDF Document Preparation: Where PDFs are required to be submitted to Engineer, prepare as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.10 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.

B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

a. Responsibilities and personnel assignments.
b. Tentative construction schedule.
c. Phasing.
d. Critical work sequencing and long lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Use of web-based Project software.
h. Procedures for processing field decisions and Change Orders.
i. Procedures for RFIs.
j. Procedures for testing and inspecting.
k. Procedures for processing Applications for Payment.
l. Distribution of the Contract Documents.
m. Submittal procedures.
n. Sustainable design requirements.
o. Preparation of Record Documents.
p. Use of the premises.
q. Work restrictions.

r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Parking availability.
y. Office, work, and storage areas.
z. Equipment deliveries and priorities.
aa. First aid.
bb. Security.
cc. Progress cleaning.
dd. List of major subcontractors and suppliers.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer and Owner of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.

x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment including final change order.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements including certificate of occupancy and closeout of permits.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.
p. Final cleaning.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at monthly intervals.

1. Coordinate dates of meetings with preparation of payment requests.

2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Status of sustainable design documentation.
        6) Deliveries.
        7) Off-site fabrication.
        8) Access.
        9) Site use.
        10) Temporary facilities and controls.
        11) Progress cleaning.
        12) Quality and work standards.
        13) Status of correction of deficient items.
        14) Field observations.
        15) Status of RFIs.
        16) Status of Proposal Requests.
        17) Pending changes.
        18) Status of Change Orders.
        19) Pending claims and disputes.
        20) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at monthly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    c. Review present and future needs of each contractor present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Deliveries.
        6) Off-site fabrication.
        7) Access.
        8) Site use.
        9) Temporary facilities and controls.
        10) Work hours.
        11) Hazards and risks.
        12) Progress cleaning.
        13) Quality and work standards.
        14) Status of RFIs.
        15) Proposal Requests.
        16) Change Orders.
        17) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

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SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 014000 “Quality Requirements” for schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, latest allowable start date, latest allowable finish date, status (where critical) and total float and free float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Unusual Event Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including phasing work stages area separations interim milestones and partial Owner occupancy.
4. Review schedule for work of Owner's separate contracts.
5. Review submittal requirements and procedures.
6. Review time required for review of submittals and resubmittals.
7. Review requirements for tests and inspections by independent testing and inspecting agencies.
8. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
9. Review and finalize list of construction activities to be included in schedule.
10. Review procedures for updating schedule.
11. Submit at this conference a preliminary network defining the planned operation during the first 60 calendar days after the Notice to Proceed.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Program Description

1. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.
2. The construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.

B. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

C. Qualifications:

1. The Contractor shall have the capability of preparing and utilizing the specified CPM schedule, or engage the services of a specialized scheduling professional to do so. Within seven days of the award of contract, provide a résumé or qualifications statement for the individual within the Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of the CPM schedule. The résumé or qualifications statement shall demonstrate that the proposed responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. The proposed responsible party for the CPM schedule is subject to approval by the Engineer and Owner. If the proposed responsible party for the CPM schedule is not approved by the Engineer and/or Owner, Contractor shall resubmit a more-appropriate candidate for approval.

D. Time Frame: Extend schedule from date established for the Notice of Award to date of Final Completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

E. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Engineer.
2. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
5. Commissioning Time: Include no fewer than 15 days for commissioning.

6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Engineer's administrative procedures necessary for certification of Substantial Completion.
7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

F. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Phasing: Arrange list of activities on schedule by phase.
2. Work under More Than One Contract: Include a separate activity for each contract.
3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Uninterruptible services.
    c. Use-of-premises restrictions.
    d. Provisions for future construction.
    e. Seasonal variations.
    f. Seasonal restrictions from working on major roadways.
    g. Environmental control.

5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:

    a. Subcontract awards.
    b. Submittals.
    c. Purchases.
    d. Mockups.
    e. Fabrication.
    f. Sample testing.
    g. Deliveries.
    h. Installation.
    i. Tests and inspections.
    j. Adjusting.
    k. Curing.
    l. Building flush-out.
    m. Startup and placement into final use and operation.
    n. Commissioning.

G. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

H. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.

4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

I. Acceptability

1. Submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.
2. The Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the contract documents. The Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract Requirements.
3. Engineer's review of the Contractor's construction schedule submittals shall not relieve the Contractor from responsibility for any deviations from the Contract Documents unless the Contractor has in writing called Engineer's attention to such deviations at the time of submission and Engineer has given written concurrence to the specific deviations, nor shall any concurrence by the Engineer relieve Contractor from responsibility for errors and omissions in the submittals. Concurrence of the CPM Activity Network by the Engineer is advisory only and shall not relieve the Contractor of responsibility for accomplishing the Work within the Contract completion date(s).
4. Concurrence, acceptance, or approval of the Contractor's CPM schedule by the Engineer in no way makes the Engineer an insurer of the CPM schedule's success, nor liable for time or cost overruns resulting therefrom.
5. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Engineer.
6. CPM schedules that contain activities with negative float, or which extend beyond the contract completion date, will not be acceptable.
7. Except where earlier completions are specified, CPM schedules which show completion of all work prior to the contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by the Contractor.

J. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity. Activities shall not be considered to be complete until they are in fact 100 percent complete.
4. Submit a narrative report based on the CPM schedule evaluation, in a format agreed upon by the Contractor and the Engineer. The report shall include a description of the progress during the previous period in terms of completed activities, an explanation of each

activity which is showing a delay, a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates and an explanation of corrective action taken or proposed.

K. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

L. The contract completion time will be adjusted only for causes specified in this Contract. In the event the Contractor requests an extension of any contract completion date, the Contractor shall furnish such justification and supporting evidence as the Engineer may deem necessary to determine whether the Contractor is entitled to an extension of time under the provisions of this Contract. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to any extension of any contract completion date, the Engineer's determination as to the total number of days extension shall be based upon the currently approved CPM schedule and on all data relevant to the extension. Such data shall be included in the next updating of the schedule. Actual delays in activities which, according to the CPM schedule, do not affect any contract completion date shown by the critical path in the network will not be the basis for a change therein.

M. Distribution: Distribute copies of approved schedule to Engineer Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed.

B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 CPM SCHEDULE REQUIREMENTS

A. Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice of Award. Outline significant construction activities for the first 90 days of construction. Include

skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.

2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
3. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Testing and inspection.
    i. Commissioning.
    j. Punch list and Final Completion.
    k. Activities occurring following Final Completion.
    l. Maintenance of existing facilities.
    m. Contract milestones.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

1.10 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.

15. Change Orders received and implemented.
16. Work Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013200

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SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Aerial and preconstruction photographs.
2. Aerial and periodic construction photographs.
3. Aerial and final completion construction photographs.
4. Preconstruction video recordings.
5. Periodic construction video recordings.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on thumb-drive. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings on thumb drive. Include copy of key plan indicating each video's location and direction.
2. Identification: With each submittal, provide the following information in file metadata tag:

a. Name of Project.
b. Name and address of photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date video recording was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

3. Transcript: Prepared on 8-1/2-by-11-inch paper, punched and bound in heavy duty, three-ring vinyl covered binders. Provide label on front and spine. Include a cover sheet with label information. Include name of Project and date of video recording on each page.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.

C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

D. Metadata: Record accurate date and time and GPS location data from camera.

E. File Names: Name media files with date, Project area and sequential numbering suffix.

F. Usage Rights

1. Obtain and transfer copyright usage rights from photographer and videographer to Owner for unlimited reproduction of photographic and videographic documentation.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.

1. Flag excavation areas before taking construction photographs.
2. Take photographs to show existing conditions adjacent to property before starting the Work.
3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take a minimum of 20 photographs weekly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take photographs in all work areas after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.

F. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum or in the allowance for construction photographs.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

a. Special events planned at Project site.
b. Immediate follow-up when on-site events result in construction damage or losses.
c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
d. Substantial Completion of a major phase or component of the Work.
e. Extra record photographs at time of final acceptance.
f. Owner's request for special publicity photographs.

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1.7 CONSTRUCTION VIDEO RECORDINGS

A. Video Recording Photographer: Engage a qualified videographer with not less than three years' experience to record construction video recordings.

B. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

C. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.

D. Preconstruction Video Recording: Before starting excavation, record video recording of Project site and surrounding properties from different vantage points, as directed by Engineer.

1. Flag construction limits before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
4. Show protection efforts by Contractor.

E. Periodic Construction Video Recordings: Record video recording monthly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013233

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SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

B. Related Requirements:

1. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
2. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
3. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
4. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
5. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. Mass Submittals: Six or more submittals or items in one day or 20 or more submittals or items in one week.

1.4 SUBMITTAL SCHEDULE

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.

4. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal Category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Engineer's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled date of fabrication.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Numbering System: Utilize the following example submittal identification numbering system to identify submittals and as file names for PDF submissions:

1. First Identifier - Alphabet Character: D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.
2. Second Identifier - Next 6 or 8 Digits: Applicable Specification Section Number. Do not mix submittals from different specification sections into a single submittal.
3. Third Identifier - Next Three Digits: Sequential number of each separate item or drawing submitted under each Specification Section, in chronological order submitted, starting at 001.
4. Fourth Identifier - Last Alphabet Character: A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.

5. EXAMPLE: D-033000.13-008-B.

    a. D = Shop Drawing.
    b. 03 30 00.13 = Section; use only 6 digits for sections that do not include 8 digits.
    c. 008 = the eighth different submittal under this Section.
    d. B = the second submission (first resubmission) of that particular shop drawing.

B. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

C. Options: Identify options requiring selection by Engineer.

D. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 30 days for initial review of each submittal (and 45 days for multi-discipline reviews). Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.
4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
5. Insert list of submittals requiring sequential review in first subparagraph below, or delete and identify submittals in Sections where they are specified. Structural, HVAC, plumbing, and electrical components are examples of the Work that often require sequential review.
6. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Engineer and to Engineer's consultants, allow 30 days for review of each submittal. Submittal will be returned to Engineer before being returned to Contractor.

    a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Engineer.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.
4. Repetitive Reviews: Shop drawings, O&M manuals, and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. BIM Incorporation: Develop and incorporate Shop Drawing files into BIM established for Project.

C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

    a. Project name and submittal number.
    b. Generic description of Sample.
    c. Product name and name of manufacturer.
    d. Sample source.
    e. Number and title of applicable Specification Section.
    f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Contractor’s Certification: Each shop drawing, working drawing, product data, and sample shall have affixed to it the following Certification Statement:

    a. "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements. "

3. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
4. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
5. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
6. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

7. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

a. Name of evaluation organization.
b. Date of evaluation.
c. Time period when report is in effect.
d. Product and manufacturers' names.
e. Description of product.
f. Test procedures and results.
g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

C. BIM Incorporation: Incorporate delegated-design drawing and data files into BIM established for Project.

1. Prepare delegated-design drawings in the following format: Same digital data software program, version, and operating system as original Drawings.

1.9 PROPOSED PRODUCT LIST

A. Within 15 days after date of Owner-Contractor Agreement, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

1.10 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Contractor Responsible for:

1. Determination and verification of materials including manufacturer’s catalog numbers.
2. Determination and verification of field measurements and field construction criteria.
3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
4. Determination of accuracy and completeness of dimensions and quantities.
5. Confirmation and coordination of dimensions and field conditions at Site.
6. Construction means, techniques, sequences, and procedures.
7. Safety precautions.
8. Coordination and performance of Work of all trades.
9. Other requirements enumerated in Contract Documents.

C. Contractor's Approval: Indicate Contractor's approval for each submittal with indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.11 ENGINEER'S REVIEW

A. Do not make mass submittals to Engineer. If mass submittals are received, Engineer's review time stated above will be extended as necessary to perform proper review. Engineer will review mass submittals based on priority determined by Engineer after consultation with Owner and Contractor.

B. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return.

1. Submittals by Web-Based Project Management Software: Engineer will indicate, on Project management software website, the appropriate action.

C. Informational Submittals: Engineer will review each submittal and will not return it or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Engineer will return without review submittals received from sources other than Contractor.

G. Submittals not required by the Contract Documents will be returned by Engineer without action.

H. Shop drawings will be returned to the Contractor with one of the following codes.

1. "APPROVED" - This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.
2. "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.
3. "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the package. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. The resubmittal is to address all comments, omissions and non-conforming items that were noted. An additional box is checked to indicate whether the resubmission is for the complete package, or for parts of the package. If no box is checked, a complete resubmittal shall be provided. Review code may designate if a partial or full submittal is required. If full submittal is required, a complete resubmittal package addressing all comments shall be provided. If a partial submittal is designated, resubmittal shall only include information pertaining to those items noted in review comments requiring clarification and any portions of submittal impacted as a result of the response. Resubmittal is to be received by the Engineer within 30 calendar days of the date of the Engineer's transmittal requiring the resubmittal.

4. "REJECTED" - This code is assigned when the submittal does not meet the intent of the Contract Documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.
5. "RECEIPT ACKNOWLEDGED (Not subject to Engineer's Approval)" - This code is assigned to acknowledge receipt of a submittal that is not subject to the Engineer's approval. This code is generally used with submittals involving the Contractor's means and methods of construction work plans, and health and safety plans.

1.12 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.

B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:

1. Use of files is solely at receiver's risk. Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
4. Receiver shall not hold Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
5. Receiver shall understand that even though Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.
6. Receiver shall not hold Engineer responsible for such viruses or their consequences, and shall hold Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

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SECTION 013545 - ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Contractor shall comply with all requirements of the Order of Conditions issued by the Yarmouth Conservation Commission appended to these Specifications.

1.2 SUMMARY

A. Section includes:

1. Erosion control.
2. Protection of streams and surface waters.
3. Protection of land resources.
4. Protection of air quality.
5. Noise control.
6. Maintenance of pollution control facilities during construction.

1.3 QUALITY CONTROL

A. Comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

B. Engineer will notify the Contractor in writing of any non-compliance with the foregoing provisions or of any environmentally objectionable acts and corrective action to be taken. State or local agencies responsible for verification of certain aspects of the environmental protection requirements shall notify the Contractor in writing, through the Engineer, of any non-compliance with State or local requirements. After receipt of such notice from the Engineer or from the regulatory agency through the Engineer, immediately take corrective action. Such notice, when delivered to the Contractor or his authorized representative at the site of the work, shall be deemed sufficient for the purpose. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor unless it is later determined that the Contractor was in compliance.

1.4 PREINSTALLATION MEETINGS

A. Prior to commencement of the work, meet with the Engineer to develop mutual understandings relative to compliance with these provisions and administration of the environmental pollution control program.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EROSION CONTROL

A. Provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion control measures, such as siltation basins, hay check dams, mulching, jute netting and other equivalent techniques, shall be used as appropriate. Offsite surface water shall be diverted around the site, to a downstream channel ahead of siltation barriers. Flow of surface water into excavated areas shall be prevented. Ditches around construction area shall also be used to carry away water resulting from dewatering of excavated areas. All erosion control measures shall be in place in an area prior to construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 312500 “Erosion and Sedimentation Controls.” At the completion of the work, ditches shall be backfilled, and the ground surface restored to original condition.

3.2 PROTECTION OF STREAMS AND SURFACE WATERS

A. Take all precautions to prevent, or reduce to a minimum, any damage to any stream or surface water from pollution by debris, sediment, or other material, or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing, that contains oils or sediments that will reduce the quality of the water in the stream, shall not be directly returned to the stream. Divert such waters through a settling basin or filter before being directed into streams or surface waters.

B. Do not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. Take all preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the Massachusetts Department of Environmental Protection. Submit two copies of approved contingency plans to the Engineer.

D. Water being flushed from structures or pipelines after disinfection, with a Cl2 residue of 2 mg/l or greater shall be treated with a dechlorination solution, in a method approved by the Engineer, prior to discharge.

3.3 PROTECTION OF LAND RESOURCES

A. Restore land resources within the project boundaries and outside the limits of permanent work to a condition, after completion of construction that will appear to be natural and not detract from the appearance of the project. Confine all construction activities to areas shown on the Drawings.

B. Outside of areas requiring earthwork for the construction of the new facilities, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

C. Before beginning operations near them, protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.

D. Trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.

1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Engineer, shall be immediately removed and replaced.

E. The locations of the Contractor's storage and other construction buildings required temporarily in the performance of the work, shall be cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Engineer and shall not be within wetlands or floodplains. The preservation of the landscape shall be an imperative consideration in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for approval of the Engineer.

F. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, he shall submit the following for approval at least ten days prior to scheduled start of such temporary work.

1. A layout of all temporary roads, excavations, embankments and drainage to be constructed within the work area.
2. Details of temporary road construction.
3. Drawings and cross sections of proposed embankments and their foundations, including a description of proposed materials.
4. A landscaping drawing showing the proposed restoration of the area. Indicate the proposed removal of any trees and shrubs outside the limits of existing clearing area. Indicate locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged. The Drawing shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made

only with the written approval of the Engineer. No unauthorized road construction, excavation or embankment construction including disposal areas will be permitted.

G. Remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess of waste materials, or any other vestiges of construction as directed by the Engineer. It is anticipated that excavation, filling and plowing of roadways will be required to restore the area to near natural conditions which will permit the growth of vegetation thereon. The disturbed areas shall be prepared and seeded as described in Section 329200 “Turf and Grasses,” or as approved by the Engineer.

H. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.4 PROTECTION OF AIR QUALITY

A. Burning - The use of burning at the project site for the disposal of refuse and debris will not be permitted.

B. Dust Control - Maintain all excavations, embankment, stockpiles, access roads, plant sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.

C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides may be permitted with approval from the Engineer.

D. Sprinkling, to be approved, must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Engineer.

3.5 NOISE CONTROL

A. Make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.6 MAINTENANCE OF POLLUTION CONTROL FACILITIES DURING CONSTRUCTION

A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

END OF SECTION 013545

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SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities to be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

E. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term “testing laboratory” shall have the same meaning as the term “testing agency.”

H. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

I. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.4 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.6 ACTION SUBMITTALS

A. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1. Delegated-Designer: Professionals currently registered in Commonwealth in which project work occurs.

1.7 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports and documents as specified.

E. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work. All fees associated with these permits shall be paid by the Contractor as part of the Work. Work shall not commence on any phase of the work requiring a permit until the permit is obtained. Failure of the Contractor to acquire required permits in a timely manner shall not be cause for schedule relief.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Design Professional Qualifications: A professional engineer / registered architect who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Design / engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged in the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329**,** and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect, demonstrate, repair and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods. Contractor responsibilities include the following:

1. Provide test specimens representative of proposed products and construction.
2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
4. When testing is complete, remove test specimens and test assemblies, mockups; do not reuse products on Project.
5. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.

5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor’s Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Coordinate and submit concurrently with Contractor's Construction Schedule. Update and submit with each Application for Payments.

1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
2. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Bid Prices unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, testing agencies, and authorities having jurisdiction.

B. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

C. Water from Existing System: Water from Owner's existing water system is available for use with metering. Provide connections and extensions of services and metering as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

1.5 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.

B. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

C. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

D. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch-thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch-OD line posts and 2-7/8-inch-OD corner and pull posts, with 1-5/8-inch-OD top and bottom rails. Provide concrete bases for supporting posts.

B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Engineer from manufacturer's standard colors.

C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Engineer’s Field Office: Of sufficient size, but minimum 12-feet by 50-feet, to accommodate needs of Owner, Engineer, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections for duration of project. Alternatively, the Contractor may provide separate suitable office space in an existing building within the project area of equal area as specified. Keep office clean and orderly. Furnish and equip offices as follows:

1. Field office trailer shall have at least one office, one conference room, one bathroom, one closet, and two exterior doors.
2. Bathroom shall include toilet, sink and faucet, medicine cabinet with mirror, exhaust fan, toilet tissue holder, paper towel holder, light fixture, five-gallon capacity water heater and lockable door.
3. Conference room shall include built-in plan table.
4. Engineer's field office shall be weather-tight construction with floor, walls, and ceiling completely insulated. Each room shall have at least one operating window. Each window shall have a venetian blind and full insect screen. Furnish two sets of keys for each exterior door. Provide fully insulated skirting on all sides of the field office trailer. Provide steps, platforms, handrails, and boot scrapers for each exterior door.
5. Field office trailer shall be Mobile Mini, ModSpace, Williams Scotsman, or equal. Converted storage or box containers will not be acceptable.
6. Furnishings:

    a. Provide the following furnishings for the Engineer's temporary field office for the duration of the project. All furnishings shall be new – or in very good condition – subject to approval of the Engineer.

        1) Two 60-inch by 30-inch desks with file drawer and 5 drawers, all lockable.
        2) Upholstered swivel type chair with arms for each desk.
        3) One 30-inch by 84-inch conference table.
        4) Eight armless side chairs (stacking type).
        5) One 54-inch by 30-inch folding tables.
        6) Two file cabinets, 4 drawer, legal size, Hon No. HN-315C, or equal.
        7) Four wastebaskets.
        8) One rolling plan storage rack, 10-stick capacity.
        9) One lockable storage cabinet, 72-inch high, 36-inch wide, and 18-inch deep.
        10) Four steel bookcase units, 4 shelves high, Hon No. HN-S48 ABC, or equal.
        11) Two wall mounted coat hangers with at least four hooks.
        12) One electric bottled water dispenser with hot and cold outlets and refrigerator unit. Adequate water bottles shall be provided (and paid for by the Contractor) until Final Completion.
        13) Two smoke/carbon monoxide detectors, with batteries.
        14) Two dry erase boards, aluminum frame, 36-inch by 60-inch, markers and eraser, Quartet Model No. TS-S 535 or equal.
        15) One 1000-watt minimum 1.4-cu.ft. microwave oven.
        16) One 6-cf refrigerator.
        17) One first aid kit, OSHA (1910.151.b) and ANSI (Z308.1-2003) compliant, suitable for ten people.
        18) Two (2) 24-inch or larger computer monitors, two (2) wireless keyboard & mouse combination, and two (2) Dell E-Port replicators with USB 3.0.
        19) Two desk lamps.

7. Equipment:

    a. Provide the following equipment for the Engineer's temporary field office for the duration of the project. All equipment shall be new.

        1) A multifunction Photocopier, printer and scanner with 50-sheet auto-feeder, capable of double-sided copying, printing, stapling and scanning letter-

sized, legal-sized, and 11x17-inch documents. Photocopier shall be connected to a wireless network to allow printing from any computer connected to the network. The photocopier shall also allow scanned documents to be accessed/emailed directly to any computer on the network. Contractor to provide paper and ink cartridges (black and color), as required, for the duration of the project.

2) Network router for wireless internet. Engineer's network shall be separate from the Contractor's network. WIFI strength shall be "strong" in all locations in the trailer/office and be capable of supporting video conferencing.
3) Commercial duty cross-cut shredder with basket, designed for 3 to 5 users, Fellowes Powershred SB-125i, or equal.
4) Digital Camera for the Engineer's use for the project duration. Camera shall be a major brand name (e.g., Minolta, Cannon, Olympic, Pentax, etc. – subject to the Engineer's approval) and shall have an automatic date function, 60 Mega pixel or greater, 18x optical zoom or better, at least 64 GB SD digital memory card, USB interface with driver and cable. The camera shall come complete with carrying case, rechargeable batteries, battery charger, flash memory reader, and all necessary software. After completion of project the camera will become the property of the Owner**.**
5) Three 8-outlet surge protectors with six-foot cord and minimum 1800-joule energy rating or greater; as manufactured by Belkin, or equal.
6) One 4-cup or 12-cup coffeemaker with timer, by Krups, or equal.

8. Services:

a. Provide the following services for the duration of the project. Services shall include all costs for installation, use, maintenance, and removal of all products, services and equipment billed by each provider for each service specified herein.

1) Field office shall have complete and fully functional electrical, plumbing, and HVAC systems. Provide at least two smoke detectors hard-wired into the electrical system. Perform all scheduled and unscheduled maintenance for all systems and as directed by the Engineer.
2) Electrical System: Provide connection to temporary electric service. Comply with the electrical requirements of the furnished office trailer. Provide main circuit panel, sufficient GFCI outlets and lighting in each room, exterior lights at each exterior door, and proper grounding of entire electrical system.
3) Plumbing system: Connect to existing potable water supply. Provide hot water heater and hot and cold water to each fixture. Connect waste pipes to a waste holding tank. Heat trace and insulate exterior piping to prevent freezing.
4) HVAC System: Provide central heating and air conditioning system with programmable thermostat. System shall be capable of maintaining an interior temperature of 70 degrees F when the exterior temperature is 0 degrees F and an interior temperature of 75 degrees F when exterior temperature is 100 degrees F.
5) Sanitary service: Provide regular pumping of waste holding tank, if applicable, as needed. Portable restroom will not be acceptable.

b. Communications:

1) The Contractor shall be responsible for furnishing all temporary communications.
2) Provide Verizon Fios or equal or cable line with internet access.
3) Pay all costs for installation, maintenance, and removal of the internet service and instruments.

9. Parking: the Engineer's office site shall include space for parking a minimum of five cars for the exclusive use of the Engineer and visitors.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction.

2.4 TEMPORARY WATER SERVICE

A. Furnish all labor, materials, equipment and incidentals required and install and remove bypass and temporary service pipe and fire hydrants of the sizes required to provide adequate service to all water consumers whose service will be interrupted by new water main installation and to fulfill fire service requirements. Existing fire hydrants connected to pipe being replaced and serving as temporary fire hydrants shall be connected to the temporary pipe at locations directed by the Engineer.

B. Furnish all labor, materials, equipment, and incidentals required for providing tap holes for temporary service by as required by the Engineer/Owner. The work to be done, without limiting the generality thereof, shall be as follows:

1. Excavate all tap holes as required.
2. Provide at no additional cost, sheeting and bracing, and decking as required.
3. Make taps in existing water mains of the necessary size required as approved by the Engineer.

4. Install tapping sleeve and valve at existing main.
5. Backfill all tap holes as required.
6. Restore the excavated surface.

C. Notify the Owner and all respective Fire Department(s) of all existing hydrants taken out of service. The Contractor shall cover all out-of-service hydrants with bags clearly labeled “Not In Service” or “Out Of Service”.

D. The Contractor is responsible for ensuring that all temporary hydrants are compatible with equipment used by the Owner’s Fire Department.

E. Provide temporary water service to water customers with small diameter services currently connected to mains to be shut off, in order to facilitate the work, by means of temporary hose connections. All hoses shall be 1-inch minimum diameter and shall be capable of withstanding at least 1.5 times the normal working pressure. All hoses that are to supply potable water to buildings are to be NSF 61 and/or FDA approved for contact with drinking water. These temporary service connections shall be made to sill stops outside the buildings or to temporary connections at the meter inside the buildings, as may be required or directed. All temporary piping and service connections to be installed shall be included in the respective bid prices included on the Bid Form. Payment for temporary service shall be included in the prices for furnishing and installing the various sizes of temporary pipe.

F. In cases where access to the building water meter is not possible or where temporary service connection using hoses would not provide adequate supply capacity a temporary service connection shall be made to the existing service pipe in the street between the shutoff valve at the main and the property line, or in the sidewalk area between the shutoff valve and the service shut off valves inside the building. Payment for temporary service connections shall be included in the unit Bid Price for furnishing and installing the various sizes of temporary pipe.

G. The work of relocating existing service and of furnishing and installing temporary service pipe, temporary customer services and other branches, maintaining the same, providing suitable safety precautions and removal of the temporary service pipe system shall be the sole responsibility and expense of the Contractor.

H. Temporary services shall not be used between November 1st and April 15th to prevent freezing.

I. Submit to the Engineer a daily log of all building/house addresses where temporary service connections have been installed and removed. These forms are included at the end of this section. Payment for temporary service connections and submittal of these daily logs shall be included in the unit Bid Price for furnishing and installing the various sizes of temporary pipe. No payment will be made for furnishing and installing the various sizes of temporary pipe until the Contractor has submitted all daily logs of buildings/houses transferred to and removed from temporary service pipe.

J. Size requirements for temporary bypass piping and temporary bypass piping water supply layouts shall be as follows:

1. The minimum size of temporary bypass piping shall be 2-inches.
2. The minimum size of temporary bypass piping that supplies temporary fire hydrants shall be 4- or 6-inches or shall be a minimum diameter of at least the same diameter of the existing fire service connections.

3. Temporary hydrants shall be attached to temporary bypass piping that is at least 4-inches in size or the minimum diameter of at least the same diameter of the existing fire service connections. If 4-inch temporary bypass piping is not looped and is supplied at one end only, the length shall not exceed 400 feet. For 4-inch temporary bypass piping that is looped and supplied at both ends, the length shall not exceed 1,200 feet. Temporary bypass piping that is 6-inches in size shall be used when the bypass piping lengths exceed 400 feet if bypass piping is supplied at one end only or when lengths exceed 1,200 feet when bypass piping is supplied at both ends.
4. Review Owner records to determine all water service locations and sizes that need to be supplied by temporary bypass piping.
5. Verify the condition all nearby hydrants prior to installing temporary services.
6. Consult with the Owner to confirm locations of all affected water mains, hydrants and service connections within anticipated shut down limits.

K. Submit, in accordance with Section 013300 “Submittal Procedures”:

1. Plans for temporary bypass piping.
2. Proposed temporary bypass piping layouts to maintain water supply to all water customers affected by water mains to be shut down for each and every work area and proposed.
3. Materials to be used for temporary bypass water supply shall be submitted for Engineer’s review and approval.
4. Engineer and Owner reserve the right to review Contractor’s proposed temporary bypass water supply plans and layouts. The safety and integrity of the water system is of prime importance.

L. If after installation of temporary bypass piping there are problems with water supply to any areas, make necessary changes to temporary bypass piping layouts as directed by Engineer. The safety and integrity of the water supply system is of prime importance.

M. Products:

1. The temporary service pipe, connections and branches shall be of the highest quality and shall be fully adequate to withstand the pressures and all conditions of use. Provide wye connections at all customer sill cocks so customer has access to water supply for outdoor watering. All hoses shall be minimum 1-inch diameter and shall be capable of withstanding at least 1.5 times the normal working pressure. All hoses that are to supply potable water to buildings shall be NSF 61 approved for contact with drinking water.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where shown on the Drawings or where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work. Engineer’s trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use within 30 days of the Notice to Proceed and prior to Commencement of Work at the site. Do not remove until approved by Engineer or are replaced by authorized use of completed permanent facilities.

3.3 ENGINEER'S OFFICE

A. Engineer's trailer shall be set up and ready for occupancy within 30 days of the Notice to Proceed and prior to commencement of Work at the site. All systems, furnishings, equipment, and services specified herein shall be furnished, installed, and completely operational for the field office to be considered established.

1. Provide regular office cleaning services for the duration of the project.
2. Provide supplies including, but not limited to restroom supplies (toilet tissue paper, paper towels, and soap), as well as light bulbs, air conditioner filters, etc.
3. Provide office supplies for printers and fax machines, hanging files and folders for filing cabinets, pens, pencils, markers, staplers, 3-hole punch, 3-ring binders, etc., as directed by the Engineer.
4. Supply all fuel for heating and pay all utility bills.

B. Install field office plumb and level.

C. Provide snow removal in the parking area and stairs by 7 AM each workday when necessary.

D. All files that are to be transferred to the Owner at the end of the project shall be moved by the Contractor as directed by the Engineer. All storage boxes, binders, etc. necessary to move and store the files shall be provided by the Contractor.

E. Engineer's trailer shall be removed, and the site shall be cleaned up and restored before Final Completion of the project.

3.4 CONTRACTOR'S FIELD OFFICE

A. Provide a temporary field office(s) for the Contractor's use for the duration of the project. An authorized representative of the Contractor shall be present at all times while the Work is in progress. Instructions received at the Contractors field office from the Engineer shall be considered delivered to the Contractor.

B. Locate field office(s) in accordance with approved shop drawings, in a location separate from the Engineer's field office, and as directed by the Owner.

C. Establish and occupy field office within 30 days of the Notice to Proceed, unless otherwise approved by the Engineer or Owner.

3.5 AREAS FOR CONSTRUCTION STAGING AND CONSTRUCTION TRAILERS

A. Areas used for construction staging, construction trailers, and Contractor parking shall the responsibility of the Contractor and shall be staked in the field for review and approval by the Engineer and Owner prior to installation. After the limits of areas are approved, the areas shall be covered with geotextile fabric and a minimum 6-in layer of crushed stone on top of the fabric to prevent disturbance of existing soil and lawn areas throughout the construction period.

B. Protect all areas used for construction staging and construction trailers with temporary construction fencing. Temporary fencing shall be chain link fencing, 6 feet high, fabricated from No. 9 gauge galvanized wire -woven in a 2-in diamond mesh with top salvage and having galvanized steel H or pipe intermediate and terminal posts. Post spacing shall not exceed 8 feet on center. Cross bracing, reinforcing gates and other parts of fencing shall conform to standard Specifications of the National Chain Link Manufacturers Association. All posts shall be set into temporary concrete footings or driven into the ground. Furnish and install matching gates equipped with suitable locks and other hardware to provide access for construction apparatus or firefighting equipment. Contractor shall examine and repair vandalized, broken or downed fence and gates on a daily basis and immediately after high winds. The Contractor shall remove and dispose of all temporary fencing and concrete footings at the completion of the project.

C. The Contractor's temporary offices and staging yard(s) shall be completely surrounded and contained within a temporary chain link fence. The fence shall be a minimum of 6 feet high and include an access gate that shall be locked and secured at the end of each workday. No Trespassing/Keep Out signs shall be located at a minimum of every 40 feet along the fence line. The fenced-in yard(s) shall contain all Contractor's temporary offices, equipment, pipe and material stockpiles not to exceed side slopes of greater than 15 percent, screening operations, and all other activities associated with the Contractor's work. However, material screening/processing operations will not be allowed if the Contractor's yard is located in a residential or other sensitive area, as determined by the Owner. The fence shall be removed at the completion of the project. All activities associated with the site(s) are subject to the Town's Bylaws.

3.6 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service, if approved by Owner.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Water Service: If approved, connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Final Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Temporary Light and Power: Provide by Contractor, including 220 Volt service for welding, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Engineer and Owner.

3.7 SUPPORT FACILITIES INSTALLATION

A. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

B. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain

temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas accordance with Section 312000 "Earthwork."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary offsite parking areas for construction personnel.

E. Storage and Staging: Provide temporary offsite area for storage and staging needs.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings. Signs shall be constructed of A-A Ext – APA grade plywood, 1-in thick. Posts and braces shall be of pressure treated lumber.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.
4. Provide required SRF signage that complies with the “Guidelines for Enhanced Public Awareness of SRF Assistance Agreements” issues by the United States Environmental Protection Agency on June 3, 2015, or the “Guidelines for Implementing the Bipartisan Infrastructure Law Signage Term and Condition for the State Revolving Fund Programs” issued by the United States Environmental Protection Agency on December 8, 2022, as applicable, regarding the use of signs or other methods of enhancing awareness of SRF project.
5.
    a. 2015 guidance:

https://www.epa.gov/sites/default/files/2016-07/documents/guidelines_for_enhancing_public_awareness_srf.pdf

H. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.8 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

I. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide, install and maintain signage directing occupants to temporary egress.

J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

L. Weather protection shall comply with M.G.L. Chapter 149 Section 44G.

3.9 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.

3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Engineer.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.10 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
2. Clear snow and ice from all drives, walks and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Final Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Final Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. Just prior to Final Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

3.11 TEMPORARY SERVICE PIPE INSTALLATION

A. Temporary service pipe shall not be installed without the prior approval of the Engineer.

B. Submit a plan for the proposed layout and sizing of the temporary service pipe and connections to the existing distribution system for the Engineer's approval. This plan shall be drawn on a clean set of project drawings or Owner' water distribution system drawings and the temporary service pipe layout shall be consistent with the Contractor's proposed sequence of operations. Proposed changes in the layout of temporary service piping that the Contractor wishes to make, as the work proceeds, shall also be submitted for the Engineer's approval.

C. Generally, temporary service pipe shall be laid in gutters; however, in business areas the Contractor shall, if directed by the Engineer, lay temporary service pipe behind buildings. At driveways, pipe crossings shall be protected by cold patch cover or other approved method. At street intersections, cut a straight line in the existing bituminous paving and lay the temporary service pipe in a shallow trench covered with temporary surfacing. At the Engineer's options, the Contractor may be allowed to use hose to come around bends or to cross driveways. Sanitary precautions shall be satisfactory to the Engineer and shall meet all requirements of the public health authorities having jurisdiction. The installation shall be watertight. Care shall be exercised throughout to avoid any possible pollution of mains, house services, or the temporary service pipe. The interior of temporary service pipe, temporary hoses and any other connection pipe to convey water for potable use shall be disinfected prior to its use in accordance with AWWA C651.

D. All temporary pipe shall be suitably valved and meet the approval of the Engineer. A valve shall be provided at each hydrant connection and each tap hole connection. Valves shall be located no further than 500-feet apart when directed by the Engineer.

E. Provide a temporary fire hydrant for an existing fire hydrant connected to water mains taken out of service to facilitate new work, as directed by the Owner and Engineer.

F. Whether it is being installed, in service, or being removed, the amount of temporary service pipe kept on the job shall be the minimum that will allow the work to continue at a reasonable rate. The Owner and Engineer reserve the right to review and approve the Contractor's proposed temporary bypass piping plan and layout for all work areas to verify that the proposed amount of existing system piping shut down and the amount of temporary bypass piping proposed for installation at any one time is in direct proportion to the required areas of existing water mains required to be shut down to facilitate the installation of new work. The safety and integrity of the water system is of prime importance.

END OF SECTION 015000

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TOWN OF YARMOUTH

WASTEWATER COLLECTION AND WATER RESOURCES RECOVERY FACILITIES

PHASE 1 – CONTRACT 6

DAILY LOG FOR INSTALLATION OF TEMPORARY SERVICE CONNECTIONS

DATE:_____ **SUBMITTED BY:**_____

	STREET	BUILDING/HOUSE NO.	COMMENTS/NOTES
1			
2			
3			
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SECTION 015526 - TRAFFIC CONTROL AND POLICING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Comply with all requirements of the MassDOT State Highway Access Permit included in Appendix B.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating traffic operations on the Project including, but not limited to, the following:

1. Traffic control and protective devices, as required to expedite vehicular traffic flow during construction
2. Providing access to all buildings including business and parking areas at all times.
3. Maintaining a minimum of one 11-ft lane of traffic, in one direction, at all times.
4. Providing police details at certain times in order to maintain safe traffic control within the project area.

B. Related Requirements:

1. Section 015000 “Temporary Facilities and Controls” for staging areas and parking.

C. All traffic control shall be in accordance with the Federal Highway Administration’s Manual on Uniform Traffic Control Devices (MUTCD), the Contract Drawings and these specifications. Where reference is made to the MUTCD, the revision in effect at the time of bid opening shall apply.

D. Furnish, install, operate and maintain equipment, services and personnel, with traffic control and protective devices, as required to expedite vehicular traffic flow during construction.

E. Follow the traffic control requirements shown on the Contract Drawings (TM-1 to TM-12) detailing temporary changes in traffic control equipment, street or road closures, detours, etc. Make every effort to adhere to these requirements. The Owner and Engineer reserve the right to modify traffic control requirements throughout the course of the Contract.

1.3 ACTION SUBMITTALS

A. Traffic Control Plan:

1. Plan shall be prepared by a Traffic Engineer licensed in the Commonwealth of Massachusetts and detail all temporary changes in traffic control equipment, street or road closures, detours, etc., prior to the start of construction.
2. The Owner reserves the right to request modifications to the plan throughout the course of the Contract. When necessary, update the plan and forward changes to the Owner, Engineer, and Town of Yarmouth Police Department, Fire Department, and School Department for approval.
3. At least 15 days prior to mobilization at the site or any work commencing within the right of way, submit a detailed Traffic Control Plan to the Owner and Engineer for review, outlining plans for traffic controls during construction. Include:

    a. Locations and estimated duration of detours and traffic controls and signage to be employed.
    b. Number and width of open lanes
    c. Design and material of signs, including signage to direct traffic to businesses.
    d. Consideration of appropriate traffic interruptions during rush hour time periods on affected roads.
    e. Assume all work will be performed during normal working hours unless prior notice and approval is received from the Owner and Engineer.
    f. Phased plans showing the setup, number and width of open lanes, and schedule.
    g. Pedestrian access plan, as necessary, that includes furnishing, installing and maintaining all pedestrian access and control devices meeting ADA guidelines.
    h. Coordination with traffic control plans for other contractors working on other Owner projects.

4. The Traffic Control Plan shall meet all the requirements included in the MassDOT State Highway Access Permit included in Appendix B.
5. No work shall commence without prior approval of the Traffic Control Plan by the Engineer and Owner.

1.4 REQUIREMENTS

A. Coordinate with the Owner and Town of Yarmouth Police Department, Fire Department, and School Department to maintain access at all times at each site for emergency vehicles and school buses.

B. Cooperate fully with the Owner and the Owner’s other contractors to coordinate all work under this Contract and/or detours planned to ensure that they do not adversely impact work under this Contract or the other contracts.

C. Provide written notification to all property owners at least 14 days (excluding Saturdays, Sundays and legal holidays) in advance of any work or detours that will interfere with access to their residence or place of business.

D. Normal working hours are defined as 7AM to 4PM on weekdays. No work shall occur on Sundays or holidays observed by the Town of Yarmouth personnel. Work on Saturdays may be allowed if deemed necessary with prior approval of the Owner and Engineer.

E. Contractor will not be allowed to perform any work on Route 28 between Memorial Day and Labor Day of any year, unless authorized by the Owner and MassDOT.

F. Remove temporary equipment and facilities when no longer required and restore grounds to original conditions.

G. No road shall be closed to traffic without the prior consent of the Engineer, Owner and MassDOT (for Route 28). Contractor shall submit a written request to the Owner 14 days (Saturdays, Sundays and legal holidays excluded) in advance of any traffic pattern modifications. Written permission shall be obtained prior to implementing traffic pattern modification (e.g., road closure or detour). Owner reserves the right to reject requests without impacting the Contractor's schedule or cost.

H. Traffic control, including but not restricted to signage and devices, shall be provided for all openings in roads by the Contractor in accordance with Owner and MassDOT Highway Division standards.

1.5 MINIMUM REQUIREMENTS FOR TRAFFIC CONTROL AND PEDESTRIAN ACCESS

A. The Contractor shall furnish, install, operate and maintain equipment, services and personnel with traffic control and protective devices, as required to expedite vehicular traffic flow during construction.

B. All traffic control devices conforming to those shown on the approved Traffic Control Plan shall be in place prior to the start of any construction.

C. Provide for access to all buildings including businesses, parking areas and private residence driveways at all times.

D. Where possible, allow for the maintenance of a minimum of one 11-ft lane of traffic for both directions (lane to be shared and the direction of travel to alternate in some situations under police officer control) at all times.

E. Police details or flaggers will be required at certain times in order to maintain safe traffic control within the project area. This requirement will be determined by the Owner or Engineer, and coordinated by the Contractor. Policing is discussed in Policy Memorandum PM-15, included in Part II of the Supplementary Conditions.

F. Provide portable, electronic variable message signs (VMS), as necessary, and as directed by the Engineer. Messages shall be determined by the Engineer and the Owner. Location of signs shall be included in the approved Traffic Control Plan and will be required to be moved and set up by the Contractor as the work progresses. Payment for the use of message boards shall be made under the corresponding Bid Item in the Bid Form.

G. Maintain access to storefronts, businesses and private residences throughout the project area at all times. It is the Contractor's responsibility to coordinate with local businesses, property

owners and the Owner and to maintain access during all construction activities. Contractor shall be responsible for providing, maintaining and removing appropriate signage indicating that specific businesses are open during all construction activities.

H. Provide suitable temporary pedestrian walkways as necessary to provide safe and secure access to the storefronts and businesses in the project area at all times. Allow for receipt of deliveries, including mail, and foot traffic resulting from daily activities. Do not close or obstruct any portion of a street or walkway without obtaining prior approval from the Owner.

I. At all times conduct the Work in such a manner as to ensure the least practicable disruption and obstruction to public travel, businesses and access. The convenience of the general public, residences and businesses along and adjacent to the area of work shall be provided for in a satisfactory manner, consistent with the operation and local conditions. The Contractor shall be responsible for proper maintenance, control and detour of both vehicular and pedestrian traffic in and around the area of construction.

J. Excavated or other material stored adjacent to or partially upon a roadway surface shall be adequately marked for vehicular and pedestrian safety at all times. Excavation shall be conducted in a manner to cause the least possible interruption to traffic outside of the limits of work.

K. Maintain and coordinate access for scheduled solid waste pickup at all times. Coordinate with Owner and Owner’s solid waste collector for specific pick-up days and times.

1.6 HAUL ROUTES

A. Consult with the Owner to establish public thoroughfares that will be used as haul routes and site access.

1.7 POLICE DETAILS

A. When, in the opinion of the Owner, Engineer, or the Town of Yarmouth Police Department, public safety or convenience requires the services of police, the Engineer or Owner may direct the Contractor to provide policing to direct traffic within the location of work under this Contract.

B. When so directed, make all arrangements in obtaining the necessary policing manpower.

C. Contact the Owner to determine the need for and number of Police details. All police details must be coordinated with the Owner prior to the Contractor arranging for the necessary police details.

D. Police details shall be paid for on a weekly basis in accordance with an invoice from the Police Department, with payment sent directly to the Police Department by the Owner.

E. The intent is to ensure public safety by police direction of traffic. Police are not to serve as watchmen to protect the Contractor's equipment and materials, or to warn pedestrians of such hazards as open trenches.

F. Nothing contained herein shall be construed as relieving the Contractor of any of his/her responsibilities for protection of persons and property under the terms of the Contract.

G. Cancellation of any scheduled police detail due to inclement weather or any other reason is the responsibility of the Contractor and shall be made no less than 2 hours prior to the scheduled start time. Contractor shall be responsible for payment of police details not cancelled or cancelled without proper 2-hour minimum notice, with no reimbursement by the Owner. The Police Department will charge the Contractor the minimum 4-hours for each detail not cancelled with the 2-hour minimum notice.

H. If a requested detail cannot be filled, use of flaggers may be allowed, at the discretion of the Yarmouth Police Department.

I. All payments to police under this Contract shall be in accordance with Section 34B of Chapter 149 of the General Laws of the Commonwealth of Massachusetts which states that reserve police officers shall receive the same prevailing wage rate as paid to regular officers.

J. Use of police shall be in conformance with Policy Memorandum No. PM-15, included in Part II of the Supplementary Conditions.

PART 2 - PRODUCTS

2.1 TRAFFIC SIGNALS AND SIGNS

A. Provide and operate traffic control and directional signals required to direct and maintain a safe and orderly flow of traffic in all areas under the Contractor's control or affected by the Contractor's operations.

B. Provide traffic control and directional signs, mounted on barricades or standard posts at the following locations, as directed by the Engineer:

1. Each change of direction of a roadway and each crossroads.
2. Detours.
3. Parking areas.
4. For businesses within detour routes.
5. As specified on the Drawings.

C. The Contractor will be required to furnish, install, relocate and remove temporary barriers, fencing, signage and other traffic safety devices for various traffic setups related to different phases of the Project. Provide, where shown on the Drawings, and within approved Traffic Control Plans, traffic safety devices, including but not limited to temporary jersey barriers, temporary jersey barriers with fencing, reflector drums with lighting, etc. All traffic control devises shall conform to the MUTCD.

D. Existing permanent traffic control signing and devices, including guardrails, shall not be removed unless called for on the Drawings or without the prior consent of the Owner and the Engineer.

E. Detours around construction will be subjected to the approval of the Owner and the Engineer. Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic. While traffic is detoured, expedite construction operations and periods when traffic is being detoured will be strictly controlled by the Owner. Electronic message boards shall be utilized where required in accordance with the approved Traffic Control Plans.

F. Provide signs promoting access to impacted businesses at all times during construction.

PART 3 - EXECUTION

3.1 REQUIREMENTS

A. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. Be fully responsible for damage or injuries whether or not Police protection has been provided.

B. Take precautions to prevent injury due to structures above grade. The Contractor shall ensure that all structures (e.g., frames and covers, gate box covers, etc.) are clearly marked with orange safety paint or lighted barrels at all times or until finished grade is set. Type of protection shall be approved by the Engineer.

C. After completion of the project, remove all traffic control devices, signage and support systems and patch the disturbed area to match existing as closely as possible and to the satisfaction of the Owner and Engineer.

3.2 CONSTRUCTION PARKING CONTROL

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner’s operations, or construction operations.

B. Monitor parking of construction personnel's private vehicles, maintain free vehicular access to and through parking areas and prohibit parking on or adjacent to access roads or in non-designated areas. All parking shall be in areas approved by the Engineer and Owner. Use of private business or residents parking lots or Town-owned property is prohibited unless approved by the Owner.

END OF SECTION 015526

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SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 “Summary” for Contractor requirements related to Owner-furnished products.
2. Section 017700 “Closeout Procedures” for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycle contract materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in PART 2 “Comparable Products” Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant

qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in PART 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Paragraph 7.05 of the General Conditions for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

a. Name of product and manufacturer.
b. Model and serial number.
c. Capacity.
d. Speed.
e. Ratings.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection for wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Engineer will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

   a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

   a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product that complies with requirements.

   a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.

   a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer that complies with requirements.

   a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
   b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and

other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

a. For approval of products by unnamed manufacturers, comply with requirements in Paragraph 7.05 of the General Conditions for substitutions for convenience.

C. Visual Matching Specification: Where Specifications require the phrase "match Engineer's sample," provide a product that complies with requirements and matches Engineer's sample. Engineer's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Paragraph 7.05 of the General Conditions for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Engineer from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Engineer will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineers and owners, if requested.
5. Samples, if requested.

B. Engineer’s Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 “Submittal Procedures.”

1. Form of Approval of Submittal: As specified in Section 013300 “Submittal Procedures.”
2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

D. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor’ request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Examination.
2. Preparation.
3. Construction layout.
4. Field engineering and surveying.
5. Installation of the Work.
6. Cutting and patching.
7. Miscellaneous Work
8. Private land.
9. Pipe locations.
10. Open excavations.
11. Test Pits.
12. Maintenance of Traffic.
13. Care and protection of property.
14. Protection and relocation of existing structures and utilities.
15. Water for construction purposes.
16. Maintenance of flow.
17. Cooperate within this contract and with other contractors.
18. Cleanup and disposal of excess material.
19. Restoration.
20. Tree removal within right-of-way
21. Progress cleaning.
22. Starting and adjusting.
23. Protection of installed construction.
24. Pipe Trench Width.
25. Pipe Trench Depth.
26. Decking.
27. Notifications.

B. Related Requirements:

1. Section 011000 "Summary" for limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.

3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certified Surveys: Submit two copies signed by land surveyor.

C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:

1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
3. Products: List products to be used for patching and firms or entities that will perform patching work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.

    a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 “Quality Requirements.”

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements, whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Equipment supports.
    d. Piping, ductwork, vessels, and equipment.
    e. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraphs, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

E. Any failure of the Contractor to acquaint himself with the available information will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully

performing the work. The Owner assumes no responsibility for any conclusions or interpretation made by the Contractor on the basis of the information made available by the Owner.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, plantings, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Identification: Existing benchmarks and control points are shown on the Drawings

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items onsite and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall

coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 MISCELLANEOUS WORK

A. Crossing and Relocating Existing Utilities

1. Perform any extra work required in crossing culverts, watercourses, including brooks and drainage ditches, storm drains, gas mains, water mains, electric (including overhead wires), telephone, gas and water services, traffic signal loop detectors, and other utilities. This work shall include bracing, hand excavation, backfill (except screened gravel) and any other work required for crossing the utility or obstruction not included for payment in other items in the Bid Form. Notification of Utility Companies shall be as specified in this Section.
2. In locations where existing utilities cannot be crossed without interfering with the construction of the work as shown on the Drawings, remove and relocate the utility (including traffic signal loop detectors) as directed by the Engineer or cooperate with the Utility Companies concerned if they relocate their own utility. The Contractor will be responsible for coordinating any and all utility and service connection relocations with the respective Utility Company, whether or not these relocations are shown on the Drawings.
3. At pipe crossings and where designated by the Engineer, place screened gravel bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid diameter of the pipe crossed. Payment for screened gravel at pipe crossings will be made according to the unit price bid in the Bid Form.
4. All traffic conduits and underground loop detectors discovered during construction shall be maintained or repaired, as required.

B. Restoring Driveways, Driveway Aprons and Sidewalks

1. Existing public and private driveways disturbed by the construction shall be replaced. Paved drives shall be repaved to the limits and thicknesses existing prior to construction. Gravel drives shall be replaced, compacted, and regraded in kind. Bituminous driveways shall be saw cut across the full width at the limits of construction prior to excavation, the entire width shall be excavated and re-constructed to match the limits and thickness existing prior to construction. Cement concrete driveways shall be saw cut across the full

width at the nearest expansion or construction joint beyond the limits of construction prior to excavation, the entire width shall be excavated and re-constructed to match the limits and thickness existing prior to construction.

2. Existing public and private sidewalks disturbed by the construction shall be replaced with sidewalks of equal quality and dimension. All concrete sidewalks shall be saw cut at the nearest expansion or construction joint across the entire sidewalk width and replaced. The entire concrete sidewalk panel shall be removed and replaced with a concrete sidewalk of equal quality and dimension. All bituminous sidewalks shall be saw cut at the limits of disturbance across the entire sidewalk width and replaced with a bituminous sidewalk of equal quality and dimension.
3. Restoring driveways and sidewalks shall include furnish, install, grade and compact gravel subgrade and HMA or concrete material to repair or reconstruct Sidewalks and Driveways as directed by the Engineer. Work shall also include removal of broken HMA or concrete edges, furnish and install lot curb, curb transitions, sweeping, saw cutting and proper sealing joints.
4. Fences in the vicinity of the work shall be protected from damage under this item. If damaged, fences shall be replaced in condition equal to that prior to being damaged and the work shall be satisfactory to the Engineer.

C. Cleaning Up

1. Remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and restore the site of the work to a neat and orderly condition.

D. Incidental Work

1. Do all incidental work not otherwise specified, but obviously necessary for the proper completion of the work as shown on the Drawings and as specified herein. Unless special payment is specifically provided in Section 012001 “Price and Payment”, all incidental work and expense in connection with the completion of work under the Contract will be considered a subsidiary obligation of the Contractor and all such costs shall be included in the appropriate items in the Bid Form in connection with which the costs are incurred.

E. Digital Videotaping and Photographic Documentation of Project

1. Prior to the excavation in any street or cross-country area, document existing conditions using digital construction videos and photography as detailed in Section 013233 “Photographic Documentation.”

F. Removal and Replacement of Signs, Lampposts, Stonewalls, Fences, Gates and Mailboxes

1. Existing signs, lampposts, stonewalls, fences, gates, and mailboxes which may be damaged or removed during the course of installing the new pipelines shall be reinstalled in a vertical position at the same location from which they were removed. Replace damaged items with items of equal or better quality than the damaged items. Provide a concrete anchor as necessary, to ensure a rigid alignment. Exercise care in the reinstallation of all items to prevent damage to the newly installed pipelines, roadways, and sidewalks.

G. Restoration and Replacement of Curbing

1. Existing concrete, bituminous, timber or granite curbing shall be protected. If necessary, curbing shall be removed and replaced after backfilling. Curbing which is damaged during construction shall be replaced with curbing of equal quality and dimension at the Contractor's expense. Granite curbing removed and reset shall conform to Section 580.64 of the Massachusetts DPW Specifications. Joints between sections shall be pointed as required after resetting. Bituminous berms shall conform to Section 501 of the Mass DPW Specifications.

H. Protection and Bracing of Utility Poles

1. Make all arrangements with the proper utility companies for bracing and protection of all utility poles that may be damaged or endangered by the operations. Work under this item shall include the related removal and reinstallation of guy wires, or support poles whether shown on the Drawings or not.

I. Restoring Easements and Rights of Way

1. Be responsible for all damage to private property due to the operations. Protect from injury all walls, fences, cultivated shrubbery and vegetables, fruit trees, pavement, underground facilities, such as water pipe, sprinkler systems, or other utilities, which may be encountered along the route. If removal and replacement are required, it shall be done in a workmanlike manner so that replacement is equivalent to that which existed prior to construction, and in a timely manner so that service is restored as soon as possible after construction.
2. Existing lawn and sod surfaces damaged by construction shall be replaced in a timely manner. At a minimum, areas disturbed between the period from October 2 to March 31 shall be restored during the period from April 1 to June 1, and areas disturbed between the period June 2 to August 14 shall be restored during the period from August 15 to October 1. Cut and replace the lawn and sod, with new sod in the areas indicated on the Drawings, or restore the areas with an equivalent depth and quality of loam, seed and fertilizer as necessary to produce a stand of grass at least equal to that existing prior to construction in all other areas, as directed by the Engineer. These areas shall be maintained and reseeded, if necessary, until all work under this Contract has been completed and accepted. Any additional work required to restore property to the original condition shall be performed.
3. Existing trees, shrubs, plants and bushes outside of easements shall be fully protected as directed by the engineer. The work shall also include removing and replacing those trees, shrubs and bushes as indicated on the Drawings. It shall include the careful excavation of the root ball, which shall be wrapped with burlap while out of the ground. Replant them after backfilling the trench, stake them in an upright position and periodically water replanted trees, bushes and shrubs. Be fully responsible for ensuring that any and all trees, bushes and shrubs removed and replanted "take" and return to a viable state. Any replanted item that fails to "take" or that is so damaged as to be unsuitable for replanting shall be replaced, at no additional cost to the Owner, with a tree, bush or shrub equal to the one removed.
4. The Engineer will inspect all work for provisional acceptance upon the written request received at least 10 days before the anticipated date of inspection.

a. After all necessary corrective work has been completed, the Engineer will certify in writing the provisional acceptance of the planting.
b. All plants shall be guaranteed for not less than 1 full year from the time of provisional acceptance.
c. At the end of this period, any plant that is missing, dead, or not in satisfactory growth, as determined by the Engineer, shall be replaced.
d. All replacements shall be plants of the same kind and size. They shall be furnished and planted as specified herein. The cost of replacement shall be borne by the Contractor except where it can be definitely shown that loss resulted from vandalism or the Owner's failure to maintain planting as instructed.
e. At the end of the guarantee period, inspection will be made by the Engineer upon written request submitted by the landscape contractor at least 10 days before the anticipated date.
f. After all necessary corrective work has been completed and tree staking has been removed, the Engineer will certify in writing the final acceptance of the planting.

J. Temporary Facilities

1. Furnish, install, maintain and remove all temporary facilities and equipment required for construction or called for in Section 015000 “Temporary Facilities and Controls”, or as required by the Engineer.

K. Environmental Protection Measures

1. Furnish, install, maintain, and remove all environmental protection measures including, but not limited to, compost socks, silt fences, siltation control devices, and berms as specified in the contract documents.

L. Removal and Replacement of Underground Sprinkler Systems

1. Investigate to locate existing underground irrigation/sprinkler systems located within easement areas on private property and along Town rights-of-way prior to the Work of this Contract. All sprinkler systems encountered shall either be protected or removed and replaced as required. Repairs to sprinkler systems shall be performed within 10 working days of their removal/damage. Coordinate all work associated with removal and replacement with the individual property owners.

M. Protection and/or Removal and Replacement of Traffic Loops

1. Protection and/or removal and replacement of Traffic Signal Conduits, Wiring and Loop Detectors and Town Fire Box Wiring that is damaged during construction:

a. Existing traffic signal conduit, wiring and loop detectors and fire box wiring conduit and wiring that are damaged or removed during construction shall be reconstructed, restored in “like new” working condition, and approved by Owner and Engineer in the same location from which they were removed.
b. Temporary loop detectors shall be placed in temporary patching and as directed by the Engineer. Permanent loop detectors shall be placed in permanent trench patch areas, final binder course or as directed by the Engineer.

c. Test all replaced loop detectors following installation in accordance with the MHSSHB and IMSA testing procedures in the presence of the Engineer and submit a copy of the testing results to the Owner.

N. Loaming and Seeding

1. The Contractor shall be responsible for replacing all loamed and seeded areas that are disturbed during construction. Damaged areas shall be restored to conditions equal to or better than the original conditions. The Contractor shall be responsible for the condition of the restored area for a period of one year.

O. Coordination of Policing

1. The Contractor shall be responsible for making all arrangements in obtaining the proper policing manpower. Coordinate all policing with the Owner and Police Department. Any costs incurred by the Contractor for making arrangements and coordination for policing shall be reimbursed under the Miscellaneous Work and Cleanup item. All invoices for policing will be paid directly by the Owner.

P. Repair of Existing Utilities Damaged During Construction

1. Assume full responsibility for the protection of all buildings, structures, utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, manholes, catch basins, electric ducts, cable ducts, and telephone ducts, whether or not they are shown on the Drawings. Support and protection of some existing utilities are called out on the Drawings for the Contractor's information, but the Contractor is responsible for support and protection of all utilities. Carefully support and protect all structures and utilities from damage of any kind during construction. All damage resulting from the Contractor's operations shall be repaired by him/her at his/her expense.

3.8 PRIVATE LAND

A. Do not enter or occupy private land outside of easements, except by written permission of the landowner and the Owner.

3.9 PIPE LOCATIONS

A. Locate pipelines substantially as indicated on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve him/her from laying and jointing different or additional items where required.

3.10 OPEN EXCAVATIONS

A. Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide suitable

and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions, but shall always be confined to the limits prescribed by the Engineer. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street, and requiring that the trench shall not remain open overnight.

B. Take precautions to prevent injury to the public due to open trenches. Provide adequate light at all trenches, excavated material, equipment, or other obstacles which could be dangerous to the public at night.

C. As mandated by Chapter 82A of the Massachusetts General Law (MGL), the trench safety regulations require that all Contractors, whether public or private, take specific precautions to protect the general public and prevent unauthorized access to unattended trenches. Accordingly, unattended trenches must be covered, barricaded or backfilled. Covers shall be road plates at least 3/4 –in thick or equivalent; barricades shall be fences at least 6-ft high with no openings greater than 4-in between vertical supports; backfilling shall be sufficient to eliminate the trench. Alternatively, Contractors may choose to attend trenches at all times, for instance by hiring a police detail, security guard or other attendant who shall be present during times when the trench will be unattended by the Contractor. For purposes of this Paragraph, a "trench" shall be defined as an excavation which is narrow in relation to its length, made below the surface ground in excess of 3 feet below grade and the depth of which is, in general, greater than the width, but the width of the trench, as measured at the bottom, is no greater than 15 feet and the words "excavator", "excavation" and "emergency" shall have the same meanings as defined in Section 40 of Chapter 82 of the MGL. The word "excavator" as used in this Paragraph shall also mean "Contractor.

3.11 TEST PITS

A. Excavate test pits, at the direction of the Engineer, to locate underground pipelines or structures or confirm dimensions, measurements, and pipe outside diameter for materials fabrication, in advance of the construction. Backfill test pits immediately after their purpose has been satisfied and restore and maintain the surface in a manner satisfactory to the Engineer.

1. The excavation of test pits will require work by the Contractor including: excavation, cutting the existing pavement or sidewalk, disposal of excavated materials and/or reuse in the backfill of suitable materials, sheeting, supporting utilities, bracing and drainage, decking (if required or directed), re-bedding existing pipe backfilling, providing granular materials if so directed, water handling, disposal of surplus material, and temporary and/or permanent pavement restoration as directed.
2. Test pits shall be refilled using backfilling techniques and procedures suitable for permanent re-bedding of the pipe and refilling of the excavation to provide suitable subgrade for heavy vehicular traffic. Temporary pavement shall be provided and maintained until permanent pavement restoration is made at the direction of the Engineer.
3. Test pits shall be of sufficient dimensions and depths to definitely establish: pipe depths, existing pipe materials, outside pipe diameters; locations of existing joints, fittings, and valves; and other information on the existing subsurface conditions that may be needed for planning the Contractor's operations and selecting and ordering materials for the work

reasonably in advance of executing the work for its orderly progression and completion, and for the minimum inconvenience to the public.

4. Barricades shall be provided as specified or as directed for protection of the public.

3.12 MAINTENANCE OF TRAFFIC

A. Unless permission to close a street is received in writing from the proper authority, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Engineer.

B. Detours around construction will be subject to the approval of the Owner, the Engineer, and the Yarmouth Police Department in accordance with the provisions included in Section 015526 “Traffic Control and Policing.” Where detours are permitted, provide all necessary barricades and signs as required to divert the flow of traffic. Submit a traffic management plan for review and approval prior to implementing any detours. Expedite construction operations while traffic is detoured. Periods when traffic is being detoured will be strictly controlled by the Owner. All unpaved roads or ways used for traffic diversion, detours or Contractor's access routes, must be maintained dust free by means of water or calcium chloride, or a combination of both, as directed by the Engineer.

C. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. Be fully responsible for damage or injuries whether or not police protection has been provided.

D. Use of police for traffic control shall be in conformance with Department of Environmental Protection Bureau of Water Resources Policy Memorandum No. PM-15 included in Part II of the Supplementary Conditions.

E. Emergency vehicles and school buses shall be provided access to all streets at all times.

F. All streets shall be plated, as necessary, every night subject to the approval of the Owner and MassDOT (for Route 28). No open excavations will be allowed after working hours.

3.13 CARE AND PROTECTION OF PROPERTY

A. Be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the Engineer.

3.14 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. Assume full responsibility for the protection of all buildings, structures and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water

pipes, hydrants, sewers, drains and electric and telephone cables, whether or not they are shown on the Drawings. Carefully support and protect all such structures and utilities from injury of any kind. Immediately repair any damage resulting from the construction operations.

B. Assistance will be given the Contractor in determining the location of existing services. The Contractor, however, shall bear full responsibility for obtaining all locations of public and private underground structures and utilities (including existing water services, drain lines and sewers). Contractor shall be responsible to notify Dig Safe and private utility mark-out companies prior to excavating. Maintain services to buildings and pay all costs or charges resulting from damage thereto.

C. Protection and temporary removal and replacement of existing utilities and structures (culverts, water courses, storm drains, gas mains, water mains, cable TV, electric, telephone, gas and water services, etc.) as described in this Section shall be a part of the work under the Contract and all costs in connection therewith shall be included in the prices bid for water pipe items in the Bid Form. This work shall include but is not limited to the following: bracing, hand excavation and backfill (except screened gravel), and any other work required for crossing the utility or obstruction.

D. Notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays and Legal holidays) before excavating in any public way. Also notify Massachusetts Dig Safe, telephone 811 or 1-888-344-7233 at least 72 hours prior to start of work.

E. If, in the opinion of the Engineer, permanent relocation of a utility owned by the Owner is required due to a direct invert conflict with the work of this Contract, he/she may direct the Contractor, in writing, to perform the work. Work so ordered will be paid for at the prices bid for applicable pipe items, where applicable, or as extra work under Article 11 of the Supplementary Conditions where no applicable pipe item exists. If relocation of a privately-owned utility is required, the Owner will notify the Utility to perform the work as expeditiously as possible. Fully cooperate with the Owner and Utility. No claim for delay will be allowed due to such relocation.

F. At pipe crossings and where designated by the Engineer, furnish and place screened gravel bedding so that the existing utility or pipe is firmly supported for its entire exposed length. The bedding shall extend to the mid-diameter of the pipe crossed. Payment for screened gravel at pipe crossings will be made according to the unit price established in the Bid Form.

G. Remove and reset traffic loops and signals, if required for performance of the work, at no additional cost to the Owner.

H. The following emergency notification procedures shall be followed regarding damage to gas mains and/or gas services during excavation. These procedures shall also be followed for situations where a gas odor or blackened earth is encountered in areas with no gas main and/or service piping present.

1. Alert Notification

    a. Call 911
    b. Call Gas Company
    c. Call Yarmouth Department of Public Works, where required.

3.15 WATER FOR CONSTRUCTION PURPOSES

A. In locations where public water supply is available, the Contractor may be allowed to use water without charge for construction purposes. However, water used by the Contractor shall be metered. Supply properly calibrated meters and backflow preventers at each connection to the Yarmouth Water Department water distribution system or obtain from the Water Department, if available.

B. The express approval of the Yarmouth Water Department and the Owner shall be obtained before water is used. Waste of water by the Contractor shall be sufficient cause for withdrawing the privilege of unrestricted use. Hydrants shall only be operated under the supervision of the Water Department personnel.

3.16 MAINTENANCE OF FLOW

A. Provide for the flow of sewers, drains and water courses interrupted during the progress of the work, and immediately cart away and remove all offensive matter. Discuss the entire procedure of maintaining existing flow with the Engineer well in advance of the interruption of any flow.

3.17 COOPERATION WITHIN THIS CONTRACT AND WITH OTHER CONTRACTORS

A. All firms or persons authorized to perform any work under this Contract shall cooperate with the Contractor and his/her Subcontractors or trades and shall assist in incorporating the work of other trades where necessary or required.

B. Cutting and patching, drilling and fitting shall be carried out where required by the trade or subcontractor having jurisdiction, unless otherwise indicated herein or directed by the Engineer.

C. Sewer and water main construction and paving operations by others will be ongoing in adjacent areas of Yarmouth during construction under this Contract. Coordinate with all other Contractors, as necessary, to avoid conflicts. Fully cooperate in the coordination and scheduling of the Work between all the contracts.

3.18 CLEANUP AND DISPOSAL OF EXCESS MATERIAL

A. All hydrants and valves removed as part of this contract shall be delivered to the Yarmouth Department of Public Works and neatly placed in the location directed by the Owner.

B. During the course of the work, keep the site of operations in as clean and neat a condition as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.

C. In order to prevent environmental pollution arising from the construction activities related to the performance of this Contract, comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.

D. Disposal of excess excavated material in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by him will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be required to remove the fill and restore the area impacted at no increase in the Contract Price.

E. The disposal of all cobbles and boulders measuring 12 inches in diameter and greater, bituminous concrete, concrete, and other materials deemed by the engineer as unsuitable for disposal within the Town shall be the responsibility of the Contractor.

3.19 RESTORATION

A. Restore all areas to conditions that existed prior to construction. Restoration outside of the pipe trench limits required as a result of the installation of the pipeline shall be at the Contractor's own expense. Restoration within the pipe trench limits is included in the pipe items in the Bid Form.

B. Existing public and private driveways and sidewalks disturbed by the construction shall be replaced to the limits and thicknesses existing prior to construction and as specified in this Section.

C. Existing signs, lampposts and mailboxes that may be damaged by the Contractor or removed by the Contractor during the course of installing the new pipelines shall be reinstalled in a vertical position at the same location from which they were removed. Damaged items shall be replaced with an item equal to or better than the damaged items. A concrete anchor shall be provided as necessary, at no additional cost, to ensure a rigid alignment. Care shall be exercised in the reinstallation of all items to prevent damage to the newly installed pipelines.

D. Existing concrete, bituminous, timber or granite curbing shall be protected. If necessary, curbing shall be removed and replaced after backfilling. Curbing which is damaged during construction shall be replaced with curbing of equal quality and dimension at the Contractor's expense. Granite curbing removed and reset shall conform to the Owner’s and MassDOT Standards. Joints between sections shall be pointed as required after resetting. Bituminous berms shall conform to the Owner’s and MassDOT Standards.

3.20 TREE REMOVAL WITHIN RIGHT-OF-WAY

A. Any trees within Town rights-of-way that need to be removed to facilitate construction must be posted with the Town’s Tree Warden. Trees must be posted for a two-week period prior to removal. Contractor shall be responsible for contacting and coordinating with the Tree Warden.

3.21 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Remove all construction material, excess excavation, buildings, equipment and other debris remaining on the job as a result of construction operations and restore the site of the work to a neat and orderly condition. This shall include removal and proper disposal of all material from catch basins located in the project area after construction has been completed.
2. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
3. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F
4. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

    a. Use containers intended for holding waste materials of type to be stored.

5. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
3. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.
4. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.22 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.23 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity

3.24 DECKING

A. Furnish, install, maintain and remove decking over street openings where, in the opinion of the Engineer, traffic requires unrestricted use of the street. At such locations work may be suspended during periods of heavy traffic, to ensure the public safety.

B. All street openings ordered decked by the Engineer shall be sheeted and braced regardless of depth unless otherwise instructed by the Engineer. Furnish, put in place, and maintain such sheeting and bracing required to support the sides of the excavation and prevent loss of ground which could damage or delay the work or endanger adjacent structures. If the Engineer is of the opinion that at any points sufficient or proper supports have not been provided, he may order additional supports placed at the expense of the Contractor. Compliance with such order shall not relieve the Contractor from his responsibility for the sufficiency of such supports. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed they shall be immediately filled and rammed.

C. If decking is placed by the Contractor over any opening when not so ordered by the Engineer, all costs of decking at such location, maintaining traffic and safeguarding open excavation shall be included in the price bid for installing new water mains.

D. Before the decking and supporting systems are placed, submit to the Engineer detailed plans showing the structure he proposes to use. The construction shall be steel. The decking and supports shall be of sufficient strength to carry a load of 200 psi over the entire deck area or 10 tons on an axle with wheels five feet on centers without exceeding the allowable stress specified in the ASSHTO Standard Specifications for Highways and Bridges.

E. Decking placed at an opening shall remain over the open excavation until backfilling is complete except to provide access for the removal and replacement of valves, or for other work under this Contract directed by the Engineer.

3.25 NOTIFICATIONS

A. Coordinate all interruptions of water service with the Owner to determine the extent of affected abutters. Develop and distribute water interruption notices to abutters including an emergency contact number. The Owner may supply letterhead for the notices. The notices will be prepared and distributed by the Contractor at least 48 hours in advance of the shut down and no more than 72 hours in advance.

END OF SECTION 017300

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer’s use prior to Engineer’s inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's “punch list”), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.

5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment in accordance with Article 15 of the General Conditions.
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

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1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File. Engineer will return annotated file.
    b. PDF Electronic File. Engineer will return annotated file.
    c. Three Paper Copies. Engineer will return two copies.

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Engineer and by email to Engineer.

E. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.

h. Remove labels that are not permanent.

i. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 “Execution” before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

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SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Engineer. Enable reviewer comments on draft submittals.
2. Submit three paper copies. Engineer will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of

contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Engineer.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:

1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.

8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format,

identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

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1.11 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record Product Data.
3. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit PDF electronic files of scanned record prints and one set of file prints.

b. Final Submittal:

1) Submit PDF electronic files of scanned Record Prints and three sets of file prints.

B. Record Product Data: Submit annotated PDF electronic files and directories and two paper copies of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

C. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories and two paper copies of each submittal.

D. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

    a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    b. Accurately record information in an acceptable drawing technique.
    c. Record data as soon as possible after obtaining it.
    d. Record and check the markup before enclosing concealed installations.
    e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

    a. Dimensional changes to Drawings.
    b. Revisions to details shown on Drawings.
    c. Depths of foundations.
    d. Locations and depths of underground utilities.
    e. Revisions to routing of piping and conduits.
    f. Revisions to electrical circuitry.
    g. Actual equipment locations.
    h. Duct size and routing.
    i. Locations of concealed internal utilities.
    j. Changes made by Change Order or Work Change Directive.
    k. Changes made following Engineer's written orders.
    l. Details not on the original Contract Drawings.
    m. Field records for variable and concealed conditions.
    n. Record information on the Work that is shown only schematically.
    o. Laboratory test reports (e.g., bacteriological and primary & secondary water quality).
    p. Linear distance along pipelines from appurtenance, fittings, manholes or structures to appurtenance, fittings, manholes or structures, including pipe material and size.
    q. Depth of cover measurements for all pipelines and at all locations of critical changes in elevation (e.g., vertical bends).
    r. Horizontal coordinates in the state plane coordinate system for all fittings, valves, corporations, stubs, caps/plugs, manholes, structures, etc.
    s. Rim elevation for all manholes, structures and catch basins.

t. Invert and crown elevations for all pipes in manholes, structures, or catch basins.
u. Record actual installed pipe material, class, size, joint type, etc.
v. Supplemental record information with detailed sketches with measurements or ties, if necessary, to clearly indicate the work, as constructed.
w. Legibly mark the Specifications to record the manufacturer, trade name, catalog number, and supplier of each product and item of equipment or material actually installed, as well as any changes made by Field Order, Change Order, RFI, and approved shop drawing.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
7. Record documents shall be stored on-site apart from documents used for construction. Record documents shall not be used for construction purposes. The information submitted by the Contractor in the Record Drawings and Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information and shall bear the costs resulting from the correction of incorrect data.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Engineer for resolution.
4. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 013100 "Project Management and Coordination" for requirements related to use of Engineer's digital data files.
b. Engineer will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.

4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Engineer.
    e. Name of Contractor.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file and scanned PDF electronic file(s) of marked-up paper copy of Product Data.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file and scanned PDF electronic file(s) of marked-up miscellaneous record submittals.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours. As a prerequisite for monthly progress

payments, exhibit the updated record documents for review by Owner and Engineer for accuracy and completeness.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

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SECTION 025619 - GAS CONTAINMENT - SOIL VAPOR INTRUSION BARRIER

PART 1 - GENERAL

1.1 SITE LOCATION AND SCOPE OF WORK

A. This Section covers furnishing, handling, and installation of soil vapor barrier system and under the Pumping Station 2 (PS2) on the property located at 280 Main Street in West Yarmouth, Massachusetts.

B. The Contractor will provide a soil vapor barrier as indicated on the Contract Drawings and specified herein

1.2 SUMMARY

A. This section includes the following:

1. Substrate preparation.
2. Vapor intrusion barrier components.
3. Seam sealer and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. Provide a vapor intrusion barrier system that prevents the passage of volatile organic compound vapors and complies with physical requirements as demonstrated by testing performed by an independent testing agency of manufacturer’s current vapor intrusion barrier formulations and system design.

1.4 QUALITY ASSURANCE

A. Soil vapor barrier contractor/applicator will be trained and approved by soil vapor barrier manufacturer. A pre-installation conference must be held prior to application of soil vapor barrier to assure proper substrate and installation conditions, to include Contractor, applicator, and Engineer.

B. Obtain vapor intrusion barrier materials and system components from a single manufacturer source.

C. All materials, equipment, apparatus, controls, accessories, and other work shall be provided as specified in this Section or indicated on the Design approved by the Engineer.

D. Apply vapor intrusion barrier system field sample within the working area to demonstrate application, detailing, thickness, texture, and standard of workmanship.

1. Notify the Engineer one week in advance of the dates and times when field sample will be prepared.

2. If the Engineer determines that field sample, does not meet requirements, reapply field sample until field sample is approved.
3. Retain and maintain approved field sample during construction in an undisturbed condition as a standard for judging the completed vapor intrusion barrier.

1.5 SUBMITTALS

A. The Contractor will prepare and submit a site Health and Safety Plan (HASP) for the work to be performed. The HASP shall be prepared in accordance with all applicable regulations. All work will comply with the Occupational Safety and Health Act (OSHA) standard, "Hazardous Waste Operations and Emergency Response" (29 CFR 1910.120), and other federal, state, and local procedures that require the development and implementation of a HASP. The Engineer will review but not approve the HASP.

B. Manufacturer's product data for each type of vapor intrusion barrier, including manufacturer's printed instructions for evaluating and preparing the substrate, technical data, operating manuals, tested physical and performance properties, and other pertinent information. All data must be submitted for approval by the Engineer.

C. Submit vapor barrier system plan for approval by the Engineer including:

1. Product information.
2. Description of installation methods.
3. Shop drawing including:

    a. Limits of barrier.
    b. Locations and details of penetrations.

4. Performance criteria
5. Field testing and inspection methods

D. Contractor will submit representative samples to the Engineer for approval of the vapor intrusion barrier components, including, but not limited to:

1. Cured fluid-applied soil vapor barrier membrane material.
2. Manufacturer's protection course for fluid-applied soil vapor barrier membrane material.
3. Fluid-applied soil vapor barrier membrane base fabric.
4. Non-woven geotextile.

E. Submit photographs to Engineer via jpeg electronic format.

F. Contractor must be certified by the manufacturer to install the specific vapor barrier system to be installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original unbroken packages bearing manufacturer's label showing brand, weight, volume, and batch number. Store materials at site in strict compliance with manufacturer's instructions.

B. Materials will be stored in such a manner to prevent freezing of the materials in containers prior to application

C. Remove and replace material that cannot be applied within its stated shelf life.

1.7 JOB CONDITIONS

A. Protect all adjacent areas not to receive soil vapor barrier. Where necessary, apply masking to prevent staining of surfaces to remain exposed wherever membrane abuts other finish surfaces.

B. Perform work only when existing and forecasted weather conditions are within manufacturer's recommendations for the material and product used.

C. Ambient temperature must be within manufacturer's specifications. If winter conditions apply, the use of space heaters and necessary cover to bring ambient temperature within specified range.

D. All plumbing, electrical, mechanical and structural items to be under or passing through the soil vapor barrier will be positively secured in their proper positions and appropriately protected prior to membrane application, in accordance with manufacturer's recommendations.

E. Soil vapor barrier will be installed before placement of fill material and reinforcing steel. When not possible, all exposed reinforcing steel must be masked by general contractor prior to membrane application.

F. Expansion joints must be filled with conventional waterproof expansion joint material.

G. Surface preparation will be done in accordance with manufacturer's recommendation.

1.8 PRODUCT WARRANTY

A. Submit a written warranty signed by vapor intrusion barrier manufacturer agreeing to repair or replace vapor intrusion barrier that does not meet requirements or that does not remain volatile organic compound vapor tight within the specified warranty period.

B. Under this warranty the barrier shall be replaced if defects are observed prior to construction and retrofitted into the building following construction at no extra charge for any product not meeting these specifications, provided it has been applied in accordance with manufacturers written directions for use recommended suitable for this product.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. All materials and equipment must conform to the respective sections and other requirements specified in Part 1. All materials and equipment will be new and delivered to the jobsite in original containers, cartons, or other shipping material.

B. The recommendations of the MassDEP Vapor Intrusion Guidance will be followed concerning chemical constituents in all sealing materials. Materials and products must have low VOC content and low toxicity.

C. Polyvinylchloride piping:

1. SCH 40 PVC Pipe 4-in: ASTM D-2665 PVC 12454-B
2. SCH 40 PVC Pipe 6-in: ASTM D-2466 PVC 12454-B
3. PVC Fittings: ASTM D-2665 PVC 12454-B
4. PVC Solvent (cement): ASTM D-2564, Weldon
5. PVC Primer: ASTM F-656, Weldon
6. Primer and cements used in solvent-welded connections shall have low VOC content and low toxicity.)

D. Fluid applied vapor intrusion barrier:

1. Tensile Strength and Elongation: ASTM 412
2. Resistance to Decay: ASTM E-154 Section 13
3. Accelerated Aging: ASTM G-23
4. Moisture Vapor Transmission: ASTM E-96
5. Hydrostatic Water Pressure: ASTM D-751
6. Perm Rating: ASTM E-96
7. Adhesion: ASTM C-836
8. Hardness and Crack Bridging: ASTM C-836
9. Heat Aging: ASTM D-4068
10. Environmental Stress Cracking: ASTM D-1693
11. Oil Resistance: ASTM D-543
12. Soil Burial: ASTM D-4068
13. Low Temperature Flexibility: ASTM C-836

E. Axillary Materials

1. Sheet flashing will be 60-mil reinforced modified asphalt sheet good with double-sided adhesive.
2. Reinforcing strip will be manufacturer’s recommended polypropylene and polyester fabric.
3. Manufacturer recommended gas venting materials and associated fittings.
4. Seam detailing will be a high or medium viscosity polymer modified water-based asphalt material. Back rod will be of closed-cell polyethylene foam.

F. Crack Sealing:

1. Polyurethane -based caulk: Radon Pro PGS or equal
2. Self-leveling sealant: Vulken 45 SSL or equal
3. Epoxy: Rhino® High Strength Epoxy or equal
4. Construction sealant: NuFlex 446 Acoustical & Vapor Barrier Sealant/Adhesive or equal
5. Non-shrink hydraulic cement/grout: Quikrete Hydraulic Water-Stop Cement or equal
6. Non-shrink grout: Quikrete Precision Grout or equal
7. Foam backer rod: Sika® Backer Rod or equal or equal

G. Miscellaneous:

1. Restricting collar: RC-1 3M Co. or equal.
2. Plumbers Strap: Standard Plastic or Metal Perforated.
3. Brass Fittings: Parker Fitting Co. or equal.
4. All thread: Standard 3/8-in cut to suit.
5. Electrical conduit: Rigid PVC SCH 40.
6. Wire: No. 12 AWG copper Type THW stranded.
7. PVC bird screen: Manufactured by R.F. Simon Co., Inc. or equal.
8. Steel band clamps: Fernco or equal.
9. All Purpose Screws: Stud Rite or equal.
10. Riser Clamps: Standard Riser clamps.
11. Crushed Stone: MassDOT standard specifications, M2.01.0 Crushed Stone.
12. Carbon Monoxide Detector: Kidde hardwired 120-volt carbon monoxide alarm with battery backup or equal.

PART 3 - EXECUTION

3.1 AUXILIARY MATERIALS

A. Examine substrates, areas, and conditions under which vapor intrusion barrier will be applied, with installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 EXTRACTION POINT/SUCTION PIT

A. Contactor will install extraction point(s) and associated suction pit(s) using the approach described in MassDEP Vapor Intrusion Guidance document.

B. The depth of each suction pit must be at least 12 inches below the bottom of the floor slab, with a diameter of (i) 12 inches if coarse sub-slab materials are encountered, or (ii) 18 inches if tight sub-slab materials are encountered. The suction pit void space will be filled with ¾ inch to 1¼ inch washed crushed stone that is free of fines.

C. The PVC extraction pipe will be inserted through the cylindrical core hole created in the concrete floor slab to the bottom of the concrete floor slab, but will not contact the crushed stone. The pipe must be supported in a manner that will permanently prevent downward movement. A gasket or backer rod will be placed in the annular space between the PVC pipe and the concrete slab, and this annular space must be sealed with a urethane-based sealant. Alternatively, if necessary, large gaps between the pipe and concrete floor slab will first be filled with a non-shrinking hydraulic cement/grout, followed by the application of the urethane sealant once the hydraulic cement/grout has cured.

3.3 INTERIOR AND EXTERIOR PIPING

A. Installation of Sub-Slab Venting Pipe – Passive vent pipe will consist of minimum 4-inch diameter, Schedule 40 PVC. Pipes to be placed plumb and horizontal runs sloped to drain. Connect all pipe and fittings in proper placement according to the design.

B. Installation of Turbine Vent – One (1) non-electric turbine wind vent for attachment to the minimum 4-inch diameter vent PVC pipe.

C. Installation of Stack Vent - Stack vent will consist of minimum 4-inch diameter, Schedule 40 PVC. Stack vents will be installed plumb and with as few offsets as possible. When offsets are unavoidable, they will be made with 45-degree elbows. The stack vent must be adequately supported to prevent buckling of or undue pressure on the base fitting of the stack. Support of the stack vent must be at each floor level with standard riser clamps and at the roof. Supports shall be installed at a minimum every 5-ft in horizontal run. Connect all vent ducts and fittings in proper placement according to the Design. The stack vent will extend a minimum of 2 feet above the edge of the roof line. Vent caps will be installed on top of the roof in such a manner as to not constrict the movement of exhausted vapor.

D. Final location of the turbine vent and above ground piping will be submitted prior to installation for the approval of the Engineer.

E. All PVC pipe is to be cut with a hacksaw or saw specifically designed to cut PVC pipe. Cuts are to be square to allow for uniform embedding of pipe into fittings. Clean all burrs from pipe end. If necessary, dry fit and assemble each component prior to cementing to assure proper placement. Make any needed adjustments and match mark.

F. Clean PVC of excess dirt, grease, moisture, etc., from end of pipe to be fitted. Use an approved PVC solvent/cleaner on end of pipe and fitting. Use an approved PVC cement, spread uniformly inside of fitting full depth on pipe end. Set pipe into fitting while giving a quarter turn twist until pipe sets firmly against inside shoulder of fitting. Align to dry fit match marks if applicable. Wipe off any excess cement from pipe and/or fitting.

G. Riser or Stack Clamps will be installed wherever vent piping passes through a floor. Clamps shall be standard riser clamps.

H. Pipe Hangers will be installed for horizontal piping and shall securely fastened to building construction where necessary. Wooden plugs will not be permitted. Minimum hanger spacing shall be 5-ft center to center.

3.4 SUBGRADE SURFACE PREPARATION

A. Verify substrate is prepared according to manufacturer’s recommendations. On a horizontal surface, the substrate should be free from material that can potentially puncture the vapor intrusion barrier. Additional protection or cushion layers might be required if the earth or gravel substrate contains too many jagged points and edges that could puncture one or more of the system components. Contact manufacturer to confirm substrate is within manufactures recommendations.

B. The finish surface must be smooth, uniform, free of any debris or standing water. Penetrations shall be proposed in shop drawings in accordance with manufacturer recommendations and as depicted on the Contract Drawings. All form stakes that penetrate the membrane must be of rebar which will be bent over and left in the slab. Adjoining grade will be finish graded and compacted. Excavated walls will be vertical or sloped back, free of roots and protruding rocks. If organic materials with potential for growth exist within the sub-base, spray apply soil sterilant at the sterilant manufacturer’s recommended rate.

C. Surfaces may need to be wiped down or cleaned prior to application. This includes, but is not limited to, the removal of forming oils, concrete curing agents, dirt accumulation, and other debris. Contact form release agent manufacturer or concrete curing agent manufacturer for VOC content and proper methods for removing the respective agent.

D. Mask off adjoining surface not receiving the vapor intrusion barrier system to prevent the spillage or over spray affecting other construction.

E. Earth, sand or gravel subgrades should be prepared and compacted to local building code requirements.

3.5 INSTALLATION OF VAPOR INTRUSION BARRIER

A. Verify substrate is prepared according to manufacturer's recommendations. On a horizontal surface, the substrate should be free from material that can potentially puncture the vapor intrusion barrier. Additional protection or cushion layers might be required if the earth or gravel substrate contains too many jagged points and edges that could puncture one or more of the system components. Contact manufacturer to confirm substrate is within manufactures recommendations.

B. All pipe penetrations will be securely in place prior to the installation of the fluid-applied soil vapor barrier system. Any loose penetrations should be secured prior to application, as loose penetrations could potentially exert pressure on the membrane and damage the membrane after installation.

C. Set up equipment according to manufacturer's instructions.

D. Mix and prepare materials according to manufacturer's instructions.

E. Apply the fluid-applied soil vapor barrier in accordance with the manufacturer's instructions and to the thickness of the manufacturer's specifications. The amount of each application should be adjusted based on the ambient air temperature and surface temperature of the substrate.

F. Extend terminations on horizontal and vertical surfaces, exterior footings, pile caps, interior footings and grade beams according to the termination detail provided by manufacturer.

G. Visually verify there are no gaps/fish-mouths in seams.

H. Do not penetrate membrane after it has been installed. If membrane is penetrated after the membrane is installed, it is the responsibility of the Contractor to notify the certified installer to make repairs.

3.6 PROJECT PHOTOGRAPHS

A. The Contractor will take progress photographs of all portions of the work as the work is being completed, and will take a final set of photographs upon completion. The photographs must be provided to the Engineer via jpeg electronic format. In addition, a contact/index sheet of photographs will be provided in PDF format with description and date of each photograph. The contact/index sheet will be provided on the same CD-ROM or USB flash drive as the jpeg files.

3.7 ADJUSTING, INSPECTION AND TESTING

A. No piping will be covered until it has been inspected, tested and approved by the Engineer. If any piping is covered before it has been inspected, tested and approved, it will be uncovered by the Contractor at his/her own expense when so notified by the Engineer.

B. It will be the duty of the Contractor to give notice to the Engineer when work is ready for test or inspection. Contractor will make sure that the work is complete before calling for inspection.

C. Contractor will measure air flows within piping above each extraction point using a pitot tube or other flow measuring device.

D. Contractor will perform a leak test on pipe according to procedures approved by the Engineer. Contractor will propose methods to identify leakage areas. Leak tests will not be conducted until Engineer has approved proposed procedures.

E. Seal any leaks detected using applicable sealants and approved methods and materials.

F. Continue to perform leak testing until no leakage is detected.

G. If the Engineer finds that all or a portion of the work does not meet the requirements of this specification, the Contractor will be required to make the necessary corrections at his/her own expense and the work must be re-submitted for inspection.

H. All material, equipment and labor necessary for inspection or tests will be furnished by the Contractor at its own expense.

3.8 WARRANTY

A. Provide a written warranty covering all labor, material, and equipment for a period of 5 years after acceptance of the soil vapor intrusion barrier.

B. Make all required repairs, replacements, modifications, or other adjustments necessary during the warranty period.

C. Contractor will submit a brochure or manual containing operation instructions, lubrication, routine, and breakdown maintenance operating equipment.

END OF SECTION 025619

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SECTION 026110 - EXCAVATION AND MANAGEMENT OF EXCESS AND CONTAMINATED SOILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section is provided for the management of soil generated during construction. Furnish labor, materials, tools, equipment necessary for screening, tracking, stockpiling, and management of excavated soil.

B. The Site is located at 280 Main Street, West Yarmouth, Massachusetts within an area of mixed commercial/industrial, agricultural, and residential land use. The parcel is developed with a single commercial structure, paved parking areas, and limited landscaped areas. The Site was formerly utilized for commercial laundry and dry-cleaning operations for several decades. During this period of operation, releases of chlorinated volatile organic compounds (CVOCs), primarily tetrachloroethylene (PCE) have occurred as a result of historical dry-cleaning activities and associated waste handling and disposal practices. As a result, the property has been assigned Regional Tracking Number (RTN) 4-6020. In addition, petroleum-related compounds have been identified in environmental media at the Site, attributed to historical releases from former underground storage tanks (USTs) used for fuel storage. All historical documentation for the property is publicly available by searching the MassDEP Energy & Environmental Affairs Waste Site/Reportable Release File Viewer for 4-6020 at https://eeaonline.eea.state.ma.us/DEP/wsc_viewer/main.aspx

   An Activity and Use Limitation (AUL) was recorded in 2020 by the former property owner to manage residual contamination associated with historical releases. The AUL establishes restrictions and obligations to ensure that the property continues to be used in a manner consistent with conditions protective of human health and the environment. The Site is currently occupied by a tile, stone, showroom, and sales operation.

   The obligations of the AUL include the development of a soil management plan to address the management of soil excavated on the property. A Release Abatement Measure (RAM) will be prepared by the LSP of record to address this requirement of the AUL. New buildings on property will require a vapor barrier and a SSVS (or equivalent) and follow-up indoor air sampling. These provisions are covered under Specification 025619 “Soil Vapor Barrier”. A Health and Safety Plan is also required to be developed by the Contractor.

C. Soil pre-characterization activities were performed during installation of a groundwater monitoring well located downgradient of Site, just outside the limits of the disposal site boundary, in the vicinity of the proposed pump station. Three samples were collected from the soil boring B-PS2 at depths of 2’-8’, 12’-18’, and 24’-30’. Samples collected from B-PS2 (2-8)

and B-PS2 (12-18) were analyzed for total metals, VOCs, SVOCs, polychlorinated biphenyl (PCB) aroclors, and total petroleum hydrocarbons (TPH). The sample collected from B-PS2 (24-30) was analyzed for VOCs. Sampling results were below the Massachusetts Contingency Plan (MCP) reportable concentrations (RCS-1) and are attached in Appendix E.

D. If visual, olfactory, or other field screening readings indicate potential for contamination, contact the Engineer immediately.

E. A groundwater sample was collected at location B-PS2. It is anticipated that groundwater will be encountered during construction and the contractor will be responsible for obtaining any permits necessary for dewatering discharge.

F. Based on the pre-characterization data collected to-date, a Reportable Condition does not exist for soil or groundwater within the project area under the Massachusetts Contingency Plan (MCP). If additional sampling during construction activities identified a Reportable Condition, notification to MassDEP will be made by CDM Smith on behalf of Owner. Engineer is responsible for preparation and submittal of relevant MassDEP MCP documents on behalf of the Owner.

G. Furnish all labor, materials, tools, and equipment necessary for screening, tracking, and stockpiling of excavated soil, and sampling of soil if determined to be surplus. Utilize the services of an Environmental Professional (EP) to perform Work of this Section. Utilize the services of a Licensed Site Professional (LSP) for preparation of applicable documentation and oversight of Contractor's work in compliance with the MCP.

H. If Toxicity Characteristic Leaching Procedure (TCLP) material will be encountered, in-situ TCLP treatment and the associated verification sampling, will be required to stabilize leachable contaminants in soils associated with failed TCLP results prior to any excavation and handling of the material.

I. Be responsible for securing appropriate receiving facilities for all surplus material requiring off-site disposal. Perform all the additional sampling and analysis required by these receiving facilities.

J. Section Includes:

1. Excavating, screening, tracking, stockpiling, stockpile sampling, and managing of excavated soil.
2. The Work of this Contract involves the excavation of potentially contaminated soil based on reported releases of oil and hazardous materials (OHM) at and/or adjacent to the site.

K. Related Requirements:

1. Section 028100 "Transportation and Disposal of Contaminated Material."
2. Section 312319 "Dewatering."
3. Section 312333 "Trenching and Backfilling."

1.3 DEFINITIONS

A. Contaminated Groundwater: Groundwater with contaminant concentration above the applicable MCP reportable concentrations (RCGW-1 and RCGW-2).

B. Contaminated Soil: Any surface or subsurface soil with contaminant concentrations above the applicable MCP reportable concentrations (RCS-1) or excavated soil with visual or olfactory evidence of environmental impact, or with headspace readings greater than or equal to 5 parts per million (ppm). Conduct soil management and handling under all applicable regulations. Contaminated soil management and handling will be conducted under the MCP and may require a Utility-related Abatement Measure (URAM) Plan or a Release Abatement Measure (RAM) be prepared by the Engineer.

C. Environmental Professional (EP): Someone who is certified by the State or specializes in soil remediation to conduct site investigations and/or remedial actions at hazardous waste sites

D. EPA: United States Environmental Protection Agency.

E. Excess Soil: Soil that cannot be reused onsite and requires offsite disposal. Collectively surplus soil, unsuitable soil, contaminated soil, and uncontaminated soil may be excess soil.

F. Generator: The Owner will be the generator and will sign all waste profiles, bills of lading (BOLs), and hazardous and non-hazardous waste manifests, material shipping records (MSRs), and similar documents.

G. LSP: Licensed Site Professional, a hazardous waste site cleanup professional, as defined in M.G.L. c. 21A, § 19, holding a valid license issued by the Board of Registration of Hazardous Waste Site Cleanup Professionals pursuant to M.G.L. c. 21A, §§ 19 through 19J.

1. Contractor's LSP: An LSP retained by Contractor and who supervises all aspects of Contractor soil sampling, testing, and management, Contractor health and safety plans, and preparation of draft shipping documentation. Contractor's LSP will serve as LSP-of-record for only oil and hazardous material (OHM) releases caused by the Contractor.
2. LSP-of-Record: The LSP engaged by the Owner who will perform LSP-of-Record Services and regulatory interaction/coordination for the project. The LSP-of-Record is responsible for the preparation of any MCP regulatory submittals on behalf of the Owner, including but not limited to Utility Related Abatement Measures (URAM) Plan, Release Abatement Measure (RAM) Plan, and/or Bills of Lading (BOLs).

H. MassDEP: Massachusetts Department of Environmental Protection.

I. MCP: Massachusetts Contingency Plan, 310 CMR 40.0000.

1. MCP reporting category defined in 310 CMR 40.0361(1)(b) - (RCS-1).

J. Soil Disposal Category: Designations are based on the category of soil disposal facility, defined in Section 028100 "Transportation and Disposal of Excess Material," that soil can be accepted at based on analytical soil characterization data. Soil disposal categories may include but are not limited to; Soil Reclamation Facility, In-state Unlined Landfill, In-state Lined Landfill, or Out of State facility. The Contractor is responsible for confirming the applicable soil disposal category following any additional sampling conducted.

K. Suitable Soil: Excavated soil that is uncontaminated and suitable geotechnical characteristics for use as backfill material.

L. Surplus Soil: Excavated soil that is not usable for project backfill or reuse. If excavated soil has been stockpiled for use as backfill, but there are no excavations left to be backfilled, the remaining stockpile could be surplus. This includes (but is not limited to) topsoil, soil excavated during utility installation, building construction, and soil from site grading. Includes excavated soil that cannot be re-used due to physical or chemical characteristics of the material or project restrictions.

M. TCLP Material: Soil, through toxic characteristic leaching procedure (TCLP) analysis, that exceeds the regulatory limit established for any one or more RCRA metals set forth in Table 1 of 40 CFR 261.24.

N. TSD: Treatment, storage and disposal.

O. TCLP Treatment: Soil treatment to stabilize leachable lead in soil identified as TCLP Material. Stabilize material to render TCLP and SPLP concentrations less than the regulatory limit prior to excavation or off-site disposal.

P. Uncontaminated Soil: Excavated soil that is not impacted based on visually and olfactory observations, and/or is not considered Contaminated Soil.

Q. Unsuitable Soil: Excavated soil that is uncontaminated but has geotechnical characteristics unsuitable for use as backfill material.

R. Uncontaminated Groundwater: Groundwater that does not contain site-related contaminants of concern.

S. Underlying Hazardous Constituent (UHC): As defined in 40 CFR 268.2, "Any constituent listed in 40 CFR 268.48, Table UTS – Universal Treatment Standards, except fluoride, selenium, sulfides, vanadium and zinc which can be reasonably expected to be present at the point of generations of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard." For this project, metals and PAHs are the UHCs, "reasonably expected" to be present above applicable UTS.

T. Universal Treatment Standard (UTS): Numerical standards set forth in 40 CFR 268.48, Table UTS – Universal Treatment Standards. Non-wastewater and wastewater treatment standard levels that are used to regulate most prohibited hazardous wastes. Applicable UTS for soils are defined in 40 CFR 268.49(c).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review geotechnical report.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.

5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system

1.5 REGULATORY REQUIREMENTS

A. United States Department of Environmental Protection (EPA).

1. Federal Hazardous Waste Regulations, 40 CFR Parts 261-268.

B. Massachusetts Department of Environmental Protection (MassDEP).

1. Massachusetts Contingency Plan, 310 CMR 40.0000.
2. Massachusetts Hazardous Waste Regulations, 310 CMR 30.000.
3. Interim Remediation Waste Management Policy for Contaminated Soils, Policy # WSC-94-001.
4. Reuse and Disposal of Contaminated Soils at Massachusetts Landfills, Policy # COMM-97-001.

C. Disposal of TCLP material at RCRA Landfills is subject to all applicable provisions of the Phase IV Land Disposal Restrictions (LDR) of 40 CFR 268. The Work of this Section shall include all necessary supplemental treatment required to reduce concentrations of all Underlying Hazardous Constituents (UHCs) to levels below applicable Universal Treatment Standards (UTS) prior to landfill disposal.

1.6 ACTION SUBMITTALS

A. Prepare a Soil Management Plan. The plan should be prepared and signed by the Contractor's Environmental Professional and at a minimum, this plan shall describe detailed procedures that the Contractor plans to follow regarding management of all soil and include the following components:

1. Schedule of activities and anticipated volume of excavated material generation for various activities.
2. Details of soil excavation, tracking, stockpiling, reuse of soil on-site, and/or off-site disposal.
3. Soil characterization procedures including sampling frequency, methods and data quality management.
4. Name of the laboratory that will be used for sampling analysis.
5. Storage area location(s)
6. Soil stockpile area controls and location(s).
7. Plans/drawings indicating location to be used for various activities (e.g., storage/stockpile areas, loading areas, etc.).
8. Soil segregation procedures.
9. Soil loading location and method.
10. Operating log to track soil origin, storage location and final disposition.
11. Inspection and maintenance procedures.
12. Erosion control.

13. Anti-tracking procedures and decontamination station.
14. Emergency and preparedness procedures.
15. Transportation routes.
16. Proposed transporters and disposal facilities.
17. Clean fill import and sampling.
18. Decontamination of equipment.
19. Site security.
20. If TCLP soil is encountered in the project area based on future sampling, include a TCLP lead soil treatment plan and procedures for treatment and post-treatment confirmatory sampling.

B. Submit all analytical laboratory reports to Engineer. Laboratory shall be approved by the Commonwealth of Massachusetts. Preservation of samples for analysis shall be consistent with the laboratory requirements.

C. The Engineer will be responsible for preparing all MCP filings including but not limited to:

1. Release Notification Form (RNF).
2. Release Abatement Measure (RAM) Plan.
3. RAM Status Report(s).
4. RAM Completion Report.
5. Permanent Solution Statement (PSS) .

D. Prepare a Health and Safety Plan. The plan shall be prepared by a certified Industrial Hygienist, or other qualified individual sufficiently trained in worker health and safety requirements. The plan shall meet the requirements of the AUL filed on the property and at a minimum include the following:

1. Site Description and Evaluation.
2. Names of key personnel and alternates responsible for site safety and health (responsibilities and chain of command).
3. Safety and health hazard assessment and risk analysis for each site task and operation (Accident Prevention Plan).
4. Education and Training.
5. Personnel Protective Equipment.
6. Standard Operating Procedures, Engineering Controls and Work Practices.
7. Site Control Measures (Work Zones, Communications and Security including sign-in and sign-out procedures).
8. Personnel Hygiene and Decontamination.
9. Equipment Decontamination.
10. Emergency Equipment and First Aid Requirements.
11. Pre-Emergency Planning, Emergency Response Plan and Contingency Procedures.
12. Emergency recognition and prevention.
13. Evacuation routes and procedures.
14. Emergency medical treatment, first aid, and hospital route.
15. Fall Protection.
16. Excavation safety.
17. Environmental monitoring

E. INFORMATIONAL SUBMITTALS

F. Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

G. Qualification Data: Environmental Professional (EP) shall have the following minimum qualifications:

1. A minimum of five years of demonstrated experience on contaminated site projects.
2. A minimum of three assignments where similar soil screening program has been undertaken.
3. A.S. or B.S. degree in engineering, engineering technology or science.
4. Registration as a P.E. (Professional Engineer), LSP (Licensed Site Professional), QEP (Qualified Environmental Professional), or CHMM (Certified Hazardous Materials Manager).
5. 40-hour OSHA (Occupational Safety and Health Administration) health and safety training, 8-hour OSHA supervisory training, current 8-hour OSHA refresher training and current medical monitoring.

H. Product:

1. High density polyethylene (HDPE) liner.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: All laboratory results including the data validation reports.

1.8 PRECONSTRUCTION TESTING

A. Engineer has completed environmental sampling prior to the start of construction. Summary tables with applicable analytical soil sampling results are included in Appendix E.

B. Verify available warranties and warranty periods.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing MassDEP notification regulations before beginning work. Comply with hauling and disposal regulations of authorities having jurisdiction.

2.2 HIGH DENSITY POLYETHYLENE (HDPE) LINER

A. Manufactured of new, first-quality product designed and manufactured specifically for the intended use and have the following properties:

1. 3-ply polyethylene reinforced with a non-woven grid of high strength nylon cord.
2. U.V. resistant (black in color) and cold crack resistant to minus 40 degrees F.

3. Manufactured in a minimum 12-feet seamless width. Labels on the rolls shall identify the thickness, length, width, and manufacturer's mark number.

B. Retain "Products" Subparagraph and list of manufacturers and products below to require specific products or a comparable product from other manufacturers.

1. List manufacturers' names in alphabetical order.

C. TCLP testing shall be performed for RCRA 8 Metals and VOCs when the total concentrations exceed the minimum theoretical levels at which TCLP criteria may be exceeded. Verify testing procedures and certification programs with standards organizations. Verify type of label or stamp provided by standards organization.

PART 3 - EXECUTION

3.1 HEALTH AND SAFETY APPLICABILITY

A. As a minimum, prepare and adhere to a Health and Safety Plan that addresses Work involving Contaminated Soil and or Contaminated Groundwater. The Health and Safety Plan must consider the data collected for the project area as well as the data available from the adjacent disposal site RTN 4-6020.

B. At the direction of the Engineer, decontaminate grossly contaminated equipment by means of dry methods such as brooms and absorbent towels.

C. Provide workers with personal protective equipment as necessary to comply with the Health and Safety Plan.

3.2 EXCAVATED SOIL MANAGEMENT

A. Excess soil generated from throughout the project area will need to be properly managed and disposed of. Pre-characterization has been performed to identify areas of contaminated and uncontaminated soil. The boring locations and soil sampling results for this pre-characterization are included in Appendix E. Excess soil generated from throughout the project area will need to be properly managed and disposed. The project area is located just outside of a known disposal site (a former dry cleaner with chlorinated solvent and petroleum related contamination). The AUL for the disposal site does pertain to the entire property so the project area is within the AUL area and therefore the provisions of the AUL do apply. Testing has indicated that both the soil and groundwater have not been impacted, however, Contractor should be aware that contaminated material could be encountered in the excavation based on reported release adjacent to project area.

B. Conduct management of excavated soil in accordance with this Section and the analytical sample results collected to-date and included in Appendix E. Separate Soil Disposal Categories shall be segregated and stockpiled separately following excavation. Soil Disposal Categories will be confirmed by any additional sampling performed by Contractor.

C. Contractor is responsible for the development and implementation of their approved Soil Management Plan (SMP) for handling of both contaminated and uncontaminated material. Manage excavated soil in accordance with the SMP, Health and Safety Plan and all other procedures in the Contract documents. Contractor is responsible for all soil management costs (stockpiling, transportation, and disposal), including laboratory analysis required by the disposal facilities.

D. If stockpiling is required, temporarily stockpile excavated soil onsite in stockpiles in accordance with the requirements of this Section, as applicable, pending re-use in the project area or off-site disposal. Handle all excavated soil that is stockpiled in accordance with the most recent version of MassDEP guidance policies. Do not co-mingle soil from different Soil Disposal Categories. Assign each stockpile a unique identifier. Prepare the stockpile area to contain water draining from excavated soil. Fully prepare the stockpile area prior to the commencement of excavation. Manage water generated from soil draining in accordance with applicable permits. As necessary, dry soils and by decanting or using an additive to prevent free drainage of liquid from the materials.

E. All excavated soil requires proper handling and management, until it has been identified for reuse in the project area or for off-site disposal. Dispose of soils in accordance with Section 028100 “Transportation and Disposal of Excess and Contaminated Material.”

F. Identify appropriate disposal facilities, provide waste profiles and acceptance criteria to the Engineer, and secure approvals from the disposal facilities for soil disposal. Be responsible for preparing the waste profiles and shipping documents in accordance with Section 028100 “Transportation and Disposal of Contaminated Material” and providing to Engineer for review, approval, and signature as LSP of Record.

G. Perform work and decontamination procedures in areas containing contaminated material in accordance with standard industry practices including use of decontamination facilities, barriers, liners, and other means to control cross-contamination.

H. Employ methods necessary to isolate contaminated soils from uncontaminated soils, including benching.

I. Reuse onsite as much excavated soil as possible, provided material meets reuse and backfill requirements in this Section and Section 312333 “Trenching and Backfilling.”

J. Excavated uncontaminated soil may be reused in the project area at the point of excavation if determined to be physically suitable. Contaminated soil may be permissible for reuse in the project area, upon review and agreement by the LSP of Record. Any reuse of contaminated soil requires compliance with a Release Abatement Measure (RAM) Plan and applicable regulations.

3.3 HAZARDOUS WASTE CHARACTERIZATION

A. TCLP Material will require treatment to stabilize leachable lead prior to excavation in that area. Treatment must render TCLP concentrations less than the regulatory limit prior to excavation for disposal or stockpiling. Sampling results from boring B-PS2 (2-8) and B-PS2 (12-18) exhibited concentrations below 20 times the criteria and are therefore do not exhibit characteristics of hazardous waste.

B. If future sample results indicate that the TCLP concentration for any metal exceeds the regulatory limit set forth in Table 1 of 40 CFR 261.24, stabilize the soil to render TCLP concentrations less than the regulatory limit prior to excavation for stockpiling or disposal.

C. Perform soil treatment to stabilize leachable lead in soil identified as TCLP Material, as defined in "Definitions" Article. Stabilize material to render TCLP concentrations less than the regulatory limit of 5.0 mg/L prior to excavation or off-site disposal.

D. Conduct post-treatment TCLP sampling at a frequency of one post-treatment TCLP sample per 100 tons, or at the frequency required by the Contractor's selected disposal facility, whichever is more stringent. Any treated material that fails a post-treatment TCLP test will need to be re-treated and re-tested until it passed TCLP before it can be excavated.

3.4 SOIL TRACKING, STOCKPILING AND TESTING

A. Track excavated soil from the point of excavation, through stockpiling to final disposition. Do not comingle stockpiles of pre-characterized soil. Stockpile each Soil Disposal Category separately, and give each soil stockpile a unique identifier. Record soil movement including excavation location, quantities, and final disposition on a tracking form for the duration of the project.

B. Contaminated soil designations are based on pre-characterization analytical sampling. Refer to Appendix E for pre-characterization sampling results and soil management figures. As applicable, separate soil disposal categories shall be segregated and stockpiled separately following excavation. performed by the Contractor. Keep suitable and unsuitable soil separate. Soil disposal categories will be confirmed by any additional sampling.

C. Stockpile contaminated soil to meet the disposal facility requirements, in stockpiles not exceeding a volume of 500 cubic yards. Segregate and stockpile contaminated soil separately from uncontaminated and uncharacterized soil. Multiple categories have been identified for disposal of soil, therefore each separate Soil Disposal Category (i.e., Soil Reclamation Facility, In-state Unlined Landfill, In-state Lined Landfill, or Out of State Facility) shall be segregated separately and properly labeled to prevent comingling of soil. Contaminated soil/material that requires special handling or off-site disposal, as specified in Section 028100 "Transportation and Disposal of Contaminated Material," shall be segregated and stockpiled separately. Blending of soil to attain composition thresholds by dilution is not allowed. Use "Jersey" barriers to separate stockpiles. Prepare the stockpile area to contain water draining from excavated soil. Manage water generated from soil draining in accordance with permits.

D. Track stockpiles to provide complete data necessary to locate any stockpile within the site. Include all Work necessary to coordinate stockpiling from placement to disposal. Provide Engineer with duplicate copies of all documentation at the time of stockpiling.

E. Remove the temporarily stockpiled soil from the site in accordance with applicable regulatory deadlines or no later than the completion date of this Contract, whichever is less.

F. Securely barricade stockpiles and clearly label with a stockpile identification number and the initial accumulation date. Place hay bales, straw wattles, or berm material around the stockpile areas.

G. Give each soil stockpile a unique identifier. Utilize the sample tracking form included in the Soil Management Plan. Provide to the Engineer and Owner, on a daily basis, copies of field records documenting the location of stockpiled material in the grid system, and stockpile identification data.

H. After proposed soil disposal facilities have been submitted to the Engineer for approval and the acceptance criteria for each facility have been established, be responsible for the collection of any additional samples required for characterization based on the requirements of the disposal facility(s) identified by the Contractor. Be responsible for identifying a backup facility for material that does not meet the requirements of the identified facility.

I. Engineer shall be responsible for approving the final disposition of all soil and material removed from the site. A review period of one week should be anticipated for Engineer's review of analytical data and summary.

J. Reuse uncontaminated suitable soil in accordance with Section 312333 "Trenching and Backfilling."

K. Dispose of excess and unsuitable soil in accordance with Section 028100 "Transportation and Disposal of Contaminated Material."

L. Suitably dewater soil/material prior to its leaving the site, to prevent free water from developing during transport to the disposal facility. All soil must pass the EPA Paint Filter Test prior to shipping or disposal.

3.5 STOCKPILE MANAGEMENT

A. All excavated soil requires proper handling and management, until it has been reused in the project area or taken for off-site disposal. If stockpiling is required, securely barricade and clearly label stockpiles.

1. Identify a temporary stockpile storage location(s) for use, and propose these locations to the Owner for approval in writing inclusive of a map showing the proposed stockpile location(s). All locations proposed for temporary stockpiling locations will require approval by the Owner before any soil can be transported and stored.
2. Segregate and stockpile soil in accordance with all requirements of this Section.
3. Place excavated materials on a base lined with 20 mil (or higher gauge) HDPE and completely and securely cover with 10 mil (or higher gauge) HDPE.
4. Berm the HPDE around the edges to prevent any infiltration of stormwater or exfiltration of leachate. Berm height shall be at least 12 inches. Place hay bales or other berm material in a manner that prevents soil from spilling out of the stockpile.
5. Do not co-mingle soil from different Soil Disposal Categories.
6. Assign each stockpile a unique identifier.
7. Track stockpiles to provide complete data necessary to locate any stockpile within the site. Include all Work necessary to coordinate stockpiling from placement to disposal. Provide Engineer with duplicate copies of all documentation at the time of stockpiling. Remove the stockpiled soil from the site in accordance with applicable regulatory deadlines or no later than the completion date of this Contract, whichever is less.
8. Securely cover stockpiled material (from rain and wind disturbances) with a top liner (cover) at the end of each workday.

9. Top liner and stockpiled material must be configured in a manner to prevent pooling of rainwater.
10. Adjust the location of the hay bales or other berm material based on the volume of stockpiled material to prevent sagging of the top liner and to promote drainage off of the top liner.
11. Adequately secure the HDPE cover using a network of sandbags secured to one another by rope or approved equal to prevent damage or loss by wind or other weather elements.
12. Inspect stockpiles on a daily basis, and maintain the stockpiles including berms, top liner, and bottom liner, throughout construction activities.
13. Manage water generated from soil stockpile areas in accordance with applicable permits.

3.6 SOIL SCREENING

A. The following applies for any material slated for disposal at a Less than RCS-1 Facility or Less than RCS-2 Facility that requires headspace screening.

B. If required, perform jar headspace testing as follows:

1. Half-fill two clean 500 ml glass jars with the sample to be analyzed. Quickly cover each open top with one sheet of clean aluminum foil and screw on jar lid tightly.
2. Allow the samples to sit for at least 10 minutes. Vigorously shake jars for 15 seconds both at the beginning and end of the waiting period. Store samples inside a heated vehicle or building if temperature is below 32 degrees F.
3. Remove jar lid exposing aluminum foil seal. Quickly puncture foil seal with a photoionization detector (PID) to a point one-half of the "headspace" depth. Record PID reading within 2 to 5 seconds.
4. Calibrate and operate PID instruments to yield "total organic vapors" in ppm (v/v) as benzene with a 10.0 plus or minus eV lamp source.

C. Visual Evidence: Includes obvious staining, discoloration or other irregularity.

D. Olfactory Evidence: Includes petroleum, gasoline, hydrogen sulfide ("rotten egg") or any other chemical odor.

E. Perform soil screening at a frequency of one sample per 50 cubic yards, or less if required by the Contractor’s selected soil disposal facility. Soil screening includes visual and olfactory observations and jar headspace testing.

F. Utilize a screening field form for the collection of the readings. Include a field sketch showing the approximate location(s) of each reading.

3.7 DISPOSAL FACILITY TESTING

A. Characterize soil for the purposes of obtaining approvals for final disposal of contaminated and/or surplus soil. Collect samples to perform testing required by the disposal facility and the requirements of Section 028100 “Transportation and Disposal of Contaminated Material.” This analysis can be performed on samples of in situ soil collected prior to excavation or on samples of excavated soil that has been stockpiled. The frequency of sampling and parameters analyzed shall be performed as required by the Contractor’s selected disposal facility.

B. Conduct soil transportation and disposal in accordance with Section 028100 “Transportation and Disposal of Contaminated Material.”

C. Collect samples in such a manner as not to cause any cross contamination. Decontaminate all sampling equipment between collection of samples from each stockpile.

D. Within two days of receipt of laboratory results, provide analytical data, including original laboratory data, and tabulated summary to the Engineer. Include listing of all detected compounds with comparison to the Contractor’s selected reuse/recycle/disposal facility acceptance criteria.

END OF SECTION 026110

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SECTION 028100 - TRANSPORTATION AND DISPOSAL OF EXCESS AND CONTAMINATED MATERIAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section is provided for the management of excess and contaminated soil generated during construction that requires off-site disposal. Both uncontaminated and contaminated soils may be encountered, and all soil will require proper handling and management. Soil characterization results representative of soil within the Yarmouth Phase 1 Contract 6 project area are included in Appendix E. Based on the sampling conducted to-date, a Reportable Condition does not exist for soil within the project area under the Massachusetts Contingency Plan (MCP). However, the project area is adjacent to a known disposal site (former dry cleaner with petroleum related and chlorinated solvent related contamination in soil and groundwater) and within the AUL area for that disposal site. The management of excess and contaminated soil is all expected to meet the following Soil Disposal Category:

1. Soil meeting requirements of a Soil Reclamation Facility (“Less than RCS-1 Facility” or “Less than RCS-2 Facility”): all project work taking place within the construction of the proposed Pumping Station 2 (PS2).

B. Furnish all labor, material, tools and equipment necessary for the transportation and disposal of excess material generated from activities specified in Section 026110 “Excavation and Management of Excess and Contaminated Soil.”

C. If Toxicity Characteristic Leaching Procedure (TCLP) material will be encountered, in-situ TCLP treatment and the associated verification sampling, will be required to stabilize leachable contaminants in soils associated with failed TCLP results prior to any excavation and handling of the material.

D. Be responsible for securing appropriate disposal locations based on pre-characterization sampling and analysis results from Section 026110 “Excavation and Management of Excess and Contaminated Material” and any additional disposal facility testing results. Disposal determination will be subject to the Engineer's approval.

E. Owner will be the generator and will sign all waste profiles, bills of lading and hazardous waste manifests. Owner information is as follows:

1. Owner's Name: Jeffrey Colby
2. Owner’s Title: Director of Public Works
3. Owner's Address: 74 Town Brook Road, West Yarmouth, Ma 02673

4. Owner's Telephone Number: 508-398-2231
5. Owner's E-Mail Address: jcolby@yarmouth.ma.us
6. Project Name: Yarmouth Phase 1 Contract 6

F. For soil disposal, where more than one disposal option exists, select the least costly disposal option.

G. Related Requirements:

1. Section 026110 “Excavation and Management of Excess and Contaminated Soils”
2. Section 312319 “Dewatering.”
3. Section 312333 “Trenching and Backfilling.”

1.3 DEFINITIONS

A. Contaminated Soil: Any surface or subsurface soil with contaminant concentrations above the applicable MCP reportable concentrations (RCS-1) or excavated soil with visual or olfactory evidence of environmental impact, or with headspace readings greater than or equal to 5 parts per million (ppm). Conduct soil management and handling under all applicable regulations. Contaminated soil management and handling will be conducted under the MCP and under a Utility-related Abatement Measure (URAM) Plan and/or a Release Abatement Measure (RAM) prepared by the Engineer.

B. Disposal Facility: Soil Reclamation Facility, In-state Landfill, In-State Recycling Facility, Out-of-State Landfill, Out-of-State Recycling Facility, RCRA Landfill or RCRA TSD Facility.

C. Environmental Professional (EP): Someone who is certified by the State or specializes in soil remediation to conduct site investigations and/or remedial actions at hazardous waste sites.

D. EPA: United States Environmental Protection Agency.

E. Excess Soil: Soil that cannot be reused onsite and requires offsite disposal. Collectively surplus soil, unsuitable soil, contaminated soil, and uncontaminated soil may be excess soil.

F. In-State Unlined Landfill: Unlined landfill approved by the Commonwealth of Massachusetts to accept soil for reuse with concentration levels below the Department of Environmental Protection Policy # COMM-97-001 criteria listed below:

Contaminant	Unlined Landfill Reuse Levels (mg/kg)
Total Arsenic	40
Total Cadmium	30
Total Chromium	1,000
Total Lead	1,000
Total Mercury	10
Total Petroleum Hydrocarbons	2,500
Total PCBs	<2

Contaminant	Unlined Landfill Reuse Levels (mg/kg)
Total SVOCs	100
Total VOCs	4
Listed or Characteristic Hazardous Waste (TCLP)	None

G. In-State Lined Landfill: Lined and be approved by the Commonwealth of Massachusetts to accept soil for reuse with concentration levels below the Department of Environmental Protection Policy # COMM-97-001 criteria listed below:

Contaminant	Lined Landfill Reuse Levels (mg/kg)
Total Arsenic	40
Total Cadmium	80
Total Chromium	1,000
Total Lead	2,000
Total Mercury	10
Total Petroleum Hydrocarbons	5,000
Total PCBs	<2
Total SVOCs	100
Total VOCs	10
Listed or Characteristic Hazardous Waste (TCLP)	None

H. In-State Recycling Facility: Approved by the Commonwealth of Massachusetts to accept soil for reuse

I. Listed Waste Material: Soil that indicates the presence of any of F-code wastes set forth in 40 CFR 261.31 or U-code wastes set forth in 40 CFR 261.33Listed Waste Material: Soil, through VOC analysis, that indicates the presence of any of F-code wastes set forth in 40 CFR 261.31 or U-code wastes set forth in 40 CFR 261.33.

J. Generator: Owner will be the generator and will sign all waste profiles, bills of lading (BOLs), and hazardous and non-hazardous waste manifests, material shipping records (MSRs), and similar documents.

K. LSP: Licensed Site Professional, a hazardous waste site cleanup professional, as defined in M.G.L. c. 21A, § 19, holding a valid license issued by the Board of Registration of Hazardous Waste Site Cleanup Professionals pursuant to M.G.L. c. 21A, §§ 19 through 19J.

1. Contractor's LSP: An LSP retained by the Contractor and who supervises all aspects of Contractor soil sampling, testing, and management, Contractor health and safety plans, and preparation of draft shipping documentation. Contractor's LSP will serve as LSP-of-record for only oil and hazardous material (OHM) releases caused by the Contractor.

2. LSP-of-Record: The LSP engaged by the Owner who will perform LSP-of-Record Services and regulatory interaction/coordination for the project. The LSP-of-Record is responsible for the preparation of any MCP regulatory submittals on behalf of the Owner, including but not limited to Utility Related Abatement Measures (URAM) Plan, Release Abatement Measure (RAM) Plan, and/or Bills of Lading (BOLs).

L. MassDEP: Massachusetts Department of Environmental Protection.

M. MCP: Massachusetts Contingency Plan, 310 CMR 40.0000.

1. MCP reporting category defined in 310 CMR 40.0361(1)(b) - (RCS-1).

N. Out-of-State Facility: State approved or permitted to accept soil that is not classified as either a RCRA characteristic waste or RCRA listed waste as defined in 40 CFR Part 261or PCB waste as defined in 40 CFR 761. This type of landfill shall accept soil for disposal and reuse purposes.

O. Out-of-State Recycling Facility: State approved or permitted to accept soil that is not classified as either a RCRA characteristic waste or RCRA listed waste as defined in 40 CFR Part 261or PCB waste as defined in 40 CFR 761.

P. OHM: Oil and Hazardous Materials RCRA Landfill: State and federally approved to accept soil that is classified as either a RCRA characteristic waste or RCRA listed waste as defined in 40 CFR261.

Q. RCRA TSD Facility: State and federally approved to accept soil that is classified as either a RCRA characteristic waste or RCRA listed waste as defined in 40 CFR 261.

R. Soil Disposal Category: Designations are based on the category of soil disposal facility, defined in this Section that soil can be accepted at based on analytical soil characterization data. Soil disposal categories may include but are not limited to; Soil Reclamation Facility, In-state (Massachusetts) Unlined Landfill, In-state Lined Landfill, or Out of State Facility. The Contractor is responsible for confirming the applicable soil disposal category following any additional sampling conducted.

S. Soil Reclamation Facility:

1. Less than RCS-1 Facility: This type of facility is approved to accept soil that has concentrations less than the MCP RCS-1 criteria. These facilities have their own acceptance criteria which may be more stringent than the RCS-1 criteria for certain chemical constituents and may require soils to be less than the Limiting Soil Concentrations found in Table 2 of MassDEP Guidance WSC#-13-500, Similar Soils Provision Guidance. Review applicability of a less than RCS-1 facility based on an individual facility(s) acceptance criteria. In addition, most less than RCS-1 facilities have requirements regarding headspace readings and visual/olfactory contamination. Designate a Less than RCS-2 Facility and/or an in-state unlined landfill as a backup for all less than RCS-1 material in case a portion of the material is unacceptable at the Less than RCS-1 Facility.
2. Soil Reclamation Facility (Less than RCS-2 Facility): This type of facility is approved to accept soil that has concentrations less than the MCP RCS-2 criteria. These facilities have their own acceptance criteria which may be more stringent than the RCS-2 criteria for certain chemical constituents. Review applicability of a Less than RCS-2 Facility based

on an individual facility(s) acceptance criteria. In addition, most Less than RCS-2 Facilities have requirements regarding headspace readings and visual/olfactory contamination. Designate an in-state unlined landfill as a backup for all less than RCS-2 material in case a portion of the material is unacceptable at the Less than RCS-2 Facilities.

T. Suitable Soil: Excavated soil that is uncontaminated and physically suitable for use as backfill material.

U. Surplus Soil: Excavated soil that is not usable for project backfill or reuse. If excavated soil has been stockpiled for use as backfill, but there are no excavations left to be backfilled, the remaining stockpile could be surplus. This includes (but is not limited to) topsoil, soil excavated during utility installation, building construction, and soil from site grading. Includes excavated soil that cannot be re-used due to physical or chemical characteristics of the material or project restrictions.

V. TCLP Material: Soil, through TCLP analysis, that exceeds the regulatory limit established for any one or more RCRA metals set forth in Table 1 of 40 CFR 261.24.

W. TSD: Treatment, storage, and disposal.

X. TCLP Treatment: Soil treatment to stabilize leachable lead in soil identified as TCLP Material. Stabilize material to render TCLP and SPLP concentrations less than the regulatory limit prior to excavation or off-site disposal.

Y. Uncontaminated Soil: Excavated soil that is not impacted based on visually and olfactory observations, and/or is not considered Contaminated Soil.

Z. Underlying Hazardous Constituent (UHC): As defined in 40 CFR 268.2, "Any constituent listed in 40 CFR 268.48, Table UTS – Universal Treatment Standards, except fluoride, selenium, sulfides, vanadium and zinc which can be reasonably expected to be present at the point of generations of the hazardous waste, at a concentration above the constituent-specific UTS treatment standard." For this project, metals and PAHs are the UHCs, "reasonably expected" to be present above applicable UTS.

AA. Universal Treatment Standard (UTS): Numerical standards set forth in 40 CFR 268.48, Table UTS – Universal Treatment Standards. Non-wastewater and wastewater treatment standard levels that are used to regulate most prohibited hazardous wastes. Applicable UTS for soils are defined in 40 CFR 268.49(c).

1.4 REGULATORY REQUIREMENTS.

A. Massachusetts Department of Environmental Protection.

1. Massachusetts Contingency Plan, 310 CMR 40.0000.
2. Massachusetts Hazardous Waste Regulations, 310 CMR 30.000.
3. Interim Remediation Waste Management Policy for Contaminated Soils, Policy # WSC-94-001.
4. Reuse and Disposal of Contaminated Soils at Massachusetts Landfills, Policy # COMM-97-001.

B. United States Department of Environmental Protection (EPA).

1. Federal Hazardous Waste Regulations, 40 CFR 261-268.

C. Disposal of TCLP material at RCRA Landfills is subject to all applicable provisions of the Phase IV Land Disposal Restrictions (LDR) of 40 CFR 268. The Work of this Section shall include all necessary supplemental treatment required to reduce concentrations of all Underlying Hazardous Constituents (UHCs) to levels below applicable Universal Treatment Standards (UTS) prior to landfill disposal.

1.5 ACTION SUBMITTALS

A. Submit pertinent information relating to the transport and disposal of materials specified herein, including the following:

1. Transporter Information:

a. Name and address of common carrier transporters to be used on project.
b. Name and address of licensed transporters to be used on project.
c. Provide current licenses and permits to operate in all states affected by transport.
d. Provide current EPA transporter license.

2. Facility Information:

a. Include at least two facility options for each Soil Disposal Category.
b. General Information:

1) Facility Name.
2) Facility Address.
3) Name of Contact Person.
4) Title of Contact Person.
5) Telephone Number of Contact Person.
6) Permit Number.

c. The facility shall provide written confirmation that they are permitted to accept and will accept material of the general quality and quantity described by these Specifications.
d. The facility shall provide a listing of all current and valid permits, licenses, letters of approval, and other authorizations to operate that they hold, pertaining to the receipt and management of materials specified in this Contract.
e. Submit a complete list of the disposal facility's permitted allowable contaminant levels and physical characteristic requirements for contaminated material, and list any required regulatory approvals for individual waste streams.

B. Prepare and submit to the Engineer for approval all waste profiles, specialists' opinion letters, and coordinate with disposal facilities.

C. Provide the Engineer with originals of all hazardous waste manifests, non-hazardous waste manifests and bills of lading, and material shipping records, no less than 7 days in advance of shipping OHM off site.

D. Prepare bill of lading forms and material shipping records and draft LSP Opinion Letters. Submit these to the Engineer for approval at least 7 days before transport. Engineer will sign as LSP on bill of lading and LSP opinion letter and will be responsible for obtaining Owner's signature prior to said use.

E. Submit to Owner and the Engineer, prior to receiving progress payment, documentation certifying that all materials were transported to, accepted, and disposed of, at the selected receiving facility.

1. Facility signed manifests and original bills of lading (forms BWSC-12A, -12B and -12C) and material shipping records.
2. Certified tare and gross weights for each waste load removed from the site.

PART 2 - PRODUCTS

2.1 GENERAL

A. Contractor personnel shall wear personal protective equipment and protective clothing consistent with the levels of protection for this Work according to their Health and Safety Plan.

PART 3 - EXECUTION

3.1 GENERAL

A. Owner will be the generator and will sign waste profiles, hazardous waste manifests, non-hazardous waste manifests, bills of lading (BOL) and material shipping records (MSR).

B. Identify appropriate disposal facilities and make all necessary arrangements for disposal of materials. Identify at least one backup facility for each soil disposal category in the event the primary facility cannot accept the material.

3.2 DISPOSAL FACILITY TESTING

A. Provide to Engineer the sampling and analysis requirements for each of the selected soil disposal facilities (i.e., analytical requirements, sampling frequency, etc.).

B. Be responsible for the sampling and analysis and for obtaining the final approval from the disposal facility.

1. Submit a copy of all analytical results to Engineer within 2 days of receipt of the laboratory report. Disposal facility testing can be integrated into the stockpile testing specified in Section 026110 “Excavation and Management of Contaminated Material.”

C. If a Soil Reclamation Facility selected by Contractor requires jar headspace screening as a part of their disposal characterization testing, Contractor will conduct the headspace testing. Based on the headspace readings and/or visual/olfactory observations, Engineer will determine if the material is acceptable to go to the proposed Soil Reclamation Facility. If the material is not

accepted at a soil reclamation facility, the material would require disposal at the Contractor's proposed backup in-state unlined landfill facility.

D. If disposal facility testing results exceed the applicable acceptance criteria for the disposal facility identified, dispose of soil at the next applicable category of disposal facility.

E. Conduct sampling of contaminated soil at sufficient and adequately distributed locations so that the concentrations of the chemical constituents are adequately characterized.

F. Coordinate schedule so that Engineer may observe sample collection. Pre-characterization data from boring B-PS2 (2-8) and B-PS2 (12-18) exhibited TCLP concentrations below 20 times the criteria and are therefore do not exhibit characteristics of hazardous waste. If future sample results indicate that the TCLP concentration for any metal exceeds the regulatory limit set forth in Table 1 of 40 CFR 261.24, treat the soil shall to render TCLP concentrations less than the regulatory limit prior to removal.

3.3 WASTE PROFILES AND SHIPPING DOCUMENTS

A. Identify disposal facilities and provide to the Engineer all disposal facility soil acceptance information, including but not limited to waste profile forms, certifications, and acceptance criteria. Perform all coordination with the disposal facilities.

B. Prepare all soil acceptance packages including waste profiles, questionnaires, and material shipping records (MSR), draft LSP Opinion Letters, and BOL and provide to the Engineer for review and approval. Engineer will review shipping paperwork, finalize LSP Opinion Letters for inclusion in disposal packages, and will be responsible for obtaining Owner's signature prior to said use.

C. Following review, submit the completed acceptance packages to the receiving facilities.

D. Prepare all manifests and if necessary, land ban certifications. Engineer will review, approve, and be responsible for obtaining Owner's signature prior to said use.

E. Submit to Owner and Engineer, prior to receiving progress payment, documentation certifying that all materials were transported to, accepted, and disposed of, at the selected receiving facility.

1. Facility signed manifests and original bills of lading and material shipping records.
2. Certified tare and gross weights for each load.

3.4 TRANSPORT AND DISPOSAL

A. Do not transport materials off-site until all disposal facility documentation has been received, reviewed, and accepted by Owner and the Engineer. Materials are not permitted for transport until the Contractor provides back to the Engineer the disposal facility's approval letter documenting acceptance of the material.

B. Transport and dispose in accordance with all United States Department of Transportation (DOT), USEPA, MDEP regulations, and other regulations of all affected states.

C. Be responsible for ensuring that free-liquid does not develop during transport. Do not load "Wet soils" for transport. Be responsible to properly dispose of any free liquids that may result during transportation. If necessary, perform solidification of soils by decanting, mixing cement, quicklime, or a different reagent to prevent free drainage of liquid from the solidified materials.

D. For any TCLP Material, stabilize and reduce UHCs to below applicable UTS to comply with Phase IV of the Land Disposal Restrictions (LDR) prior to transport.

E. Temporarily stored material must be removed from the site in accordance with applicable regulatory deadlines, however no later than the completion date of this Contract. Dispose of hazardous waste within 90 days of generation. Be responsible for any and all actions necessary to remedy situations involving waste spilled in transit or tracked off-site; this action will be performed at the Contractor’s expense.

END OF SECTION 028100

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SECTION 033010 – MISCELLANEOUS CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 033053.13 “Cast-In-Place Concrete for Underground Ducts and Raceways for Electrical Systems” for cast-in-place concrete for underground electrical systems.
2. Section 036000 “Grouting” for grouting.
3. Section 312000 "Earthwork" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with fly ash or ground granulated blast furnace slag; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. Contractor's superintendent.
    b. Independent testing agency responsible for concrete design mixtures.
    c. Ready-mix concrete manufacturer.
    d. Concrete Subcontractor.

2. Review steel reinforcement installation; anchorage of prefabricated submersible pumping stations, precast concrete buildings to cast-in-place foundation and generator foundation; construction joints; forms and form removal limitations; cold- and hot-weather concreting procedures; vapor-retarder installation; curing procedures; concrete

finishes and finishing; special inspection and testing, and Contractor's inspecting agency procedures for field quality control; concrete repair procedures, and concrete protection.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Concrete Design Mixtures: Design Mixtures: For each formulation of concrete proposed for use, submit constituent quantities per cubic yard (cubic meter), water cementitious ratio, air content, concrete slump, type and manufacturer of cement and type and manufacturer of fly ash or ground granulated blast furnace slag. Provide either:

1. Standard deviation data for each proposed concrete mix based on statistical records.
2. Water cementitious ratio curve for concrete mixes based on laboratory tests.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, spacing, lengths, material, grade, bar schedules, bent bar diagrams, bar arrangement, splices and laps, tie spacing, and supports for concrete reinforcement. Reference bars to be the same identification marks shown on the bar bending details.

D. Construction Joint Layout: As shown on the Drawings.

E. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.
7. Vapor retarders.
8. Repair materials.

F. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates**:** Conformance to ASTM standards, including sieve analysis, mechanical properties, and deleterious substance content.
2. Mill Test Reports: Conformance to ASTM standards, including chemical analysis and physical tests.

    a. Cementitious materials.
    b. Steel Reinforcing.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For independent testing agency responsible for concrete design mixtures.

B. Certifications:

1. Certify that admixtures used in the same concrete mix are compatible with each other and the aggregates.

2. Certificate of conformance for concrete production facilities from the NRMCA.

C. Minutes of preinstallation conference.

D. PE Certification form for the design of formwork.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Provide reinforcement free from mill scale, rust, mud, dirt, grease, oil, ice, or other foreign matter that will reduce or destroy bond. Deliver, store, and handle steel reinforcement to prevent bending and damage. Store reinforcement off the ground, protect from moisture, and keep out of standing water, and free from rust, mud, dirt, grease, oil, ice, or other contaminants and deleterious matter that will reduce or destroy bond.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average of the highest and lowest temperature from midnight to midnight is expected to fall below 40 deg F for three successive days, maintain delivered concrete temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 318.
2. ACI 301
3. ACI 117

2.2 FORM-FACING MATERIALS

A. Surface Finish 2.0 Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. Structural 1, B-B or better; mill oiled and edge sealed.

B. Rough-Formed Finish Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 1 by 1 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Form-release agent to comply with Federal, State and local VOC limitations.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal form ties designed to resist lateral pressure of fresh concrete, heavy high frequency vibration of the concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615, Grade 60, new deformed bars.

2.4 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete of greater compressive strength than the specified concrete strength, according to CRSI's "Manual of Standard Practice," and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

B. Tie wires for reinforcement: 16 gauge or heavier black annealed wire to tie uncoated reinforcing.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150, Type II.
2. Fly Ash: ASTM C618, Class F.
3. Ground Granulated Blast Furnace Slag: ASTM C989, Grade 120.

C. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: As indicated by concrete mixtures specified herein.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C494, Type A.

E. Water: ASTM C94 and potable.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.7 CURING MATERIALS

A. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1-D, Class B, dissipating.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: limit percentage, by weight, of cementitious materials (Portland cement alone or in combination with fly ash or Ground Granulated Blast Furnace Slag) in concrete as follows:

1. Fly Ash: 25 percent.
2. Ground Granulated Blast Furnace Slag: 45 percent.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, for placement and workability.

2.9 CONCRETE MIXTURES

A. Normal-weight structural concrete: 16 in and greater in thickness

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 5 inches plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery.
5. Coarse Aggregate: ASTM C33, 467

B. Normal weight structural concrete 10 in and greater in thickness

1. Minimum Compressive Strength: 4000 psi at 28 days
2. Maximum W/C Ratio: .45
3. Slump Limit: 5 inches plus or minus 1 inch
4. Air Content: 6 percent plus or minus 1.5 percent at point of delivery
5. Coarse Aggregate: ASTM C33, size 57

C. Normal weight structural concrete less than 10-in thickness

1. Minimum Compressive Strength: 4000 psi at 28 days
2. Maximum W/C Ratio: .45
3. Slump Limit: 5 inches plus or minus 1 inch
4. Air Content: 6 percent plus or minus 1.5 percent at point of delivery
5. Coarse Aggregate: ASTM C33, size 67

D. Electrical Raceway Encasement:

1. The concrete mixture in this paragraph shall be used for electrical raceway encasements, except as specified in section 033053.13, “Cast-In-Place Concrete for Underground Ducts and Raceways for Electrical Systems.”
2. Minimum Compressive Strength: 2500 psi at 28 days.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

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PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Use form-facing materials as required to meet the surface finishes (SF) requirements of ACI 301, unless otherwise specified provide as-cast form finishes per ACI 301 as follows.

1. Surface Finish (SF-2.0)

D. Construct forms tight to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Provide temporary openings for cleanouts and inspection ports where necessary. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

G. Chamfer exterior corners and edges of permanently exposed concrete.

H. Form openings, chases, offsets, sinkages, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, ice, snow and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations must be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing materials are not acceptable for exposed surfaces. Re-apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer’s written instructions.

1. Lap joints 6 inches and seal with manufacturer’s recommended tape.

3.5 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose mill scale, rust, mud, dirt, grease, oil, ice, and other foreign materials that reduce or destroy the bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum clear concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Splicing:

1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.

2. Locate horizontal joints at the top of footings.
3. Space vertical joints in walls as indicated on the Drawings.
   At construction joints and at concrete joints indicated on Drawings to be "roughened", uniformly roughen the surface of concrete to a full amplitude (distance between high and low points and side to side) of 1/4 inch with chipping tools to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by waterblasting or sandblasting and prepare for bonding. At least two hours before and again shortly before the new concrete is deposited, saturate joints with water. After glistening water disappears, coat joints with neat cement slurry mixed to consistency of very heavy paste. Coat surfaces to a depth of at least 1/8 inch thick, scrubbed-in by means of stiff bristle brushes. Deposit new concrete before the neat cement dries.
4. Do not use keyways in construction joints.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid “cold” joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

3.8 FINISHING SURFACES

A. Finish concrete surfaces according to ACI 318.

B. Surface Finish 2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent

formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.11 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Limit sawcut at the perimeter of the area to a depth of 3/4 inch. Make edges of cuts perpendicular to concrete surface. Prepare surfaces per patching mortar manufacturer's recommendations.

D. Repairing Formed Surfaces:

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects using patching mortar. On surfaces exposed to view repair by blending white Portland cement and standard Portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.12 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing and inspection agency to perform field tests and inspections and prepare test reports.

B. Notify the Owner when the reinforcing is complete and ready for inspection, at least six working hours prior to the proposed concrete placement. Do not cover reinforcing steel with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been inspected by the Owner's inspection agency and the Owner's inspection agency release to proceed with the concreting has been obtained. Keep forms open until the Owner's inspection agency has completed inspection of the reinforcement.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements by the Owner's testing agency:

1. Testing Frequency: One composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143; one test at point of discharge for each composite sample, but not less than one test for each day's placement of each concrete mixture. Additional tests will be performed when concrete consistency appears to change.
3. Air Content: ASTM C231, pressure method, for concrete; one test for each composite sample at the point of placement, but not less than one test for each day's placement of each concrete mixture.
4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31.

    a. Cast and cure two sets of two standard cylinder specimens for each composite sample and one cylinder specimen is to be held for further testing if required. Cast and laboratory cure five standard 6-inch x 12-inch long cylinder specimens.

6. Coordinate the number of compression test specimens in last subparagraph above with number of compressive-strength tests in "Compressive-Strength Tests" Subparagraph below.
7. Compressive-Strength Tests: ASTM C39; test one set of two laboratory-cured specimens at 7 days, and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days, and one set of two specimens at 28 days and one cylinder specimen is to be held for further testing if required.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated. The fifth may be used to verify strength after 28 days if the 28-day test results are low.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Engineer.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

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SECTION 033053.13 - CAST-IN-PLACE CONCRETE FOR UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes; concrete and reinforcement for encasement of underground ducts and raceways for electrical systems.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete” for concrete and deformed reinforcing bars and waterstops to be used in electrical ductbank and raceway systems.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems " for electrical component related to ductwork and raceway systems.
3. Section 312333 "Trenching and Backfilling" for earthwork related to ductwork and raceway systems.

1.3 ACTION SUBMITTALS

A. Submit reinforcement under Section 033010 “Miscellaneous Cast-in-Place Concrete.”

B. Submit concrete mix design under Section 033010 “Miscellaneous Cast-in-Place Concrete.”

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Concrete: Comply with Section 033010 “Miscellaneous Cast-In-Place Concrete,” except as follows:

1. Maximum Coarse-Aggregate Size: aggregate size shall not exceed 3/8-in.
2. Minimum Compressive Strength: 2500 psi at 28 days.
3. Maximum water / cement ratio: 0.62.
4. Color: Red dye added to concrete during batching. The concrete shall be dyed red throughout the concrete; surface treatment will not be accepted. Provide colorant consisting of an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete. The costs, if any, of cleaning coloring pigment from the concrete

delivery and handling equipment and other related cleanings shall be considered as part of the work.

2.2 STEEL REINFORCEMENT MATERIALS

A. Comply with Section 033010 “Miscellaneous Cast-in-Place Concrete.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Dye Color:

1. Dye concrete red throughout by adding coloring pigment to mix during batching. Surface treatment will not be accepted.
2. Colorant Proportion: 8 lbs of integral pigment per cu. yd. of concrete.
3. Costs, if any, for cleaning coloring pigment due to concrete delivery, handling, equipment, and other related cleanings shall be considered as part of base work scope.

    a. Replace adjacent surfaces that cannot be cleaned of red dye with new materials without additional compensation.

3.3 CONCRETE AND REINFORCING INSTALLATION

A. Concrete-Encased Ducts and Duct Bank:

1. Reinforcement: Reinforce all concrete-encased duct where indicated. Arrange reinforcing bars and ties without forming conductive or magnetic loops around ducts or duct groups.

    a. Comply with requirements of Section 033010 “Miscellaneous Cast-in-Place Concrete.”

2. Forms: Form as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”
3. Concrete Cover: Provide not less than 4-in of concrete between the outside of a duct or raceway and the earth. Provide not less than 2-in of concrete between adjacent ducts or raceways.
4. Concreting Sequence: Place each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the placement. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
b. If more than one placement is necessary, terminate each placement in a vertical plane and provide construction joint as indicated.

5. Placing Concrete: Comply with requirements Section 033010 “Miscellaneous Cast-in-Place Concrete," PART 3. Place concrete carefully during placements to prevent voids under and between duct or raceway and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts or raceways. Allow concrete to flow around duct or raceway and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

6. Where ductbanks pass through concrete walls, extend concrete encasement through walls and finish flush with inside surfaces. Provide watertight construction joints with waterstops conforming to Section 033010 “Miscellaneous Cast-in-Place Concrete.”

END OF SECTION 033053.13

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SECTION 034843 - PRECAST CONCRETE BUILDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes precast concrete building.

1. Field assemble the precast concrete building on a cast-in-place concrete foundation as indicated on contract drawings and in accordance with manufacturer's recommendations.
2. Anchorage of precast concrete building to cast-in-place concrete foundation.
3. Installation of instrumentation hardware within the building.

B. Related Requirements:

1. Section 033010 "Miscellaneous Cast-In-Place Concrete" for concrete foundations.
2. Section 061753 “Shop-Fabricated Wood Trusses.”
3. Section 333256 “Submersible Pumping Stations.”
4. Division 06, 07, 08 and 09 for architectural components of the building, installed under this Section.
5. Division 40 for instrumentation hardware within the building, installed under this Section.
6. Division 26 for electrical work except as specified herein.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for precast concrete building.

B. Delegated-Design Submittal: For precast concrete building, including the following:

1. Delegated Design: Engage a qualified Design Professional, as defined in Section 014000 "Quality Requirements," to design the prefabricated pumping station.
2. Qualifications Statement: Submit qualifications for Design Professional.
3. Construction Documents: Provide a full set of drawings, specifications, calculations, and other information required by the Authority Having Jurisdiction, prepared and sealed by a Design Professional, to obtain a building permit, and any other permits required to construct the Project. As-built calculations are to be submitted for record purposes only and will not be reviewed by Engineer.

4. Submit for review and approval stamped design calculations for the connection of the prefabricated metal plate-connected wood trusses to the precast concrete building.
5. Submit for review and approval stamped shop drawings showing construction and installation details of all items to be furnished. Approval of shop drawings does not relieve the Contractor or station manufacturer of the responsibility for proper fit or detailed design of connections. Include plans, elevations, sections, details and attachment details.
6. Submit stamped precast building foundation reaction / loading table for all load combinations per the applicable code, anchorage location and details.
7. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished together with floor plans, sections and elevation showing a complete layout to scale of all equipment, piping, electrical conduits and wall sleeve locations.
8. Descriptive literature, bulletins and/or catalogs on each item of equipment. Literature shall describe the equipment in sufficient detail, including parts list and materials of construction, to establish full conformance with the Specifications.
9. The total weight of each item of equipment including the weight of the single largest component of each item.
10. A complete total bill of materials for all equipment.
11. All information required by Division 26.
12. Schematic wiring diagrams and schematics of all controllers, control panels, control devices and operators stations furnished under this Section.
13. Schematic wiring diagrams and schematics of all power and control systems including connections to work of other Sections.
14. Manufacturer cut sheets or component data sheets for all electrical equipment and accessories furnished under this section.
15. Complete hardware schedule as provided in Section 013300 “Submittal Procedures” for shop drawings. Provide catalogue cuts for each item of hardware. No templates shall be distributed until the hardware schedule has been approved by the Engineer. Provide approved physical hardware items to door manufacturer if required.
16. All other drawings and data as may be required for the complete installation of miscellaneous equipment such as details of pump control panel, heating and ventilation equipment, etc.
17. All submittal items required in other related Sections which are to be supplied and installed as part of the precast concrete building specified herein.
18. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

    a. Name and location of Project.

        1) Order number.
        2) Name of manufacturer.
        3) Name of Contractor.
        4) Building dimensions including width, length, height, and roof slope.
        5) Governing building code and year of edition- See contract drawings
        6) Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
        7) Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.

8) Building-Use Category: Risk Category III. Indicate category of building use and its effect on load importance factors.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Cast-In-Place Concrete, roof truss tie connections and all other Trade interfaces.

B. Concrete design mix data and concrete test cylinder reports from an approved concrete testing laboratory certifying that the concrete used in the structure conforms with the strength requirements specified herein.

C. Welding certificates.

D. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.

E. Manufacturer Certificate: Signed by manufacturer certifying that products comply with requirements.

F. Qualification Data: For Erector, manufacturer, professional engineer, land surveyor and testing agency.

G. Source quality-control test reports.

H. Field quality-control test reports.

I. Product Test Reports: Include reports for thermal resistance, fire-test-response characteristics, water-vapor transmission, and water absorption.

J. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

K. Maintenance Data: For precast concrete maintenance data to include in maintenance manuals.

L. Warranties: Special warranties specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Surveys: Show final elevations and locations of major members. Indicate discrepancies between actual installation and the Contract Documents. Have surveyor who performed surveys certify their accuracy.

B. Calculations and Drawings: Submit stamped as-built structural calculations and drawings for the precast building at project completion. Calculations are for record purposes only and will not be reviewed.

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1.6 QUALITY ASSURANCE

A. Precast manufacturer shall be licensed by the Commonwealth of Massachusetts.

B. Fabricator shall be a certified producer/member of The Precast/Prestressed Concrete Institute (PCI) or National Precast Concrete Association (NPCA).

C. Fabricator must have a minimum of 15 years' experience manufacturing and setting transportable precast concrete buildings. In addition, the Manufacturer shall have made no less than ten (10) Pump Stations similar to the one on this project.

D. Installer Qualifications: Manufacturer or an authorized representative who is trained and approved by manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel; D1.3, "Structural Welding Code - Sheet Steel D1.4/D1.4M, and "Structural Welding Code - Reinforcing Steel."

F. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing surveying services of the kind indicated.

G. Repair minor damage to precast concrete structures and the cast-in-place concrete foundation by approved method at no additional cost to the Owner, if repair is authorized by the Engineer. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days. Repaired structures determined to be unacceptable by the Engineer shall be replaced with new structures at no additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast concrete building so as not to be damaged or deformed. Package precast concrete building for protection during transportation and handling.

B. Unload, precast concrete building in a manner to prevent bending, warping, twisting, and surface damage.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation of precast concrete building only when weather conditions permit it to be installed according to manufacturers' written instructions and warranty requirements.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast concrete building so as not to be damaged or deformed. Package precast building for protection during transportation and handling.

B. Unload, precast concrete building in a manner to prevent bending, warping, twisting, and surface damage.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide “EASI-SET,” by Oldcastle Precast, Avon, CT or one of the following:

1. United Concrete Products, Yalesville, CT.
2. Shea Concrete Products, Wilmington, MA.
3. Or equal.

B. The Contractor or station manufacturer to have on staff a licensed Master Electrician who will perform all job-site electrical connections and startup.

C. All equipment to be designed and proportioned to have liberal strength, stability and stiffness and to be especially adapted for the intended service.

2.2 MATERIALS

A. Concrete: Minimum compressive strength of 5,000 psi at 28 days. Water shall be kept to a minimum to obtain concrete which is as dense and watertight as possible. The maximum water content shall be 4.5 gallons per 94 lb sack of cement and the minimum cement factor shall be 6.4 sacks (94 lb per sack) per cubic yard of concrete. The above ratios shall be revised for sacks of cement weighing different from 94 pounds per sack.

B. Reinforcing Steel: ASTM A 615/A 615M, grade 60 unless otherwise specified.

2.3 FABRICATION REQUIREMENTS

A. Dimensions:

1. Exterior: As indicated on Drawings.
2. Interior: As indicated on Drawings.

B. Roof: Flat.

1. Connection of the prefabricated metal plate-connected wood trusses to the precast building shall be coordinated with the approved wood truss submittal.

C. Foundation: set on a cast-in-place peripheral wall foundation as shown on Drawings.

2.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, to design the precast concrete building.

B. Engineer precast concrete building according to design requirements in ACI-318 and Concrete Reinforcing Institute, "Manual of Standard Practice" and the Massachusetts State Building Code indicated in the drawings.

C. The precast concrete electrical building shall be as shown on the design drawings and shall be designed to support its own weight, the weight of the timber roof, plus the minimum superimposed loads and design criteria shown below. Account for all additional equipment operating weights in the design of the elements. Minimum load criteria:

1. Timber Roof:

    a. Dead Load: Coordinate with delegated design per Section 061753 “Shop-Fabricated Wood Trusses.”
    b. P_g: Ground Snow Load per Massachusetts State Building Code.
    c. C_e: 1.0
    d. I:1.1

2. Precast Concrete:

    a. Roof Slab Hung Load: Coordinate with approved equipment; minimum 10 psf.
    b. Attic Space: Live load 20 psf.

3. Wind Loads:

    a. Basic Wind Speed: per Massachusetts State Building Code.
    b. Exposure: C.

4. Seismic:

    a. Importance factor:1.25.
    b. Spectral Response Acceleration per Massachusetts State Building Code.
    c. Site Classification: D.
    d. Seismic Design Category: B.
    e. Occupancy Category: III.

5. Floor Slab:

    a. Live Load: 300 psf (minimum).
    b. Design Loads: Equipment as indicated on Drawings.
    c. Engine Generator weight and plan furnished by the Generator Manufacturer.

D. Floor, roof and walls shall be analyzed by accepted engineering principles. The structural design shall take into account discontinuities in the structure produced by openings and joints in the structure. The openings shall be completely framed as required to carry the full design loads to the supports. Additional reinforcing shall be provided around all openings.

E. Provide connection detail to the cast-in-place peripheral wall footing.

F. Building floor slab shall be checked for mechanical vibration of approved generator, per ACI 351.3R. The ratio of the structure’s natural frequency to the operating frequency of the equipment will be restricted to less than 0.50 or greater than 1.50. Check structure for all

applicable modes of vibration, including vertical, lateral, and rotational. Provide Vibration isolators, if necessary.

2.5 FINISHES

A. Smooth steel form finish on all surfaces.

2.6 DOOR AND FRAME CONSTRUCTION

A. FRP Doors and Frames: As specified in Section 081500 “Fiberglass Reinforced Plastic Doors and Frames.” Provide with the precast concrete building.

2.7 FINISH HARDWARE

A. Finish Hardware: As specified in Section 087100 “Door Hardware.” Provide with the precast concrete building.

2.8 CAULKING

A. Exterior and Interior Sealant for Joints Around Openings: One-part gun grade, polyurethane base (Sikaflex 1a by Sika) or silicone base (by General Electric or Dow Corning) sealant. Primer shall be as recommended by the manufacturer. Silicone shall not be used in contact with soil or water.

2.9 SURFACE PERPARATION AND SHOP PAINTING

A. Surface Preparation and Shop Painting: As specified in Division 09. Provide with the precast concrete building.

2.10 INTERIOR INSULATION AND FINISH SYSTEM

A. Interior Insulation and Finish Systems: As specified in Division 09. Provide with the precast concrete building.

2.11 LOUVERS

A. Louvers: As specified in Section 089119 “Fixed Louvers.” Provide with the precast concrete building.

2.12 FIRE EXTINGUISHERS

A. Manufacturers: Provide fire extinguishers, with the precast concrete building, by one of the following:

1. Amerex Corporation.
2. JL Industries, Inc.; a division of the Activar Construction Products Group.
3. Kidde Residential and Commercial Division.
4. MOON American.
5. Or equal.

B. Provide one fire extinguisher in each precast concrete building.

C. Provide 20-lb capacity, carbon dioxide type, rated for 10 B:C. ; red-enameled aluminum cylinder; equal to Sentinel 20 by J.L. Industries.

D. Provide Mark Series Fire Extinguisher Brackets, supporting bottom and sides of extinguishers, by J. L. Industries or equal, for all fire extinguishers.

E. Fire extinguishers and brackets shall be installed at the locations directed by the Engineer.

2.13 FAUX WINDOW

A. Provide aluminum-clad wood window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 35.

C. Operating Type: Fixed.

D. Frames: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch-deep by 2 inches wide; water-repellent preservative treated.

1. Exterior Finish: Aluminum-clad wood.

a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight and complying with AAMA 2605.
b. Color: As selected by Engineer from manufacturer's full range.

E. Glass: Ceramic-Coated Spandrel Glass: ASTM C1048, Type I, Condition B, Quality-Q3.

2.14 WALL PENETRATIONS

A. Unless otherwise shown on Drawings or specified herein, wall penetrations shall be made using mechanical seals. Waterproof wall sleeves for use with the sealing strips shall be Schedule 40,

galvanized steel pipe conforming to ASTM A53. A suitable water stop approximately 1/4-inch thick by 2 inches wide shall be welded to the sleeve completely around the periphery of the pipe. The use of such sealing strips shall not relieve the station supplier of his responsibility of providing a guaranteed watertight installation. Different types of wall penetrations may be permitted with the express approval of Engineer.

B. Mechanical seals shall be modular, adjustable, bolted mechanical-type consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve. Bolts and hardware shall be Type 316 stainless steel. Pressure plates shall be corrosion-resistant acetal resin. The seal shall be rated by the manufacturer for 40 feet of head or 20 psig. Mechanical seals shall be Link-Seal depending on pipe size, by Thunderline Corp., Belleville, MI, or equal.

C. Wall seals for electrical conduit penetrations in the utility building, and for gas service and vent in the utility building, shall be Type CSMI as manufactured by the O-Z/Gedney Co., or approved equal.

2.15 SLEEVES AND FORMS FOR OPENINGS

A. Station manufacturer shall provide and place all sleeves for plumbing, heating and ventilation and electrical conduits penetrating in floors, walls, etc. Locate all necessary slots for electrical work and form before pouring concrete.

2.16 PAINTING

A. Painting of the interior of the electrical building shall be performed under this Section conforming to all provisions of Division 09.

2.17 HEATING AND VENTILATING

A. Refer to Division 23 for HVAC Specifications.

2.18 NATURAL GAS SYSTEMS

A. Low-pressure (less than 14-in water column) gas piping 2-in and smaller shall be Schedule 40 black steel with malleable iron fittings.

B. High-pressure (greater than 14-in water column) gas piping shall be Schedule 40 black steel with welded fittings.

C. Piping larger than 2-in diameter shall be Schedule 40 black steel pipe and fittings with welded joints.

D. Gas train vent piping shall be of the same material as that specified for low pressure piping systems.

E. Gas valves:

1. Gas valves 2-in and smaller shall be three-piece bronze ball valves with threaded ends, equal to Hammond 8604; Watts 6800 (YRPV), or Apollo 82-100, modified with tee handles.
2. Gas valves larger than 2-in shall be lubricated plug valves equal to valves manufactured by Powell; Homestead; or Rockwell.
3. Gas valves shall be specifically listed as suitable for natural gas service.

F. Limits of Work:

1. Gas piping installed from the street to the building, setting of the meter, and installation of the pressure reducing valve (PRV) shall be the responsibility of the gas supplier.
2. Contractor shall be responsible for installing gas from the downstream side of the PRV to the generators.
3. All pipe, fittings and appurtenances shall be installed in accordance with the Commonwealth of Massachusetts Fuel Gas and Plumbing Codes.

2.19 COPPER PIPING

A. Piping shall be Type “L” copper with cast bronze or wrought copper, solder type fittings for above grade, and Type “K” for buried piping. Joints shall be made with lead-free solder. All copper piping 1-1/2-in and larger and all buried piping shall be silver brazed.

2.20 GENERATOR

A. Gaseous Engine Generators are specified in Division 26.

2.21 ELECTRICAL

A. Service to the buildings shall be 480 Volt, 3-phase, 60 HZ as shown on the Drawings installed under Division 26. The building manufacture shall provide a complete and wired electrical system within the building in accordance with all applicable portions of the Division 26 specification and NEC requirements including Lighting and Fire Alarm system.

B. Building manufacturer to factory install and wire lighting, in accordance with Division 26.

C. Building manufacturer to factory install and wire all electrical and control equipment as indicated on electrical contract drawings. Refer to Division 26 for specification of electrical equipment and proposed layout of equipment, disconnect switches, starters, transformers, panelboards, conduits and fittings, wire, cable and accessories, etc. Refer to electrical drawings for control wiring diagrams and details.

2.22 INSTRUMENTATION GENERAL

A. Refer to Division 40 specifications and the Contract Drawings for panel-mounted and field-mounted instruments and control panel requirements.

B. Lightning/Surge Protection:

1. General - Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the internal plant electrical distribution system. The protection systems shall be such that the protective level shall not interfere with normal operation but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring.
2. Field Instrumentation Protection - Provide individual device protection for each field instrument mounted outside of the building or facility housing the control panel. Instruments mounted within the structure as the associated control panel shall not require surge protection. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all instrumentation device surge protectors shall be connected to a good earth ground. Where practical route each ground wire individually and insulated from each other. Device surge protectors shall be mounted within the instrument enclosure or a separate junction box coupled to the enclosure. Provide surge protection devices as manufactured by Phoenix Contact, Telecommunications Industries Inc.; or equal.
3. Control Panel Power Supply – Provide protection of all 120 VAC instrument power supply lines. Source voltage to cabinets/panels regardless of location (indoor or outdoor) shall be protected by isolation transformers and surge suppressors. Provide gas tube surge suppressors or metal oxide varisters (MOVs) located at the point where the 120V source supply enters the enclosure. Install the surge device to in strict compliance with the manufacturer's recommendation for maximum allowable circuit length between protective device and incoming circuit. Provide signal surge suppression devices as manufactured by Phoenix Contact or equal.
4. Instrument 120 V Power Supply – Provide protection for 120 VAC power to all 4-wire field instruments (indoor or outdoor). Provide individual gas tube surge suppressors or metal oxide varisters (MOVs) located at the instrument end of the circuit. Provide signal surge suppression devices as manufactured by Phoenix Contact or equal.
5. 4-20 mA Signal Lines and Non-Fiber Based Data Highway Circuits – Provide protection on all signal and data highway circuits that leave a building or are routed external to a building. Provide gas tube surge arrestors, and Zener diode protectors. Circuit protection shall be provided at both ends of the signal or data highway lines within the control panel at one end and as close to the instruments or termination device as possible. Provide signal surge suppression devices as manufactured by Phoenix Contact or equal.

2.23 MISCELLANEOUS METALS

A. Unless otherwise specified, material shall conform to the following:

1. Structural Steel: ASTM A36
2. Gray Iron Castings: ASTM A48, class 30
3. Galvanizing, General: ASTM A123, Zn w/0.05 percent min Ni
4. Galvanizing, hardware: ASTM A153, Zn w/0.05 percent min Ni
5. Aluminum (Extruded Shapes): 6061 T6
6. Aluminum (Extruded Pipe): 6063 T6
7. Aluminum Sheet and Plate: 6061 T6

8. Bolts and Nuts: ASTM A307, Grade A (hot dip galvanized nuts and washers, where galvanized bolts are indicated or specified, otherwise mechanically galvanized ASTM B695, Class 50)
9. Stainless Steel Plates and Sheets
10. Exterior, Submerged or Industrial Use: ASTM A167, Type 316 (Type 316L for welded components)
11. Interior and Architectural Use: ASTM A167, Type 304
12. Stainless Steel Shapes, Bolts, Nuts, and ASTM A276, Type 316 (Condition B for Washers fasteners)
13. Welding Rods for Steel AWS Spec. ARC Welding (E70XX)

B. Miscellaneous steel items such as angles, channels, etc. shall conform to ASTM A36 the material properties specified above and shall be at least 1/4-inch thick. All miscellaneous steel shall be galvanized.

C. Welding of parts shall be in accordance with the Standard Code for Arc and Glass Welding in Building Construction of the AWS and shall only be done where shown, specified or permitted specifically by the Engineer. All welding may only be done by welders certified as to their ability to perform welding in accordance with the requirements of the AWS code. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other means adequate to hold the parts in proper position for welding.

D. Welding of aluminum work shall be done on the unexposed side as much as possible in order to prevent pitting or discoloration.

E. All aluminum finish exposed surfaces shall have manufacturer's standard cleaned and degreased mill finish.

F. All steel and aluminum surfaces to come in contact with exposed concrete shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.

G. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

A. Earth excavation and backfill are specified under Division 31, including any necessary sheeting and bracing.

3.2 PREPARATION

A. Provide temporary shores, braces, and other supports during erection to keep precast concrete building, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION OF PRECAST CONCRETE BUILDING

A. Erect precast concrete building according to manufacturer's written erection instructions and erection drawings.

B. The buildings shall be placed level on the concrete foundation walls and located as indicated.

C. Following final setting of structures, remove lifting hooks and fill all lifting holes in all structures with non-shrink grout to match the surrounding concrete.

D. All workmanship and materials shall be of the highest quality.

3.4 FIELD QUALITY CONTROL

A. Correct deficiencies in Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 034843

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SECTION 036000 - GROUTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nonshrink cementitious grout.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete.”

1.3 ACTION SUBMITTALS

A. Product Data: Submit manufacturer information regarding grout and surface preparation, mixing and installation.

1. Commercially manufactured nonshrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, and conformity to the specified ASTM standards.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing nonshrink grouts.

C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

D. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' experience in production and use of provided grouts.

B. Pre-installation Meeting: At least ten working days before grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Notify all parties involved with grouting, including the Engineer, of the meeting at least ten working days prior to its scheduled date.

C. Services of Manufacturer's Representative: Provide services of a field technician of the nonshrink grout manufacturer who has performed at least five projects of similar size and complexity during the last five years, to attend the pre-installation meeting, to be present for the initial installation of each type of nonshrink grout, and to correct installation problems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store materials according to manufacturer instructions. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer’s recommended storage time, whichever is less.

C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location.
2. Provide additional protection according to manufacturer instructions.

1.7 AMBIENT CONDITIONS

A. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F.

B. Minimum Conditions: Do not perform grouting if the minimum temperature of base plates, supporting concrete and grout are less than 40 degrees F. Maintain minimum temperature of 40 degrees F before, during, and after grouting, until grout has set.

PART 2 - PRODUCTS

2.1 NONSHRINK CEMENTITIOUS GROUT

A. Description:

1. Pre-mixed and ready-for-use formulation requiring only addition of water.
2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, not containing expansive cement and no chlorides.
3. No shrinkage when tested in conformity with ASTM C827.

B. Performance and Design Criteria:

1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to ASTM C1107 for Grades B, C, D and CRD-C621 nonshrink grout:

a. Setting Time:

1) Initial: Approximately two hours.
2) Final: Approximately three hours.
3) Comply with ASTM C191.

b. Maximum Expansion: 0.10 to 0.40 percent.
c. Minimum Compressive Strength:

1) One-Day: 4,000 psi.
2) Seven-Day: 7,000 psi.
3) 28-Day: 10,000 to 10,800 psi.
4) Comply with CRD-C621.

2.2 FORMWORK

A. As specified in this Section and in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify areas to receive grout.

3.2 PREPARATION

A. Place grout where indicated or specified over existing concrete and cured concrete which has attained its specified design strength unless otherwise approved by Engineer.

B. Remove defective concrete, ice, laitance, dirt, oil, grease, form release agents, paints, and other foreign material from concrete surfaces, which may affect the bond or performance of the grout by brushing, hammering, chipping, sand blasting or other similar dry mechanical means until sound and clean concrete surface is achieved. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oil-less type or equipped with an oil trap in the airline to prevent oil from being blown onto the surface.

C. Roughen concrete lightly, but not to interfere with placement of grout.

D. Remove foreign materials from metal surfaces in contact with grout.

E. Align, level, and maintain final positioning of components to be grouted.

F. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of nonshrink cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface or other method acceptable to Engineer. Upon completion of the 24 hour period, remove visible water from the surface prior to grouting.

G. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other approved means. Prevent bond of shims, wedges and blocking devices by bond breaking coatings and remove after grouting unless otherwise approved by Engineer. Grout voids created by the removal of shims, wedges, and blocks.

3.3 INSTALLATION - GENERAL

A. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.
3. As specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

B. Curing:

1. Prevent rapid loss of water from grout during first 48 hours by using wet burlap bags, soaker hoses or ponding.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

3.4 SCHEDULE

A. Use particular types of grout as follows:

1. General Purpose Nonshrink Cementitious Grout (CRD-C621 Grade D): Use at locations where nonshrink grout is indicated, except for base plates greater in area than 3-feet wide by 3-feet long.

END OF SECTION 036000

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SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Wood furring.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing.
2. Section 061753 "Shop-Fabricated Wood Trusses" for wood trusses made from dimension lumber.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Power-driven fasteners.
3. Post-installed anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat all miscellaneous carpentry.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. For pressure-preservative-treated wood, use stainless-steel fasteners.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 ICC-ES AC58 ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.5 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Do not splice structural members between supports unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

I. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood: Install 1-by-3-inch nominal- size furring horizontally at 24 inches o.c.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

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SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated.

2.3 WALL SHEATHING

A. Plywood Sheathing: , Exterior, Structural I sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than indicated.

B. Oriented-Strand-Board Sheathing: Not permitted.

2.4 ROOF SHEATHING

A. Plywood Sheathing: , Exterior, Structural I sheathing.

1. Span Rating: Not less than 24/0.
2. Nominal Thickness: Not less than indicated.

B. Oriented-Strand-Board Sheathing: Not permitted.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C 1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Space panels 1/8 inch apart at edges and ends.

END OF SECTION 061600

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SECTION 061753 - SHOP-FABRICATED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood roof trusses.

1.3 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For wood-preservative-treated lumber, metal-plate connectors, metal truss accessories, and fasteners.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification from treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to truss fabricator.

B. Shop Drawings: Show fabrication and installation details for trusses.

1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
2. Indicate sizes, stress grades, and species of lumber.
3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
6. Show splice details and bearing details.
7. Show anchorage details to structure.

C. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For metal connector-plate manufacturer professional engineer and fabricator.

B. Material Certificates: For dimension lumber specified to comply with minimum specific gravity. Indicate species and grade selected for each use and specific gravity.

C. Product Certificates: For metal-plate-connected wood trusses, signed by officer of truss-fabricating firm.

D. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated lumber.
2. Metal-plate connectors.
3. Metal truss accessories.

1.6 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.

1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program, complies with quality-control procedures in TPI 1, and involves third-party inspection by an independent testing and inspecting agency acceptable to Engineer and authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations in SBCA BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal-plate-connected wood trusses.

B. Structural Performance: Metal-plate-connected wood trusses shall be capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

1. Design Loads:

a. Base design loads on Massachusetts State Building Code indicated on Drawings.
b. Snow Load:

i. P_g: Ground Snow Load per Massachusetts State Building Code
ii. C_e: 1.0
iii. I: 1.1

c. Roof Hung Load: Coordinate with approved equipment; minimum 10psf
d. Roof Live load: 20 psf
e. Wind Loads:

i. Basic Wind Speed: per Massachusetts State Building Code
ii. Exposure: C

f. Seismic:

i. Importance factor:1.25
ii. Spectral Response Acceleration: per Massachusetts State Building Code
iii. Site Classification: D
iv. Seismic Design Category: B
v. Occupancy Category: III

2. Maximum Deflection under Design Loads:

a. Roof Trusses: Vertical live load deflection of 1/180 of span.

C. Comply with applicable requirements and recommendations of TPI 1, TPI DSB, and SBCA BCSI.

D. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

2.2 DIMENSION LUMBER

A. Lumber: DOC PS 20 and applicable rules of any rules-writing agency certified by the American Lumber Standard Committee (ALSC) Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Provide dressed lumber, S4S.
3. Provide dry lumber with 15 percent maximum moisture content at time of dressing.

B. Minimum Chord Size for Roof Trusses: 2 by 6 inches nominal for both top and bottom chords.

C. Minimum Specific Gravity for Top Chords: 0.50.

D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Section 061053 "Miscellaneous Rough Carpentry."

2.3 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat trusses unless otherwise indicated.

2.4 METAL CONNECTOR PLATES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpine Engineered Products, Inc.; a division of ITW Building Components Group, Inc.
2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
3. CompuTrus, Inc.
4. Eagle Metal Products.
5. Jager Building Systems, Inc.
6. MiTek Industries, Inc.
7. Robbins Engineering, Inc.
8. Truswal Systems Corporation.
9. Or equal.

B. General: Fabricate connector plates to comply with TPI 1.

C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
2. Provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

2.6 METAL FRAMING ANCHORS AND ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Phoenix Metal Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. USP Structural Connectors.
6. Or equal.

B. Allowable design loads, as published by manufacturer, shall comply with or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Hot-Dip Heavy-Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

D. Truss Tie-Downs (Hurricane or Seismic Ties): Packaged unit consisting of L-shaped plate with pre-drilled holes and fasteners for connection to wood truss and concrete.

1. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
2. Finish: Hot-Dip galvanized.
3. Basis of Design: Provide “H Series – Hurricane and Seismic Ties,” by Simpson Strong-Tie Co., Inc., or equal by one of the following:

    a. Cleveland Steel Specialty Co.
    b. KC Metals Products, Inc.
    c. Phoenix Metal Products, Inc.
    d. USP Structural Connectors.

E. Roof Truss Bracing/Spacers: U-shaped channels, 1-1/2 inches wide by 1 inch deep by 0.040 inch thick, made to fit between two adjacent trusses and accurately space them apart, and with tabs having metal teeth for fastening to trusses.

F. Drag Strut Connectors: Angle clip with one leg extended for fastening to the side of girder truss.

1. Angle clip is 3 by 3 by 0.179 by 8 inches with extended leg 8 inches long. Connector has galvanized finish.
2. Angle clip is 3 by 3 by 0.239 by 10-1/2 inches with extended leg 10-1/2 inches long. Connector has painted finish.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 92 percent zinc dust by weight.

2.8 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly, with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.

1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

2.9 SOURCE QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections.

1. Provide special inspector with access to fabricator's documentation of detailed fabrication and quality-control procedures that provide a basis for inspection control of the workmanship and the fabricator's ability to conform to approved construction documents and referenced standards.
2. Provide special inspector with access to places where wood trusses are being fabricated to perform inspections.

B. Correct deficiencies in Work that special inspections indicate do not comply with the Contract Documents.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses as indicated; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.

H. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.

1. Install bracing to comply with Section 061053 "Miscellaneous Rough Carpentry."
2. Install and fasten strong-back bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

I. Install wood trusses within installation tolerances in TPI 1.

J. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.

K. Replace wood trusses that are damaged or do not comply with requirements.

1. Damaged trusses may be repaired according to truss repair details signed and sealed by the qualified professional engineer responsible for truss design, when approved by Engineer.

3.2 REPAIRS AND PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect wood trusses from weather. If, despite protection, wood trusses become wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

C. Repair damaged galvanized coatings on exposed surfaces according to ASTM A 780/A 780M and manufacturer's written instructions.

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3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections to verify that temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package.

END OF SECTION 061753

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SECTION 062013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior cellular PVC trim.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.3 DEFINITIONS

A. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Samples:

1. For cellular PVC trim, with half of exposed surface finished; 50 sq. in.

1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Cellular PVC trim.

B. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.8 FIELD CONDITIONS

A. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.9 WARRANTY

A. Manufacturer's Warranty for Cellular PVC Trim: Manufacturer agrees to repair or replace trim that fails due to defects in manufacturing within specified warranty period. Failures include, but are not limited to, deterioration, delamination, and excessive swelling from moisture.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXTERIOR TRIM

A. Cellular PVC Trim: Extruded, expanded PVC with a small-cell microstructure, recommended by manufacturer for exterior use, made from UV- and heat-stabilized rigid material.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. CPG Building Products LLC.
c. Gossen Corporation.
d. Kleer Lumber, LLC.
e. Kommerling USA, Inc.
f. Plasticlad, LLC.
g. Ply-Trim, Inc.

h. Royal Mouldings Limited.
i. Versatex Trimboard; a Wolfpac Technologies, Inc. company.
j. Vi-Lux Plastics Inc.
k. Or equal.

2. Density: Not less than 31 lb/cu. ft.
3. Heat Deflection Temperature: Not less than 130 deg F, according to ASTM D 648.
4. Coefficient of Thermal Expansion: Not more than 4.5 x 10^{-5} inches/inch x deg F.
5. Water Absorption: Not more than 1 percent, according to ASTM D 570.
6. Flame-Spread Index: 75 or less, according to ASTM E 84.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.

1. For applications not otherwise indicated, provide stainless-steel hot-dip galvanized-steel or aluminum fasteners.

B. Adhesive for Cellular PVC Trim: Product recommended by trim manufacturer.

C. Continuous Soffit Vents: Aluminum hat channel shape with perforations, 2 inches wide and in lengths not less than 96 inches.

1. Net-Free Area: 8 sq. in./linear ft.
2. Finish: White paint.

D. Sealants: Latex, complying with ASTM C 834 Type OP, Grade NF and applicable requirements in Section 079200 "Joint Sealants" and recommended by sealant and substrate manufacturers for intended application.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.
b. Franklin International.
c. May National Associates, Inc.; a subsidiary of Sika Corporation.
d. Pecora Corporation.
e. Schnee-Morehead, Inc., an ITW company.
f. Tremco, Inc.
g. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
3. Coordinate exterior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install cellular PVC trim to comply with manufacturer's written instructions.

B. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

C. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

D. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean exterior finish carpentry on exposed and semi-exposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.
2. Factory-laminated plastic sheet paneling.

B. Related Requirements:

1. Section 092216 “Non-Structural Metal Framing” for metal furring for installing plastic paneling.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 FACTORY-LAMINATED PLASTIC SHEET PANELING

A. Factory-Laminated Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319, laminated to water-resistant gypsum board.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Arcoplast Inc.
    b. Citadel Architectural Products, Inc.
    c. Crane Composites, Inc.
    d. Glasteel.
    e. Newcourt, Inc.
    f. Nudo Products, Inc.
    g. Or equal.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

3. Glass-Fiber-Reinforced Plastic Panel Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Smooth.
5. Color: White.
6. Water-Resistant Gypsum Board: ASTM C 1396/C 1396M or ASTM C 1178/C 1178M, 5/8 inch, Type X, with water-resistant core and surfaces.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece or two-piece, snap-on vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: White.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

E. Sealant: Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT, recommended by plastic paneling.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

B. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at trim accessory and panel joint locations for accurate installation.
2. Locate trim accessories and panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

C. Install factory-laminated panels using concealed mounting splines in panel joints.

D. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

E. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

G. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

H. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

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SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Extruded polystyrene foam-plastic board.
2. Polyisocyanurate foam-plastic board.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type IV, Drainage Panels: ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84; fabricated with shiplap or channel edges and with one side having grooved drainage channels.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. DiversiFoam Products.
    b. Dow Chemical Company (The).
    c. Owens Corning.
    d. Or equal.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Glass-Fiber-Mat Faced: ASTM C 1289, glass-fiber-mat faced, Type II, Class 2.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Atlas Roofing Corporation.
    b. Carlisle Coatings & Waterproofing Inc.
    c. Firestone Building Products.
    d. Hunter Panels.
    e. Rmax, Inc.
    f. Or equal.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 ACCESSORIES

A. Adhesive for Bonding Insulation: Product compatible with insulation and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.

3.4 INSTALLATION OF INSULATION ON CONCRETE BUILDING SURFACES

A. Polyisocyanurate Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

1. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose.

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3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

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SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-retardant, reinforced-polyethylene vapor retarders.

B. Related Requirements:

1. Section 072100 "Thermal Insulation" for ceiling and wall insulation products over which vapor retarders are installed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 REINFORCED-POLYETHYLENE VAPOR RETARDERS

A. Reinforced-Polyethylene Vapor Retarders: Sheet with outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nylon cord or polyester scrim and weighing not less than 20 lb/1000 sq. ft., with maximum permeance rating of 0.1 perm.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ISI Building Products.
b. Raven Industries, Inc.
c. Reef Industries, Inc.
d. Or equal.

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 072600

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SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Vapor-retarding, fluid-applied air barriers.

B. Related Requirements:

1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR RETARDING

A. High-Build, Vapor-Retarding Air Barrier: Modified bituminous or synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

1. Modified Bituminous Type:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Carlisle Coatings & Waterproofing Inc.
        2) Henry Company.
        3) Tremco Incorporated.
        4) W.R. Meadows, Inc.
        5) Or equal.

2. Synthetic Polymer Type:

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Carlisle Coatings & Waterproofing Inc.
        2) GCP Applied Technologies Inc.
        3) Henry Company.
        4) Hohmann & Barnard, Inc.
        5) Rubber Polymer Corporation, Inc.
        6) Sto Corp.
        7) W.R. Meadows, Inc.
        8) Or equal.

3. Physical and Performance Properties:

    a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
    b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M, Desiccant Method.
    c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

d. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested according to ASTM D 4541.
e. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
f. UV Resistance: Can be exposed to sunlight for 90 days according to manufacturer's written instructions.

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by air-barrier material manufacturer.

C. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

D. Preformed Silicone Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Corning Corporation.
b. GE Construction Sealants; Momentive Performance Materials Inc.
c. Pecora Corporation.
d. Tremco Incorporated.
e. Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.

3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

H. Bridge isolation joints expansion joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement according to manufacturer's written instructions and details.

3.3 ACCESSORIES INSTALLATION

A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip or preformed silicone extrusion so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply air-barrier material in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, High-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.

C. Do not cover air barrier until it has been tested and inspected by testing agency.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.5 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Air-barrier dry film thickness.
3. Continuous structural support of air-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
5. Site conditions for application temperature and dryness of substrates have been maintained.
6. Maximum exposure time of materials to UV deterioration has not been exceeded.
7. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

D. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, chamber pressurization or depressurization with smoke tracers.
2. Air-Leakage-Volume Testing: Air-barrier assemblies will be tested for air-leakage rate according to ASTM E 783 or ASTM E 2357.
3. Adhesion Testing: Air-barrier assemblies will be tested for required adhesion to substrate according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

F. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

G. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

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SECTION 073113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Asphalt shingles.
2. Underlayment.
3. Ridge vents.
4. Metal flashing and trim.

1.3 DEFINITION

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1. Asphalt Shingles: Full size.
2. Ridge and Hip Cap Shingles: Full size.
3. Ridge Vent: 12-inch- long Sample.

C. Samples for Initial Selection: For each type of asphalt shingle indicated.

1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For the following products, of sizes indicated:

1. Asphalt Shingles: Full size.
2. Ridge and Hip Cap Shingles: Full size.

3. Ridge Vent: 12-inch- long Sample.
4. Exposed Valley Lining: 12 inches square.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.

B. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.

C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.

D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Manufacturing defects.

2. Material Warranty Period: 40 years from date of Substantial Completion, prorated, with first three years nonprorated.
3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 130 mph for 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E 108 or UL 790 by

Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Three-Tab-Strip Asphalt Shingles: ASTM D 3462/D 3462M, glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation.
    b. GAF.
    c. Owens Corning.
    d. Or equal.

2. Strip Size: Manufacturer's standard.
3. Impact Resistance: UL 2218, Class 4.
4. Color and Blends: As selected by Engineer from manufacturer's full range.

B. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 40-mil- thick; with slip-resisting, polymer-film-reinforced or glass-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive; with release backing; cold applied; and evaluated and documented to be suitable for use for intended purpose under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction. Provide primer for adjoining concrete surfaces to receive underlayment.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation.
    b. GAF.
    c. Owens Corning.
    d. Or equal.

2. Thermal Stability: Stable after testing at 240 deg F according to ASTM D1970/D1970M.
3. Low-Temperature Flexibility: Passes after testing at minus 20 deg F according to ASTM D1970/D1970M.

2.4 RIDGE VENTS

A. Rigid Ridge Vent: Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent for use under ridge shingles.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Saint-Gobain.
    b. GAF.
    c. Owens Corning.
    d. Or equal.

2. Minimum Net Free Area: 18 square inches.
3. Width: 11-1/2 inches minimum.
4. Features:

    a. Nonwoven geotextile filter strips.
    b. External deflector baffles.

2.5 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- diameter, sharp-pointed, with a minimum 3/8-inch-diameter flat head and of sufficient length to penetrate 3/4 inch into solid wood decking or extend at least 1/8 inch through OSB or plywood sheathing.

1. Shank: Barbed or smooth.
2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Synthetic-Underlayment Fasteners: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

2.6 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Sheet Metal: Aluminum, mill finished.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

1. Drip Edges: Fabricate in lengths not exceeding 10 feet with 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provisions have been made for flashings and penetrations through asphalt shingles.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
2. Eaves: Extend from edges of eaves 36 inches beyond interior face of exterior wall.
3. Rakes: Extend from edges of rake 36 inches beyond interior face of exterior wall.
4. Ridges: Extend 36 inches on each side without obstructing continuous ridge vent slot.

3.3 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Rake Drip Edges: Install rake drip-edge flashings over underlayment and fasten to roof deck.

C. Eave Drip Edges: Install eave drip-edge flashings below underlayment and fasten to roof sheathing.

3.4 ASPHALT-SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip with tabs removed with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 3/4 inch over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Fasten asphalt-shingle strips with a minimum of four roofing nails located according to manufacturer's written instructions.

1. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots.
2. When ambient temperature during installation is below 50 deg F, seal asphalt shingles with asphalt roofing cement spots.

F. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

END OF SECTION 073113

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SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fiber-cement siding.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, grounds, nailers, and blocking.
2. Section 062013 "Exterior Finish Carpentry" for exterior foam-plastic trim.

1.3 COORDINATION

A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For fiber-cement siding including related accessories.

C. Samples for Verification: For each type, color, texture, and pattern required.

1. 12-inch- long-by-actual-width Sample of siding.
2. 24-inch- wide-by-36-inch- high Sample panel of siding assembled on plywood backing.
3. 12-inch- long-by-actual-width Samples of trim and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fiber-cement siding.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

C. Research/Evaluation Reports: For each type of fiber-cement siding required, from ICC-ES.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of fiber-cement siding including related accessories, in a quantity equal to 2 percent of amount installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with labels intact until time of use.

B. Store materials on elevated platforms, under cover, and in a dry location.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including cracking and deforming.
b. Deterioration of materials beyond normal weathering.

2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain products, including related accessories, from single source from single manufacturer.

2.2 FIBER-CEMENT SIDING

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with a flame-spread index of 25 or less when tested according to ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CertainTeed Corporation.
b. GAF.
c. James Hardie Building Products, Inc.
d. Nichiha Fiber Cement.
e. Or equal

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch.

D. Horizontal Pattern: Boards 6-1/4 to 6-1/2 inches wide in plain style.

1. Texture: Wood grain.

E. Vertical Pattern: 48-inch- wide sheets with wood-grain texture and grooves.

F. Shingle Pattern: 48-inch- wide, staggered-edge notched sheets with wood-grain texture.

G. Panel Texture: 48-inch- wide sheets with wood-grain texture.

H. Finish: Manufacturer's standard acrylic primer and finish coat.

1. Colors: As selected by the Engineer from manufacturer’s full range, for each site.

2.3 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

1. Provide accessories matching color and texture of adjacent siding unless otherwise indicated.

B. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated:

1. Starter strips.
2. Edge trim
3. Other items as recommended by siding manufacturer for building configuration.

C. Flashing: Provide stainless-steel flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

D. Fasteners:

1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
3. For fastening fiber cement, use hot-dip galvanized fasteners.

E. Insect Screening for Soffit Vents: Stainless steel, 18-by-18 mesh.

F. Continuous Soffit Vents: Hat-channel shape, with perforations; 2 inches wide and not less than 96 inches long.

1. Net-Free Area: 8 sq. in./linear ft.
2. Finish: White paint.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of fiber-cement siding and related accessories.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Do not install damaged components.
2. Install fasteners no more than 24 inches o.c.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.4 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

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B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed steep-slope roof sheet metal fabrications.
2. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 073113 "Asphalt Shingles" for materials and installation of sheet metal flashing and trim integral with roofing.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. As-Milled Finish: Mill.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.

c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane, polysulfide, or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

F. Do not use graphite pencils to mark metal surfaces.

2.5 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

B. Apply slip sheet, wrinkle free, directly on substrate before installing sheet metal flashing and trim.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

F. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

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SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Latex joint sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.5 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Engineer from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. May National Associates, Inc.; a subsidiary of Sika Corporation.
b. Pecora Corporation.
c. Sika Corporation; Joint Sealants.
d. Tremco Incorporated.
e. Or equal.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. BASF Corporation.
    b. Bostik, Inc.
    c. ER Systems; an ITW Company.
    d. Everkem Diversified Products, Inc.
    e. Pecora Corporation.
    f. Polymeric Systems, Inc.
    g. Schnee-Morehead, Inc., an ITW company.
    h. Sherwin-Williams Company (The).
    i. Sika Corporation; Joint Sealants.
    j. Tremco Incorporated.
    k. Or equal.

2.4 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Adfast.
    b. Alcot Plastics Ltd.
    c. BASF Corporation.
    d. Construction Foam Products; a division of Nomaco, Inc.
    e. Or equal.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without

deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Perimeter joints between materials listed above and frames of doors and louvers.
   b. Control and expansion joints in ceilings and other overhead surfaces.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Engineer from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

   a. Vertical joints on exposed surfaces of concrete walls.
   b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: Match Engineer's sample.

END OF SECTION 079200

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SECTION 081500 - FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fiberglass reinforced plastic (FRP) doors and frames.

B. Related Requirements:

1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 COORDINATION

A. Coordinate anchorage installation for fiberglass reinforced plastic (FRP) doors and frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and materials thicknesses.
3. Frame details for each frame type, including dimensioned profiles and material thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For fiberglass reinforced plastic (FRP) doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fiberglass reinforced plastic (FRP) doors and frames, for tests performed by a qualified testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fiberglass reinforced plastic (FRP) doors and frames in manufacturer's original unopened packaging. Mark and remove damaged materials from the project site. Where materials are covered by a referenced specification, label the package with the specification number, type, and class, as applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

B. Storage:

1. Protect materials against moisture absorption and contamination or other damage.
2. Store all materials on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer.
3. Do not store materials in buildings under construction until concrete, mortar, and plaster work is finished and dry.
4. Do not store materials outdoors.
5. Do not store materials in contact with other materials that might cause staining, denting, or other surface damage.

C. Handling:

1. Prevent damage to corners, edges and ends of materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Chempruf
2. Corrim Company
3. Pella.
4. Or equal.

2.2 DOORS

A. Non-Rated Openings: Provide the following:

1. Face Sheets - Seamless fiberglass reinforced polyester plastic, 0.110-in thick. Flush at interior. Stile and Rail type door panel as indicated at exterior.
2. Internal Stiles and Rails - Structural fiberglass reinforced plastic with solid polymer corner reinforcement.
3. Core - Polyurethane, 1-1/2-inches thick, U factor - 0.14 deg Btu/F x h x sq. ft.
4. Hardware Reinforcement - Solid polymer.
5. Intermediate Framing - Supply structural FRP as and where required for door integrity.
6. Chemically weld entire door.
7. Polyester gel-coat entire door following hardware machining, 15 mils plus/minus 3 mils dry film thickness.

B. Rated Openings: As specified above except provide mineral core, fire retardant pultruded internal FRP stiles and rails and factory installed intumescent seals recessed into edges of doors, around perimeter, all as tested and approved by UL. Provide UL label permanently fixed to hinge edge, coordinated with placement of intumescent strip. Door rating in hours shall be equal to or greater than rating required by Door Schedule.

2.3 FRAMES

A. Non-Rated Openings: Provide the following:

1. Match hollow metal frames configuration 5-3/4-in wide by 2-in depth with a hollow door stop.
2. Reinforcement - Solid polymer per templates provided by the hardware supplier.

B. ANCHORS

C. Use fiberglass reinforced T-anchors, like those used in hollow metal door construction to fasten frames to new masonry.

2.4 FASTENERS

A. Stainless steel fasteners, 300 Series as approved, shall be used for frame assembly and for all other fasteners.

2.5 PERFORMANCE REQUIREMENTS

A. Air Infiltration: When tested in accordance with ASTM E283, air infiltration is not to exceed 0.06 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot at 50 mile per hour wind.

B. Water Penetration: When tested in accordance with ASTM E331, no water penetration is allowed, at a pressure of 8 pounds per square foot of fixed area.

C. Provisions for Thermal Movement: Design doors and frames to provide for expansion and contraction of the component parts caused by an ambient temperature range of minus 0 to 100 degrees F causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

PART 3 - EXECUTION

3.1 PREPARATION

A. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. FRP Frame: Set FRP door frame plumb and true, aligned, and secured with the adjacent construction-in-place, in conformance with ASTM E2112. Anchor frame as specified and in accordance with the FRP door manufacturer's requirements.

1. Installation Tolerances:

a. Squareness: Plus or minus 1/16-inch, measure at the door rabbet on a line 90 degrees from the jamb perpendicular to the frame head.
b. Alignment: Plus or minus 1/16-inch, measure at the jamb on a horizontal line parallel to the wall plane.
c. Twist: Plus or minus 1/16-inch, measure at the opposite face corners of the jambs on parallel lines, and perpendicular to the wall plane.
d. Plumb and True: Plus or minus 1/16-inch, measure at the jambs to the floor.

B. FRP Door: Fit and hang door in accordance with clearances specified below:

1. Clearance Tolerances:

a. Jambs and Head: Plus 1/8-inch or minus 1/16-inch.
b. Pairs of Doors: Plus 1/8 inch or minus 1/16-inch.
c. Bottom of Door and Top of Threshold: Maximum 3/8-inch.
d. Bottom of Door and Top of finish floor (No Threshold: Maximum 3/4-inch.

END OF SECTION 081500

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SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.

B. Related Requirements:

1. Section 081500 “Fiberglass Reinforced Plastic Doors and Frames” for doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
2. Content: Include the following information:

a. Identification number, location, hand, fire rating, size, and material of each door and frame.
b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
e. Fastenings and other installation information.

f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
g. Mounting locations for door hardware.
h. List of related door devices specified in other Sections for each door and frame.

C. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Engineer, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedule.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including excessive deflection, cracking, or breakage.
b. Faulty operation of doors and door hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Exit Devices: Two years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

2.2 SCHEDULED DOOR HARDWARE

A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3.

2.3 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Baldwin Hardware Corporation.
c. Bommer Industries, Inc.
d. Hager Companies.
e. Lawrence Hardware Inc.
f. Stanley Commercial Hardware; a division of Stanley Security Solutions.
g. Or equal.

2.4 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
b. Allegion plc.
c. Arrow USA; an ASSA ABLOY Group company.
d. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
e. DORMA USA, Inc.
f. Hager Companies.
g. SARGENT Manufacturing Company; ASSA ABLOY.
h. Stanley Commercial Hardware; a division of Stanley Security Solutions.
i. Yale Security Inc; an ASSA ABLOY Group company.
j. Or equal.

2.5 LOCK CYLINDERS

A. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical.

B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.6 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.

1. Existing System:

a. Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel silver.

2.7 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Arrow USA; an ASSA ABLOY Group company.
c. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
d. DORMA USA, Inc.
e. Hager Companies.
f. SARGENT Manufacturing Company; ASSA ABLOY.
g. Stanley Commercial Hardware; a division of Stanley Security Solutions.
h. Yale Security Inc; an ASSA ABLOY Group company.
i. Or equal.

2.8 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co.
d. Reese Enterprises, Inc.
e. Zero International, Inc.
f. Or equal.

B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg, as follows:

2.9 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co.
d. Reese Enterprises, Inc.
e. Sealeze.
f. Zero International, Inc.
g. Or equal.

2.10 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allegion plc.
    b. Hager Companies.
    c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
    d. Or equal.

2.11 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allegion plc.
    b. Baldwin Hardware Corporation.
    c. Hager Companies.
    d. Or equal.

2.12 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Engineer.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.13 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

G. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

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3.7 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 1, Doors D-101 for Pumping Station No.1 and No.2

No.*	Item	Description
As specified	Hinges	A5111 x NRP x 630
1	Exit Device	Type 3 x F08 (lever) x 630
1	Closing Device	C02021 x 689
1	Kick Plate	J102 x B3E x 12” x 630
1	Automatic Door Bottom	R5B435
1 set	Weather Stripping	R5B115
1	Threshold	J32139

END OF SECTION 087100

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SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed, extruded-aluminum louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified

testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. Windborne-Debris-Impact Resistance: Louvers located within 30 feet of grade shall pass basic-protection, large-missile testing requirements in ASTM E 1996 for Wind Zone applicable to the location when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than louvers indicated for use on Project.

C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Design earthquake spectral response acceleration, short period (Sds) for Project is indicated.
2. Component Importance Factor: 1.5.

D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

A. Horizontal, Wind-Driven-Rain-Resistant Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airolite Company, LLC (The).
b. American Warming and Ventilating; a Mestek Architectural Group company.
c. Arrow United Industries.
d. Construction Specialties, Inc.
e. Greenheck Fan Corporation.
f. Reliable Products, Inc.
g. Ruskin Company.
h. Or equal.

2. Louver Depth: 4 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Louver Performance Ratings:

a. Free Area: Not less than 7.0 sq. ft. for 48-inch- wide by 48-inch- high louver.
b. Air Performance: Not more than 0.10-inch wg static pressure drop at 600-fpm free-area exhaust velocity.
c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 300 fpm.

5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Mill finish unless otherwise indicated.
3. Type: Non-rewirable, U-shaped frames.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.5 BLANK-OFF PANELS

A. Insulated, Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.

1. Thickness: 2 inches.
2. Metal Facing Sheets: Aluminum sheet, not less than 0.032-inch nominal thickness.
3. Insulating Core: Rigid, glass-fiber-board insulation or extruded-polystyrene foam.
4. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard extruded-aluminum-channel frames, not less than 0.080-inch nominal thickness, with corners mitered and with same finish as panels.
5. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
6. Panel Finish: Same type of finish applied to louvers, but black color.
7. Attach blank-off panels with sheet metal screws.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
3. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.

F. Provide subsills made of same material as louvers or extended sills for recessed louvers.

G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Engineer from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Engineer, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.5 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich.
b. Jaimes Industries.

c. MarinoWARE.
d. MRI Steel Framing, LLC.
e. SCAFCO Steel Stud Company.
f. Steel Construction Systems.
g. Or equal.

2. Minimum Base-Metal Thickness: 0.0329-inch.
3. Depth: 1-1/2 inches.

2.2 SUSPENSION SYSTEMS

A. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

1. Minimum Base-Metal Thickness: 0.0329 inch.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls and Ceilings: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8-inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

B. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

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SECTION 099100 – PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following substrates:

1. Aluminum (not anodized or otherwise coated).
2. Wood.
3. Plastic.

B. Aluminized steel, above roof level, for stacks: Paint with silicone aluminum as specified. Other aluminum-paint only where noted (as is specified).

C. Paint items noted in “Painting Schedule.”

D. Provide vinyl film letters and numbers for markings as specified.

E. Paint items noted in other Specification Sections as having factory finish and other factory finished items are obviously not field painted.

F. Paint all factory finish painted items replaced, repaired or damaged during construction.

G. The various Sections are responsible, as stated in each, for preparation and field touch-up of abrasions, welds and damaged primed areas of primed or galvanized components after erection.

H. The following items will not be painted:

1. Concrete except where specified.
2. Finish hardware.
3. Non-ferrous metals and stainless steel, unless specifically noted otherwise.
4. Factory pre-finished architectural components.
5. Parts of buildings not exposed to sight, unless specifically noted otherwise.
6. Maintenance equipment
7. Plumbing fixtures.
8. Mechanical, HVAC, Plumbing and Electrical equipment which has been finished painted in the factory as specified in Divisions 22, 23, 26, and 40.

I. Related Requirements:

1. Shop priming of equipment and piping (except copper piping) is included in the respective Section with the item to be primed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

1.4 QUALITY ASSURANCE

A. Shop Primers are required to be certified by the manufacturer of the field applied painting manufacturer to be compatible with the materials specified in this section.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Provide products by one of the following:

1. Tnemec, Inc. (TN)
2. The Sherwin Williams Company (SW)
3. PPG Architectural Finishes, Inc. (PPG)
4. PPG Architectural Finishes, Inc. Ameron (AME)
5. Or equal.

2.2 MATERIALS

A. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. Provide products of same manufacturer for each coat in a coating system.

B. Use paint materials without adulteration and mixed, thinned and applied in strict accordance with manufacturer's directions for the applicable materials and surface.

C. Colors: As selected by Engineer from manufacturer's full range.

2.3 COLOR CODING FOR PIPES AND EQUIPMENT

A. The color code establishes, defines and assigns a definite color for each process system. Paint all elements which are an integral part of the system, that is originating from the equipment and/or supplying the equipment, between and up to but not including the fixed flanges nor the flexible conduit connections on the equipment. Paint valves and fittings in the color of the main body of the pipe.

B. All pipes and equipment shall be painted with final coat color selected by the Engineer and shall be treated as an integral part of the Contract.

C. All hanger saddles and pipe support floor stands shall be painted the same color and with the same paint as the pipe it supports. Hanger rods and hanger rod connections to building structure shall be painted to match the color of the wall or ceiling to which it is attached.

2.4 LETTERING OF TITLES

A. Indicate the name of the materials in each pipeline and alongside this an arrow indicating the direction of flow of fluids on each pipe system. Locate the titles shall not more than 26 feet apart and directly adjacent to each side of any wall the pipeline breaches, adjacent to each side of the valve regulator, flowcheck, strainer cleanout and all pieces of equipment.

B. Identify titles by the identity of the contents with complete name at least once in each space through which it passes and thereafter by generally recognized abbreviations, letters or numerals as approved. Place identification title locations in general they shall be placed where the view is unobstructed and on the two lower quarters of pipe or covering where they are overhead. Title to be clearly visible from operating positions and adjacent to all control valves.

C. Die cut numbers and letters from 3.5 mil vinyl film and pre-space them on carrier tape. Protect adhesive and finish surface with one piece removable liners. Use white or black to provide high contrast to the substrate color.

D. Letter size shall be as indicated in the following table:

OUTSIDE DIAMETER OF PIPE OR COVERING	SIZE OF LEGEND LETTERS
3/4-in to 1-1/4-in	1/2-in
1-1/2-in to 2-in	3/4-in
2-1/2-in to 6-in	1-1/2-in
8-in to 10-in	2-1/2-in
Over 10-in	3-in

E. Use Type B ASI/2 by ASI Sign Systems; Architectural Graphics Inc. or equal. Provide Optima Bold, upper case letter type. Use Grid 2 spacing. Match arrow to letter type and size. Follow the instructions of the manufacturer in respect to storage, surface preparation and applications of letters.

2.5 TITLES FOR EQUIPMENT

A. Provide titles consisting of vinyl film as specified above on all equipment using 1-in high Optima Bold upper case, Grid 2 spacing. Use white or black to provide high contrast to the substrate color. Use titles shown on mechanical drawings for bidding purposes. Mount titles at eye level on machines or at the upper most broad vertical surface of low equipment. Where more than one piece of the equipment item to be titled exists, number the items consecutively as indicated on the mechanical drawings or as directed by the Engineer; for example, Pump No. 1, Pump No. 2, etc. Titles shall be composed in more than one line if required and justified on the left-hand side.

2.6 TESTING EQUIPMENT

A. Furnish wet and dry film thickness gauges, electronic moisture meter and all other equipment required by the Engineer for inspection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Wood: 15 percent.

B. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

H. Aluminum Substrates: Remove loose surface oxidation.

I. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

J. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Engineer, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 PAINTING SCHEDULE

A. Dry Film Thickness (DFT) for each paint product is not part of paint schedule. Submit both the Wet Film Thickness (WFT) and DFT for each product as part of submittal process. Apply paint and coating products to comply with manufacturer’s DFT thickness and application recommendations in the approved submittal.

B. The following types of paints by Tnemec Co. (TN), The Sherwin Williams Company (SW), PPG Protective & Marine Coatings, (PPG), and Ameron International (AME) have been used as a basis for the paint schedule; use one of these paints or equal:

C. Epoxy:

1. TN:Hi-build Epoxoline II, Series N69.
2. SW: Macropoxy 646, B58 Series.
3. PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4. AME: Amerlock 2/400 Series Epoxy.

D. High-Build Acrylic Polyurethane Enamel:

1. TN:Endura-Shield - semi-gloss, Series V73.
2. SW: Acrolon 218 HS, B65 Series.
3. PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
4. AME: Amercoat 450HSG Polyurethane.

E. Tie Coat, Low VOC, Epoxy:

1. TN:FC Typoxy, Series V27.
2. SW: Macropoxy 646, B58 Series.

3. PPG: Pitt-Guard Epoxy Mastic 95-245 Series.
4. AME: Amercoat 385 Multi-Purpose Epoxy.

F. Vinyl Acrylic Surface Sealer:

1. TN:PVA Sealer, Series 51.
2. SW: Prep-Rite 200 Primer, B28 Series.
3. PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer.
4. AME: Amercoat 148 Acrylic Primer.

G. The following surfaces shall have the types of paint scheduled below applied at the dry film thickness (DFT) in mils per coat as recommended by manufacturer:

1. Exterior non- submerged ferrous metals (except first coat-hollow metal-pressed metal work):

a. First Coat: On properly prepared unprimed metal or for touch-up:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

b. Second Coat:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

c. Third Coat:

1) TN: Endura-Shield - semi-gloss, Series V73.
2) SW: Acrolon 218 HS, B65 Series.
3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
4) AME: Amercoat 450HSG Polyurethane.

2. Interior non-submerged concrete scheduled for painting:

a. First and Second Coats:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

3. Interior non-submerged ferrous metals (except first coat of previously painted metal work), on properly prepared unprimed metal or for touch-up:

a. First Coat:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

b. Second and Third Coats:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) PPG: Amerlock 2/400 Series Epoxy.

4. Plastic piping and, where scheduled to be painted, plastic components:

a. First and Second Coats:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

5. Pipe insulation: (Plastic or metal sheathed insulation-paint as scheduled for appropriate substrate):

a. First Coat:
1) TN: Vinyl-Acrylic Sealer, No. 51-792.
2) SW: Prep-Rite 200, B28 Series.
3) PPG: Speedhide 6-2 Vinyl Acrylic Drywall Primer.
4) AME: Amercoat 148 Acrylic Primer.

b. Second and Third Coats:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

6. Aluminum Designated to be Painted:

a. Mechanically abrade surfaces to comply with SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals".

b. First and Second Coats - (Interior):

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

c. First Coat - (Exterior):

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

d. Second Coat - (Exterior):

1) TN: Endura-Shield - semi-gloss, Series V73.
2) SW: Acrolon 218 HS.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

7. Copper Piping:

a. First and Second Coats:

1) TN: Hi-build Epoxoline II, Series N69.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard 97-145 Series Epoxy Mastic.
4) AME: Amerlock 2/400 Series Epoxy.

8. Exterior galvanized steel surfaces:

a. Mechanically abrade surfaces to comply with SSPC SP 16 "Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-ferrous Metals".

b. First Coat:

1) TN: FC Typoxy, Series V27.
2) SW: Macropoxy 646, B58 Series.
3) PPG: Pitt-Guard Epoxy Mastic 95-245 Series.
4) AME: Amercoat 385 Multi-Purpose Epoxy.

c. Second Coat:

1) TN: Endura-Shield - semi-gloss, Series V73.
2) SW: Acrolon 218 HS.
3) PPG: Pitthane HB Semigloss Urethane 95-8800 Series.
4) AME: Amercoat 450HSG Polyurethane.

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3.7 PAINT COLOR SCHEDULE

ITEM	NUMBER/COLOR
BUILDING EXTERIOR	
Steel bollards	TBS
Hollow metal doors and frames	TBS
Miscellaneous wood trim	TBS
PVC vent pipes through roof.	Black
BUILDING INTERIOR	
Miscellaneous formed metal closures and trim	White
Metal doors and frames	TBS
Metal hangers and supports	TBS
Plywood hatch cover	TBS

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal hanger-shield inserts.
5. Fastener systems.
6. Equipment supports.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Equipment supports.

B. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer hot-dip galvanized.

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

PART 3 - EXECUTION

3.1 APPLICATION

A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits.

Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.

5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. Use thermal hanger-shield inserts for insulated piping and tubing.

I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

O. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

Q. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

R. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

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SECTION 221123 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Manual gas shutoff valves.
5. Pressure regulators.
6. Dielectric fittings.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
3. Pressure regulators. Indicate pressure ratings and capacities.
4. Service meters. Indicate pressure ratings and capacities. Include meter bars supports.
5. Dielectric fittings.

B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple

pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1. Shop Drawing Scale: 1/4 inch per foot.
2. Detail mounting, supports, and valve arrangements for service meter assembly and pressure regulator assembly.

C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of seismic restraints.
2. Design Calculations: Calculate requirements for selecting seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

B. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

C. Qualification Data: For qualified professional engineer.

D. Welding certificates.

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pressure regulators and service meters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.9 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Engineer and Owner no fewer than two days in advance of proposed interruption of natural-gas service.
2. Do not proceed with interruption of natural-gas service without Engineer's written permission.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 100 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 65 psig.

B. Natural-Gas System Pressure within Buildings: 0.5 psig or less.

C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum O-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

6. Mechanical Couplings:

    a. Steel flanges and tube with epoxy finish.
    b. Buna-nitrile seals.
    c. Steel bolts, washers, and nuts.
    d. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    e. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 or 60 -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Apollo Flow Controls; Conbraco Industries, Inc.
b. Nibco.
c. WATTS.
d. Or equal.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Valve Boxes:

1. Cast-iron, two-section box.
2. Top section with cover with "GAS" lettering.
3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
4. Adjustable cast-iron extensions of length required for depth of bury.
5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Meter Company.
b. Fisher Control Valves & Instruments; a brand of Emerson Process Management.

c. Maxitrol Company.
d. Or equal.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. American Meter Company.
b. Fisher Control Valves & Instruments; a brand of Emerson Process Management.
c. Maxitrol Company.
d. Or equal.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 05 psig

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. WATTS.
b. Wilkins.
c. Zurn Industries, LLC.
d. Or equal.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe

with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

3.4 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install underground valves with valve boxes.

C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

D. Install earthquake valves aboveground outside buildings according to listing.

E. Install anode for metallic valves in underground PE piping.

3.5 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.7 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.8 LABELING AND IDENTIFYING

A. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.9 PAINTING

A. Comply with requirements in Section 099100 "Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel (flat).
d. Color: Gray.

C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Interior latex matching topcoat.
    c. Topcoat: Interior latex (flat).
    d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.

    a. Prime Coat: Alkyd anticorrosive metal primer.
    b. Intermediate Coat: Interior alkyd matching topcoat.
    c. Topcoat: Interior alkyd (flat).
    d. Color: Gray.

D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.12 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

A. Aboveground, branch piping NPS 2 and smaller shall be the following:

1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
2. Steel pipe with malleable-iron fittings and threaded joints.

B. Aboveground, distribution piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

C. Underground, below building, piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

3.13 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

C. Valves in branch piping for single appliance shall be the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 221123

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal framing systems.
2. Fastener systems.
3. Equipment supports.
4. Post-installed mechanical expansion anchors for concrete substrates
5. Delegated Design.

B. Related Requirements:

1. Section 230548.13 "Vibration Controls for HVAC" for vibration isolation devices.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Post-Installed Expansion Anchors

1. Design Data: Submit manufacturer’s specifications and data including recommended design values and physical characteristics for expansion anchors.
2. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, materials and finishes for post-installed expansion anchors installed into cracked concrete.
3. Installation Procedures: Submit procedures stating product proposed for use, and complete installation method.

1.4 DELEGATED-DESIGN SUBMITTAL:

A. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Metal framing systems.
2. Equipment supports.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

C. Qualification Data: For professional engineer and testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. B-line, an Eaton business.
b. Thomas & Betts Corporation; A Member of the ABB Group.
c. Unistrut; Part of Atkore International.
d. Or equal.

2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: Pregalvanized G90.

2.3 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hilti, Inc.
b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
c. MKT Fastening, LLC.
d. Simpson Strong-Tie Co., Inc.
e. Or equal.

2.4 MECHANICAL-EXPANSION ANCHORS

A. Fastening to Concrete Substrate: Zinc plated carbon steel wedge type anchors, complete with zinc plated nuts and washers, unless otherwise noted.

B. Submerged or Weather Exposed Substrates: ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted.

C. Meet ICC ES AC193.

D. Length: When length or anchor embedment is not indicated, provide length sufficient to place the wedge and expansion cone portion of the anchor at least 1 inch behind concrete reinforcing steel.

E. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Simpson Strong
2. Hilti, Inc.
3. DeWalt Power
4. Or equal.

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MATERIALS

A. Aluminum: ASTM B 221.

B. Carbon Steel: ASTM A 1011/A 1011M.

C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; galvanized.

D. Stainless Steel: ASTM A 240/A 240M.

E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

F. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

B. Mechanical Expansion Anchors:

1. Install anchoring system in strict compliance with manufacturer's published installation instructions and approved Shop Drawings. Comply with recommended surface preparation, temperature, and moisture of substrate and ambient conditions.
2. Use drill bit of correct diameter and drill to required depth using rotary impact type hammer drills with carbide-tipped bits.
3. Drill holes perpendicular to concrete surface, unless otherwise indicated.
4. Use oil free compressed air to blast out loose particles and dust from drilled holes.
5. Check expansion anchors for tightness a minimum of 24 hours after initial installation.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 099100 "Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel metal framing systems and attachments for general service applications.

F. Use stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use thermal-hanger shield inserts for insulated piping and tubing.

H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is unnecessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is unnecessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

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SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Open-spring isolators.
4. Restrained-spring isolators.
5. Housed-restrained-spring isolators.
6. Pipe-riser resilient supports.
7. Resilient pipe guides.
8. Elastomeric hangers.
9. Spring hangers.
10. Vibration isolation equipment bases.
11. Restrained isolation roof-curb rails.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 DELEGATED-DESIGN SUBMITTAL

A. For each vibration isolation device:

1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads: Type 1.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.
d. Or equal.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Ribbed or waffle pattern.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts: Type 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.

c. Mason Industries, Inc.
d. Or equal.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators: Type 3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.
d. Or equal.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.4 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint: Type 4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.
d. Or equal.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes.
    c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.5 HOUSED-RESTRAINED-SPRING ISOLATORS

A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing: Type 4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. California Dynamics Corporation.
    b. Kinetics Noise Control, Inc.
    c. Mason Industries, Inc.
    d. Or equal.

2. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.

    a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.6 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.7 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.8 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods: Type 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.
d. Or equal.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.9 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression: Type 3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. California Dynamics Corporation.
b. Kinetics Noise Control, Inc.
c. Mason Industries, Inc.
d. Or equal.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
9. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.10 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.
4. Or equal.

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A36/A36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.11 RESTRAINED ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control, Inc.
3. Mason Industries Inc.
4. Or equal.

B. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.

C. Upper Frame: Upper frame shall provide continuous and captive support for equipment.

D. Lower Support Assembly: The lower support assembly shall be formed sheet metal section containing adjustable and removable steel springs that support upper frame. The lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches of rigid glass-fiber insulation on inside of assembly. Adjustable, restrained-spring isolators shall be mounted on elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

3.3 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

END OF SECTION 230548.13

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Brimar Industries, Inc.
c. Carlton Industries, LP.
d. Or equal.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Or equal.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: Black.

D. Background Color: White and orange.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Or equal.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 STENCILS

A. Stencils for Ducts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brimar Industries, Inc.
b. Carlton Industries, LP.
c. Craftmark Pipe Markers.

d. Marking Services Inc.
e. Or equal.

2. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

B. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brimar Industries, Inc.
b. Carlton Industries, LP.
c. Craftmark Pipe Markers.
d. Marking Services Inc.
e. Or equal.

2. Lettering Size: Minimum letter height of 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.
3. Stencil Material: Fiberboard or metal.
4. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Or equal.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Brimar Industries, Inc.
3. Carlton Industries, LP.
4. Champion America.
5. Or equal.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety-yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:
1. Condenser-Water Piping: White letters on a safety-green background.
2. Refrigerant Piping: White letters on a safety-purple background.

3.5 DUCT STENCIL INSTALLATION

A. Duct Stencils: Stenciled labels showing service and flow direction.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Condenser Water: 1-1/2 inches, round.
b. Refrigerant: 1-1/2 inches, round.

2. Valve-Tag Colors:

   a. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
   b. Flammable Fluids: Black letters on a safety-yellow background.
   c. Combustible Fluids: White letters on a safety-brown background.
   d. Potable and Other Water: White letters on a safety-green background.
   e. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.
b. Variable-air-volume systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 60 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

E. Certified TAB reports.

F. Sample report forms.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by NEBB or AABC.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or AABC.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or AABC as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

1.6 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible, and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

K. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete, and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

2. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning per the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started, and proper rotation is verified.
i. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete, and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
    c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
    d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.
3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.

3. Re-measure all final fan operating data, rpms, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Adjust the variable-air-volume systems as follows:

1. Verify that the system static pressure sensor is located two-thirds of the distance down the duct from the fan discharge.
2. Verify that the system is under static pressure control.
3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure and adjust system static pressure control set point so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows:

    a. Adjust controls so that terminal is calling for maximum airflow. Some controllers require starting with minimum airflow. Verify calibration procedure for specific project.
    b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
    c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
    d. Adjust controls so that terminal is calling for minimum airflow.
    e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
    f. When in full cooling or full heating, ensure that there is no mixing of hot-deck and cold-deck airstreams unless so designed.
    g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.

5. After terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
    c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

6. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.
b. Measure static pressure directly at the fan inlet or through the flexible connection.
c. Measure static pressure across each component that makes up the air-handling system.
d. Report any artificial loading of filters at the time static pressures are measured.

7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
b. Verify that terminal units are meeting design airflow under system maximum flow.

8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure set point to the most energy-efficient set point to maintain the optimum system static pressure. Record set point and give to controls contractor.
9. Verify final system conditions as follows:

a. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to match design if necessary.
b. Re-measure and confirm that total airflow is within design.
c. Re-measure final fan operating data, rpms, volts, amps, and static profile.
d. Mark final settings.
e. Test system in economizer mode. Verify proper operation and adjust if necessary. Measure and record all operating data.
f. Verify tracking between supply and return fans.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and heat exchangers. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and heat exchanger flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check liquid level in expansion tank.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

5. Verify that motor starters are equipped with properly sized thermal protection.
6. Check that air has been purged from the system.

3.8 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

A. Adjust pumps to deliver total design gpm.

1. Measure total water flow.

   a. Position valves for full flow through coils.
   b. Measure flow by main flow meter, if installed.
   c. If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

2. Measure pump TDH as follows:

   a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
   b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
   c. Convert pressure to head and correct for differences in gage heights.
   d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

3. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

B. Adjust flow-measuring devices installed in mains and branches to design water flows.

1. Measure flow in main and branch pipes.
2. Adjust main and branch balance valves for design flow.
3. Re-measure each main and branch after all have been adjusted.

C. Adjust flow-measuring devices installed at terminals for each space to design water flows.

1. Measure flow at terminals.
2. Adjust each terminal to design flow.
3. Re-measure each terminal after it is adjusted.
4. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
5. Perform temperature tests after flows have been balanced.

D. For systems with pressure-independent valves at terminals:

1. Measure differential pressure and verify that it is within manufacturer's specified range.
2. Perform temperature tests after flows have been verified.

E. For systems without pressure-independent valves or flow-measuring devices at terminals:

1. Measure and balance coils by either coil pressure drop or temperature method.
2. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

F. Verify final system conditions as follows:

1. Re-measure and confirm that total water flow is within design.
2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
3. Mark final settings.

G. Verify that memory stops have been set.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the differential-pressure sensor is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no diversity:

1. Adjust pumps to deliver total design gpm.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gage heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

    a. Measure differential pressure and verify that it is within manufacturer's specified range.
    b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

    a. Measure and balance coils by either coil pressure drop or temperature method.
    b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system differential-pressure set point.
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.

10. Verify that memory stops have been set.

D. For systems with diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by the design engineer.

3. Adjust pumps to deliver total design gpm.

    a. Measure total water flow.

        1) Position valves for full flow through coils.
        2) Measure flow by main flow meter, if installed.
        3) If main flow meter is not installed, determine flow by pump TDH or exchanger pressure drop.

    b. Measure pump TDH as follows:

        1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
        2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
        3) Convert pressure to head and correct for differences in gage heights.
        4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
        5) With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved.

    c. Monitor motor performance during procedures and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

    a. Measure flow in main and branch pipes.
    b. Adjust main and branch balance valves for design flow.
    c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

    a. Measure flow at terminals.
    b. Adjust each terminal to design flow.
    c. Re-measure each terminal after it is adjusted.
    d. Position control valves to bypass the coil and adjust the bypass valve to maintain design flow.
    e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

    a. Measure differential pressure and verify that it is within manufacturer's specified range.
    b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

    a. Measure and balance coils by either coil pressure drop or temperature method.

b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system differential-pressure set point.
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion open discharge valve 100 percent and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Verify final system conditions as follows:

    a. Re-measure and confirm that total water flow is within design.
    b. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
    c. Mark final settings.

12. Verify that memory stops have been set.

3.10 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.11 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record fan and motor operating data.

3.12 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each water coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.

3. Water pressure drop for major (more than 20 gpm) equipment coils, excluding unitary equipment such as reheat coils, unit heaters, and fan-coil units.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Voltage and amperage input of each phase at full load.
5. Calculated kilowatt at full load.
6. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each steam coil:

1. Dry-bulb temperature of entering and leaving air.
2. Airflow.
3. Inlet steam pressure.

D. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.

3.13 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.14 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Engineer's name and address.
6. Contractor's name and address.
7. Report date.
8. Signature of TAB supervisor who certifies the report.
9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
10. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer's name, type, size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Pipe and valve sizes and locations.
4. Terminal units.
5. Balancing stations.
6. Position of balancing devices.

E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Center-to-center dimensions of sheave and amount of adjustments in inches.
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat-coil static-pressure differential in inches wg.
g. Cooling-coil static-pressure differential in inches wg.
h. Heating-coil static-pressure differential in inches wg.
i. Outdoor airflow in cfm.
j. Return airflow in cfm.
k. Outdoor-air damper position.
l. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.

h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.
k. Leaving-water temperature in deg F.
l. Refrigerant expansion valve and refrigerant types.
m. Refrigerant suction pressure in psig.
n. Refrigerant suction temperature in deg F.
o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.

h. Low-fire fuel input in Btu/h.
i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft.
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

    a. Total airflow rate in cfm.
    b. Total system static pressure in inches wg.
    c. Fan rpm.
    d. Discharge static pressure in inches wg.
    e. Suction static pressure in inches wg.

J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling-unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft.
    g. Indicated airflow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual airflow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

K. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Apparatus used for test.
    d. Area served.
    e. Make.
    f. Number from system diagram.
    g. Type and model number.
    h. Size.
    i. Effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling-unit identification.
    b. Location and zone.
    c. Room or riser served.
    d. Coil make and size.
    e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Entering-water temperature in deg F.
    c. Leaving-water temperature in deg F.
    d. Water pressure drop in feet of head or psig.
    e. Entering-air temperature in deg F.
    f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

    a. Unit identification.
    b. Location.
    c. Service.
    d. Make and size.
    e. Model number and serial number.
    f. Water flow rate in gpm.
    g. Water pressure differential in feet of head or psig.
    h. Required net positive suction head in feet of head or psig.
    i. Pump rpm.
    j. Impeller diameter in inches.
    k. Motor make and frame size.
    l. Motor horsepower and rpm.
    m. Voltage at each connection.
    n. Amperage for each phase.
    o. Full-load amperage and service factor.
    p. Seal type.

2. Test Data (Indicated and Actual Values):

    a. Static head in feet of head or psig.
    b. Pump shutoff pressure in feet of head or psig.
    c. Actual impeller size in inches.
    d. Full-open flow rate in gpm.
    e. Full-open pressure in feet of head or psig.
    f. Final discharge pressure in feet of head or psig.
    g. Final suction pressure in feet of head or psig.
    h. Final total pressure in feet of head or psig.
    i. Final water flow rate in gpm.
    j. Voltage at each connection.
    k. Amperage for each phase.

3.15 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Engineer.

B. Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

F. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," and "Indoor Duct and Plenum Insulation Schedule," article for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type II for sheet materials.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.

c. Owens Corning.
d. Or equal.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or equal.

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Knauf Insulation.
c. Owens Corning.
d. Or equal.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.
e. Or equal.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Mon-Eco Industries, Inc.
e. Or equal.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic: Water based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Knauf Insulation.
d. Vimasco Corporation.
e. Or equal.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White

C. Vapor-Retarder Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.
c. Foster Brand; H. B. Fuller Construction Products.
d. Or equal.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

D. Color: WhiteBreather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Eagle Bridges - Marathon Industries.

c. Foster Brand; H. B. Fuller Construction Products.
d. Knauf Insulation.
e. Mon-Eco Industries, Inc.
f. Vimasco Corporation.
g. Or equal.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Foster Brand; H. B. Fuller Construction Products.
c. Vimasco Corporation.
d. Or equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Mon-Eco Industries, Inc.
c. Eagle Bridges - Marathon Industries.
d. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.6 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ITW Insulation Systems; Illinois Tool Works, Inc.
    b. RPR Products, Inc.
    c. Or equal.

2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Finish and thickness are indicated in field-applied jacket schedules.
    b. Moisture Barrier for Indoor Applications: 1-mil thick, heat-bonded polyethylene and kraft paper.
    c. Moisture Barrier for Outdoor Applications: 2.5-mil-thick polysurlyn.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Avery Dennison Corporation, Specialty Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.
    c. Knauf Insulation.
    d. Or equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.
d. Or equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.
d. Or equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.8 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.
c. Or equal.

2. Stainless Steel: ASTM A167 or ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Hardcast, Inc.
        4) Or equal.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

        1) AGM Industries, Inc.
        2) CL WARD & Family Inc.
        3) Gemco.
        4) Or equal.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

        1) AGM Industries, Inc.
        2) Gemco.
        3) Midwest Fasteners, Inc.
        4) Or equal.

    b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    c. Spindle: Aluminum or stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
    d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Or equal.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.
2) Gemco.
3) Hardcast, Inc.
4) Or equal.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.9 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface.

Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 50 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and

inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099100 "Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed ductwork located in the area it serves.
9. Return air ductwork located in return air ceiling spaces above the area it serves, except where the return ductwork is installed in ceiling spaces with a roof above.

3.10 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. See schedule on Drawings for type of field-applied jacket to be provided.

B. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

C. If more than one material is listed, selection from materials listed is Contractor's option.

END OF SECTION 230713

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SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes insulation for HVAC piping systems.

1. Generator Exhaust Piping, indoors

B. Related Sections:

1. Section 230713 "Duct Insulation" for duct insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Calcium Silicate: Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C533, Type I.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Or equal.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

G. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Aeroflex USA, Inc.
b. Armacell LLC.
c. K-Flex USA.
d. Or equal.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Vimasco Corporation.
    e. Or equal.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to plus 180 deg F**.**
4. Comply with MIL-PRF-19565C, Type II, for permeance requirements.

C. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Or equal.

2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Mon-Eco Industries, Inc.
    e. Vimasco Corporation.
    f. Or equal.

2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.5 LAGGING ADHESIVES

A. Adhesive shall comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Vimasco Corporation.
    d. Or equal.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Mon-Eco Industries, Inc.
    d. Or equal.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Or equal.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm) for covering pipe and pipe fittings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.
b. Or equal.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Foster Brand; H. B. Fuller Construction Products.
b. Vimasco Corporation.
c. Or equal.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Airex Manufacturing.
    b. Johns Manville; a Berkshire Hathaway company.
    c. P.I.C. Plastics, Inc.
    d. Proto Corporation.
    e. Speedline Corporation.
    f. Or equal.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. ITW Insulation Systems; Illinois Tool Works, Inc.
    b. RPR Products, Inc.
    c. Or equal.

2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

    a. Finish and thickness are indicated in field-applied jacket schedules.
    b. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    c. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    d. Factory-Fabricated Fitting Covers:

        1) Same material, finish, and thickness as jacket.
        2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
        3) Tee covers.
        4) Flange and union covers.
        5) End caps.
        6) Beveled collars.
        7) Valve covers.
        8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.
d. Or equal.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. 3M Industrial Adhesives and Tapes Division.
b. Avery Dennison Corporation, Specialty Tapes Division.
c. Ideal Tape Co., Inc., an American Biltrite Company.
d. Knauf Insulation.
e. Or equal.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Ideal Tape Co., Inc., an American Biltrite Company.
b. Or equal.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.
b. Ideal Tape Co., Inc., an American Biltrite Company.
c. Knauf Insulation.
d. Or equal.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.
c. Or equal.

2. Stainless Steel: ASTM A240/A240M, Type 316; 0.015 inch thick, 1/2 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.

3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inchesbeyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation,

install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe

insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word “union” matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation.
4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated and for horizontal applications, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections, with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded

strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

A. Generator Exhaust Piping

1. All sizes: Insulation shall be the following:

a. Calcium Silicate: 2 inches thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Piping, Concealed:

1. None.

C. Piping, Exposed:

1. PVC: 20 mils thick.

END OF SECTION 230719

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SECTION 230923.12 - CONTROL DAMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of control dampers and actuators for DDC systems:

1. Rectangular control dampers.
2. General control-damper actuator requirements.
3. Electric and electronic actuators.

B. Related Requirements:

1.3 DEFINITIONS

A. DDC: Direct-digital control.

B. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and[mounting] details.
2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, and equipment.
2. Size and location of wall access panels for control dampers and actuators installed behind walls.
3. Size and location of ceiling access panels for control dampers and actuators installed above inaccessible ceilings.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control dampers to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Backup Power Source: Systems and equipment served by a backup power source shall have associated control damper actuators served from a backup power source.

E. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance.

Enclosure shall be internally insulated, electrically heated and cooled, filtered, and ventilated as required by instrument and application.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:

   a. Outdoors: Type 4 or Type 4X.
   b. Indoors, Heated with Filtered Ventilation: Type 1 or Type 2.
   c. Indoors, Heated with Non-Filtered Ventilation: Type 2 or Type 12.
   d. Indoors, Heated and Air Conditioned: Type 1.
   e. Mechanical Equipment Rooms:

      1) Chiller and Boiler Rooms: Type 12 Type 4 Type 4X.
      2) Air-Moving Equipment Rooms: Type 1, Type 2 or Type 12.
      3) Rooms with exposed water: Type 4 or Type 4X.
      4) Rooms with water or wastewater pumps: Type 4 or Type 4X.

   f. Localized Areas Exposed to Washdown: Type 4 or Type 4X.
   g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2, Type 3 or Type 12.
   h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4 or Type 4X.
   i. Hazardous Locations: Explosion-proof rating for condition.
   j. Chemical storage rooms: Type 4X.

F. Selection Criteria:

1. Dampers shall have stable operation throughout full range of operation, from design to minimum airflow over varying pressures and temperatures encountered.
2. Two-position dampers shall be full size of duct or equipment connection unless otherwise indicated.

2.2 RECTANGULAR CONTROL DAMPERS

A. General Requirements:

1. Unless otherwise indicated, use parallel blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed blade configuration.
2. Factory assemble multiple damper sections to provide a single damper assembly of size required by the application.
3. Damper actuator shall be factory installed by damper manufacturer as integral part of damper assembly. Coordinate actuator location and mounting requirements with damper manufacturer.

B. Insulated Rectangular Dampers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

   a. Greenheck.
   b. Pottorff.
   c. Ruskin Company.
   d. Or equal.

2. Performance:

   a. Leakage: AMCA 511, Class 1A. Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.
   b. Pressure Drop: 0.1-inch wg at 1500 fpm across a 24-by-24-inch damper when tested according to AMCA 500-D, figure 5.3.
   c. Velocity: Up to 4000 fpm.
   d. Temperature: Minus 100 to plus 185 degrees F.
   e. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.
   f. Damper shall have AMCA seal for both air leakage and air performance.

3. Construction:

   a. Frame:

      1) Material: ASTM B 211, Alloy 6063 T5 extruded-aluminum profiles, 0.08 inch thick.
      2) C-shaped channel with integral flange(s). Mating face shall be a minimum of 1 inch.
      3) Width not less than 4 inches.
      4) Entire frame shall be thermally broken by means of polyurethane resin pockets, complete with thermal cuts.
      5) Damper frame shall be insulated with polystyrofoam on four sides.

   b. Blades:

      1) Airfoil shaped, extruded aluminum.
      2) Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken. Complete blade shall have an insulating factor of R-2.29 and a temperature index of 55.
      3) Blade Action: See schedule on Drawings.
      4) Material: ASTM B 211, Alloy 6063 T5 aluminum, 0.08 inch thick.
      5) Width not to exceed 6 inches.
      6) Length as required by close-off pressure, not to exceed 48 inches.

   c. Seals: Blade and frame seals shall be of flexible silicone and secured in an integral slot within the aluminum extrusions.
   d. Axles: 0.5-inch diameter plated or stainless steel, mechanically attached to blades.

e. Bearings:

1) Bearings shall be composed of a Celcon inner bearing fixed to axle, rotating within a polycarbonate outer bearing inserted in the frame, resulting in no metal-to-metal or metal-to-plastic contact.
2) Where blade axles are installed in vertical position, provide thrust bearings.

f. Linkage:

1) Concealed in frame.
2) Constructed of aluminum and plated or stainless steel.
3) Hardware: Stainless steel.

g. Transition:

1) For round and flat oval duct applications, provide damper assembly with integral transitions to mate to adjoining field connection.
2) Factory mount damper in a sleeve with a close transition to mate to field connection.
3) Damper size and sleeve shall be connection size plus 2 inches.
4) Sleeve length shall be not less than 12 inches for dampers without jackshafts and shall be not less than 16 inches for dampers with jackshafts.
5) Sleeve material shall match adjacent duct.

h. Additional Corrosion Protection for Corrosive Environments:

1) Provide anodized finish for aluminum surfaces in contact with airstream. Anodized finish shall be a minimum of 0.0007 inch thick.
2) Axles, damper linkage, and hardware shall be constructed of Type 316L stainless steel.

2.3 GENERAL CONTROL-DAMPER ACTUATORS REQUIREMENTS

A. Actuators shall operate related damper(s) with sufficient reserve power to provide smooth two-position action and proper speed of response at velocity and pressure conditions to which the damper is subjected.

B. Actuators shall produce sufficient power and torque to close off against the maximum system pressures encountered. Actuators shall be sized to close off against the fan shutoff pressure as a minimum requirement.

C. The total damper area operated by an actuator shall not exceed 80 percent of manufacturer's maximum area rating.

D. Provide one actuator for each damper assembly where possible. Multiple actuators required to drive a single damper assembly shall operate in unison.

E. Avoid the use of excessively oversized actuators which could overdrive and cause linkage failure when the damper blade has reached either its full open or closed position.

F. Use jackshafts and shaft couplings in lieu of blade-to-blade linkages when driving axially aligned damper sections.

G. Provide mounting hardware and linkages for connecting actuator to damper.

H. Select actuators to fail in desired position in the event of a power failure.

I. Actuator Fail Positions: See Drawings.

2.4 ELECTRIC AND ELECTRONIC ACTUATORS

A. Type: Motor operated, with or without gears, electric and electronic.

B. Voltage:

1. See Drawings.
2. Actuator shall deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.
3. Actuator shall function properly within a range of 85 to 120 percent of nameplate voltage.

C. Construction:

1. Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. 100 up to 400 W: Gears ground steel, oil immersed, shaft-hardened steel running in bronze, copper alloy, or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel, or cast-aluminum housing.
3. Greater Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

D. Field Adjustment:

1. Spring return actuators shall be easily switchable from fail open to fail closed in the field without replacement.
2. Provide gear-type actuators with an external manual adjustment mechanism to allow manual positioning of the damper when the actuator is not powered.

E. Two-Position Actuators: Single direction, spring return or reversing type.

F. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

G. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.
2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.
3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

H. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

I. Damper Attachment:

1. Unless otherwise required for damper interface, provide actuator designed to be directly coupled to damper shaft without need for connecting linkages.
2. Attach actuator to damper drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

J. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 degrees F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

K. Enclosure: See “Environmental Conditions” Article for NEMA rating requirements.

L. Stroke Time:

1. Operate damper from fully closed to fully open within 90 seconds.
2. Operate damper from fully open to fully closed within 90 seconds.
3. Move damper to failed position within 30 seconds.
4. Select operating speed to be compatible with equipment and system operation.
5. Actuators operating in smoke control systems comply with governing code and NFPA requirements.

M. Sound:

1. Spring Return: 62dBA.
2. Non-Spring Return: 45dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for dampers and instruments installed in duct systems to verify actual locations of connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL-DAMPER APPLICATIONS

A. Control Dampers: See schedule on Drawings.

3.3 INSTALLATION, GENERAL

A. Provide products required to satisfy most stringent requirements indicated.

B. Properly support dampers and actuators, tubing, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a 5 lb force.

C. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Seal penetrations made in fire-rated and acoustically rated assemblies.

E. Fastening Hardware:

1. Stillson wrenches, pliers, or other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

F. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

G. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.

2. If possible, avoid or limit use of materials in corrosive environments, including, but not limited to, the following:

    a. Laboratory exhaust airstreams.
    b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.
4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
5. Where actuators are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.4 ELECTRIC POWER

A. Provide electrical power to products requiring electrical connections.

B. Provide circuit breakers. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers."

C. Provide power wiring. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

D. Provide raceways. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL DAMPERS

A. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.

B. Clearance:

1. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
2. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

C. Service Access:

1. Dampers and actuators shall be accessible for visual inspection and service.
2. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Section 233300 "Air Duct Accessories."

D. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.

E. Attach actuator(s) to damper drive shaft.

F. For duct-mounted and equipment-mounted dampers installed outside of equipment, install a visible and accessible indication of damper position from outside.

3.6 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with damper identification on damper.

3.8 CHECKOUT PROCEDURES

A. Control-Damper Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check dampers for proper location and accessibility.
3. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.
4. Verify that control dampers are installed correctly for flow direction.
5. Verify that proper blade alignment, either parallel or opposed, has been provided.
6. Verify that damper frame attachment is properly secured and sealed.
7. Verify that damper actuator and linkage attachment are secure.
8. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
9. Verify that damper blade travel is unobstructed.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING:

A. Stroke and adjust control dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer's recommended procedure, so damper is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressure.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 230923.12

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SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Single-wall round ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation bottom of ducts.
5. Dimensions of all duct runs from building grid lines.
6. Fittings.

7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations including analysis data signed and sealed by the qualified professional engineer responsible for their preparation] for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7

C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."[All longitudinal seams shall be Pittsburgh lock seams unless otherwise specified for specific application.]

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

N. Branch Connections: Use lateral or conical branch connections.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR LABORATORY EXHAUST AND FUME HOOD EXHAUST DUCTS

A. Install ducts in accordance with NFPA 45, "Fire Protection for Laboratories Using Chemicals."

B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.

C. Connect duct to fan, fume hood, and other equipment indicated on Drawings.

3.4 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to be welded. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

1. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 230713 "Duct Insulation."

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use duct cleaning methodology as indicated in NADCA ACR.

C. Use service openings for entry and inspection.

1. Provide openings with access panels appropriate for duct static-pressure and leakage class at dampers, coils, and any other locations where required for inspection and cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and

liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

3.9 STARTUP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. See “Ductwork Schedule” on Drawings.

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

3. Aluminum Ducts: Aluminum or Type 316 stainless-steel.

C. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

    a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
        1) Radius-to Diameter Ratio: 1.5.

    b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
    c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

D. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: 90-degree tap.
    b. Velocity 1000 to 1500 fpm: Conical tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

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SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flange connectors.
2. Duct-mounted access doors.
3. Flexible connectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Elgen Manufacturing.
4. Or equal.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gauge and Shape: Match connecting ductwork.

2.2 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Greenheck Fan Corporation.
4. Pottorff.
5. Ruskin.
6. Or equal.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

    a. Double wall, rectangular.
    b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    c. Vision panel.
    d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
    e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.3 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Ventfabrics, Inc.
5. Or equal.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install test holes at fan inlets and outlets and elsewhere as indicated.

D. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At outdoor-air intakes and mixed-air plenums.
2. Downstream from control dampers and equipment.
3. Control devices requiring inspection.
4. Elsewhere as indicated.

E. Install access doors with swing against duct static pressure.

F. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

G. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

H. Install flexible connectors to connect ducts to equipment.

I. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

J. Install duct test holes where required for testing and balancing purposes.

K. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

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3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect locations of access doors and verify that purpose of access door can be performed.

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sidewall propeller fans.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 DELEGATED-DESIGN SUBMITTAL

A. For unit hangars and supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design vibration isolation, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

2.2 SIDEWALL PROPELLER FANS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Loren Cook Company.
2. PennBarry.
3. Or equal.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring, with baked-enamel finish coat applied after assembly.

C. Fan Wheels: Formed-steel blades riveted to heavy-gauge steel spider bolted to cast-iron hub.

D. Fan Drive: Direct-drive motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Accessories:

1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Motorized Dampers: Parallel-blade dampers with electric actuator wired to close when fan stops.
3. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
4. Wall Sleeve: Galvanized steel to match fan and accessory size.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. AMCA Certification: Fans shall comply with AMCA 11 and bear the AMCA-Certified Ratings Seal.

C. Fan Sound Ratings: Comply with AMCA 311, and label fans with the AMCA-Certified Ratings Seal. Sound ratings shall comply with AMCA 301. The fans shall be tested according to AMCA 300.

D. Fan Performance Ratings: Comply with AMCA 211 and label fans with AMCA-Certified Rating Seal. The fans shall be tested for air performance - flow rate, fan pressure, power, fan efficiency, air density, speed of rotation, and fan efficiency - according to AMCA 210/ASHRAE 51.

E. Operating Limits: Classify according to AMCA 99.

F. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

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PART 3 - EXECUTION

3.1 INSTALLATION OF HVAC POWER VENTILATORS

A. Install power ventilators level and plumb.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

C. Support suspended units from structure using threaded steel rods and elastomeric hangers having a static deflection of 1-inch. Vibration-control devices are specified in Section 230548.13 "Vibration Controls for HVAC."

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.3 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that there is adequate maintenance and access space.
4. Verify that cleaning and adjusting are complete.
5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

C. Replace fan and motor pulleys as required to achieve design airflow.

D. Lubricate bearings.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

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SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each air-handling unit.
2. Gaskets: One set for each access door.
3. Fan Belts: One set for each air-handling unit fan.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: One year from date of Substantial Completion.
b. For Parts: One year from date of Substantial Completion.
c. For Labor: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, or comparable product by one of the following:

1. LG.
2. Samsung HVAC.

3. Carrier.
4. Or equal.

2.2 PERFORMANCE REQUIREMENTS

A. Outdoor unit Sound rating: not to exceed 55 dB(A).

B. Indoor unit Sound rating: not to exceed 50 dB(A).

C. Maximum allowable indoor and outdoor vertical separation: 98 feet.

D. Maximum allowable line set length: 98 feet.

E. Cooling operating temperature range:

1. Outdoor: 0 to 115 deg F with or without the addition of wind baffle accessory.
2. Indoor: 67 to 90 deg F.

F. Heating operating temperature range:

1. Outdoor: Minus 4 to 75 deg F.
2. Indoor: 50 to 82 deg F.

G. Testing: Indoor and outdoor unit individually run tested at factory.

2.3 WALL MOUNTED INDOOR UNIT

A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to piping, power, and control board with field connections.

B. Cabinet:

1. Material: High impact plastic chassis and fascia.
2. Mounting: Manufacturer-designed provisions for field installation. Wall mounted with front panel access to the filter.
3. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.

C. DX Coil Assembly:

1. Construction: Nonferrous construction, aluminum fins coated on copper tubing.
2. Coil Tubes: Copper with internal grooves.
3. Internal Tubing: Copper tubing with brazed joints.
4. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
5. Field Piping Connections: Manufacturer's standard.
6. Factory Charge: Dehydrated air or nitrogen.
7. Testing: Factory pressure tested and verified to be without leaks.

D. Drain Assembly:

1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
2. Condensate Removal: Condensate pump. Refer to unit schedule for condensate pump specifications.
3. Field Piping Connection: Non-ferrous material.

E. Fan and Motor Assembly:

1. Fan: Direct-drive fan(s) driven by a single motor statically and dynamically balanced.
2. Construction: Fabricated from non-ferrous components.
3. Motor: Brushless DC or electronically commutated with permanently lubricated bearings.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
5. Speed Settings and Control: Three or more speed settings with a speed range of at least 50 percent.

F. Filter Assembly:

1. Access: Included with fascia panel, to accommodate filter replacement without the need for tools.
2. Efficiency: MERV 8.

G. Unit Electrical:

1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls, 208/230 V, single phase, 60 hertz.
3. Control Transformer: Manufacturer's standard, factory installed.
4. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

2.4 OUTDOOR UNITS

A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.

B. Cabinet:

1. Galvanized steel, with a powder coated baked enamel finish.
2. Piping Connections: Make pipe connections inside the outdoor unit chassis. Refrigerant pipes can exit through the front, side, rear, or bottom sides of the outdoor unit.

C. Compressor and Motor Assembly:

1. Twin positive-displacement, inverter driven, scroll compressors.
2. Vibration Control: Integral isolation to dampen vibration transmission.
3. Accumulator: Systems shall have an accumulator with accumulator return valve control.
4. Expansion Valve: Electronic modulating type with linear or proportional characteristics, to control refrigerant flow to the indoor unit.

5. Protection: Systems shall have a high-pressure safety switch, fuse, over-current protection, over-voltage protection, temperature limit protection logic, compressor overload sensing.

D. Condenser Coil Assembly: Aluminum, flat fin, micro-channel with integral guard.

E. Condenser Fan and Motor Assembly:

1. Fans: One or two, propeller type.

a. Horizontal discharge airflow.
b. Direct-drive arrangement.
c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.

2. Fan Guards: Raised guards to protect moving parts.
3. Motor(s): Brushless DC with permanently lubricated bearings and rated for outdoor duty.
4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.

F. Unit Electrical:

1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
2. Field Connection: Single point connection to power entire unit and integral controls.
3. Control Transformer: Manufacturer's standard.
4. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

2.5 ACCESSORIES

A. See schedule on Drawings for the accessories specified which each unit.

B. Remote Controller:

1. Wall mounted controller with LCD display and built-in temperature sensor where system operating parameters are observed and input.
2. Casing: Suitable for indoor dry locations.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Low ambient cooling kit.

F. 18-inch-high mounting stand.

2.6 SYSTEM CONTROLS

A. Description: Each indoor unit and outdoor unit contain a microprocessor and are associated with a remote controller connected by communications cable.

B. Indoor unit microprocessor capabilities:

1. Monitoring return air temperature and indoor coil temperature.
2. Receiving and processing commands from a remote controller.
3. Operating the system without a remote controller.
4. Controlling the outdoor unit.

C. Outdoor unit microprocessor capabilities:

1. Receiving and processing commands from the indoor unit controller.
2. Controlling the components of the outdoor unit.

2.7 REFRIGERANT

A. ASHRAE 34, Class A2L refrigerant classification.

B. Refrigerant: A full charge of R-454B is included for the condensing unit by system manufacturer for lines sets up to 25 feet. Provide additional refrigerant based on diameters and lengths of system liquid refrigerant lines, and indoor equipment model and quantity.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

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SECTION 238239.16 - PROPELLER UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes propeller unit heaters with electric-resistance heating coils.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. PTFE: Polytetrafluoroethylene plastic.

C. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which propeller unit heaters will be attached.
2. Method of attaching hangers to building structure.
3. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Sprinklers.
    d. Access panels.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicate don Drawings or a comparable product by one of the following:

1. Modine
2. Trane.
3. Or equal.

2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 2021.

D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded and sealed in steel or corrosion-resistant metallic sheath. Element ends shall be enclosed in terminal box.

1. Circuit Protection: Overcurrent protection and limit controls for high-temperature protection of heaters.

2.6 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated, explosion proof.

2.7 CONTROLS

A. Control Devices:

1. Unit-mounted thermostat.

2.8 EXECUTION

2.9 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

2.10 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods andspring hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

2.11 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

2.12 ADJUSTING

A. Adjust initial temperature set points.

2.13 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters.

END OF SECTION 238239.16

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SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26. This Section is also referenced by related Work specified in other Divisions.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
2. Division 03 “Concrete” for cast in place concrete work, including concrete encasements for electrical duct banks, equipment pads, and light pole bases.
3. Division 31 “Earthwork” for excavation and backfilling, including gravel or sand bedding for underground work.
4. Division 40 “Process Interconnections” for SCADA, instrumentation, and process control equipment.

1.3 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.

16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.
32. EPM: Electrical preventive maintenance.
33. EPS: Emergency power supply.
34. EPSS: Emergency power supply system.
35. ESS: Energy storage system.
36. EV: Electric vehicle.
37. EVPE: Electric vehicle power export equipment.
38. EVSE: Electric vehicle supply equipment.
39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
40. FLC: Full-load current.
41. ft: Foot.
42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
43. GEC: Grounding electrode conductor.
44. GFCI: Ground-fault circuit interrupter.
45. GFPE: Ground-fault protection of equipment.
46. GND: Ground.
47. HACR: Heating, air conditioning, and refrigeration.
48. HDPE: High-density polyethylene.
49. HID: High-intensity discharge.
50. HP or hp: Horsepower.
51. HVAC: Heating, ventilating, and air conditioning.
52. Hz: Hertz.
53. IBT: Intersystem bonding termination.
54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
56. IR: Infrared.
57. IS: Intrinsically safe.

58. IT&R: Inspecting, testing, and repair.
59. ITE: Information technology equipment.
60. kAIC: Kiloampere interrupting capacity.
61. kcmil or MCM: One thousand circular mils.
62. kV: Kilovolt.
63. kVA: Kilovolt-ampere.
64. kVAr or kVAR: Kilovolt-ampere reactive.
65. kW: Kilowatt.
66. kWh: Kilowatt-hour.
67. LAN: Local area network.
68. lb: Pound (weight).
69. lbf: Pound (force).
70. LCD: Liquid-crystal display.
71. LCDI: Leakage-current detector-interrupter.
72. LED: Light-emitting diode.
73. Li-ion: Lithium-ion.
74. lm: Lumen, the SI derived unit of luminous flux.
75. LNG: Liquefied natural gas.
76. LP-Gas: Liquefied petroleum gas.
77. LRC: Locked-rotor current.
78. LV: Low voltage.
79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
80. m: Meter.
81. MCC: Motor-control center.
82. MDC: Modular data center.
83. MG set: Motor-generator set.
84. MIDI: Musical instrument digital interface.
85. MLO: Main lugs only.
86. MV: Medium voltage.
87. MVA: Megavolt-ampere.
88. mW: Milliwatt.
89. MW: Megawatt.
90. MWh: Megawatt-hour.
91. NC: Normally closed.
92. Ni-Cd: Nickel-cadmium.
93. Ni-MH: Nickel-metal hydride.
94. NIU: Network interface unit.
95. NO: Normally open.
96. NPT: National (American) standard pipe taper.
97. OCPD: Overcurrent protective device.
98. ONT: Optical network terminal.
99. PC: Personal computer.
100. PCS: Power conversion system.
101. PCU: Power-conditioning unit.
102. PF or pf: Power factor.
103. PHEV: Plug-in hybrid electric vehicle.
104. PLC: Programmable logic controller.
105. PLFA: Power-limited fire alarm.
106. PoE: Power over Ethernet.
107. PV: Photovoltaic.
108. PVC: Polyvinyl chloride.

109. pW: Picowatt.
110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
111. RMS or rms: Root-mean-square.
112. RPM or rpm: Revolutions per minute.
113. SCADA: Supervisory control and data acquisition.
114. SCR: Silicon-controlled rectifier.
115. SPD: Surge protective device.
116. sq.: Square.
117. SWD: Switching duty.
118. TCP/IP: Transmission control protocol/Internet protocol.
119. TEFC: Totally enclosed fan-cooled.
120. TR: Tamper resistant.
121. TVSS: Transient voltage surge suppressor.
122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
123. UL CCN: UL Category Control Number.
124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VFD: Variable-frequency drive. See VFC.
134. VOM: Volt-ohm-multimeter.
135. VPN: Virtual private network.
136. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
137. W: Watt, unit of real electrical power.
138. Wh: Watt-hour, unit of electrical energy usage.
139. WPT: Wireless power transfer.
140. WPTE: Wireless power transfer equipment.
141. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.

15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. GRS: Galvanized rigid steel conduit. See ERMC-S-G.
21. HDPE: HDPE underground conduit (thick wall).
22. HDPE-40: Schedule 40 HDPE underground conduit.
23. HDPE-80: Schedule 80 HDPE underground conduit.
24. IMC: Steel electrical intermediate metal conduit.
25. LFMC: Liquidtight flexible metal conduit.
26. LFMC-A: Aluminum liquidtight flexible metal conduit.
27. LFMC-S: Steel liquidtight flexible metal conduit.
28. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
29. LFNC: Liquidtight flexible nonmetallic conduit.
30. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.
31. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
32. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
33. PVC: Rigid PVC conduit.
34. PVC-40: Schedule 40 rigid PVC conduit.
35. PVC-80: Schedule 80 rigid PVC Conduit.
36. PVC-A: Type A rigid PVC concrete-encased conduit.
37. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
38. RAC: Rigid aluminum conduit. See ERMC-A.
39. RGS: Rigid galvanized steel conduit. See ERMC-S-G.
40. RMC: Rigid metal conduit. See ERMC.
41. RTRC: Reinforced thermosetting resin conduit.
42. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
43. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
44. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
45. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
46. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.

C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:

1. AC: Armored cable.
2. CATV: Coaxial general-purpose cable.
3. CATVP: Coaxial plenum cable.
4. CATVR: Coaxial riser cable.
5. CI: Circuit integrity cable.
6. CL2: Class 2 cable.
7. CL2P: Class 2 plenum cable.
8. CL2R: Class 2 riser cable.
9. CL2X: Class 2 cable, limited use.
10. CL3: Class 3 cable.
11. CL3P: Class 3 plenum cable.
12. CL3R: Class 3 riser cable.

13. CL3X: Class 3 cable, limited use.
14. CM: Communications general-purpose cable.
15. CMG: Communications general-purpose cable.
16. CMP: Communications plenum cable.
17. CMR: Communications riser cable.
18. CMUC: Under-carpet communications wire and cable.
19. CMX: Communications cable, limited use.
20. DG: Distributed generation cable.
21. FC: Flat cable.
22. FCC: Flat conductor cable.
23. FPL: Power-limited fire-alarm cable.
24. FPLP: Power-limited fire-alarm plenum cable.
25. FPLR: Power-limited fire-alarm riser cable.
26. IGS: Integrated gas spacer cable.
27. ITC: Instrumentation tray cable.
28. ITC-ER: Instrumentation tray cable, exposed run.
29. MC: Metal-clad cable.
30. MC-HL: Metal-clad cable, hazardous location.
31. MI: Mineral-insulated, metal-sheathed cable.
32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
33. MV: Medium-voltage cable.
34. NM: Nonmetallic sheathed cable.
35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
37. NPLF: Non-power-limited fire-alarm circuit cable.
38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
40. NUCC: Nonmetallic underground conduit with conductors.
41. OFC: Conductive optical fiber general-purpose cable.
42. OFCG: Conductive optical fiber general-purpose cable.
43. OFCP: Conductive optical fiber plenum cable.
44. OFCR: Conductive optical fiber riser cable.
45. OFN: Nonconductive optical fiber general-purpose cable.
46. OFNG: Nonconductive optical fiber general-purpose cable.
47. OFNP: Nonconductive optical fiber plenum cable.
48. OFNR: Nonconductive optical fiber riser cable.
49. P: Marine shipboard cable.
50. PLTC: Power-limited tray cable.
51. PLTC-ER: Power-limited tray cable, exposed run.
52. PV: Photovoltaic cable.
53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
54. RHW: Thermoset rubber, moisture-resistant cable.
55. SA: Silicone rubber cable.
56. SE: Service-entrance cable.
57. SER: Service-entrance cable, round.
58. SEU: Service-entrance cable, flat.
59. SIS: Thermoset cable for switchboard and switchgear wiring.
60. TBS: Thermoplastic cable with outer braid.
61. TC: Tray cable.
62. TC-ER: Tray cable, exposed run.

63. TC-ER-HL: Tray cable, exposed run, hazardous location.
64. THW: Thermoplastic, heat- and moisture-resistant cable.
65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
66. THHW: Thermoplastic, heat- and moisture-resistant cable.
67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
68. TW: Thermoplastic, moisture-resistant cable.
69. UF: Underground feeder and branch-circuit cable.
70. USE: Underground service-entrance cable.
71. XHH: Cross-linked polyethylene, heat-resistant cable.
72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."

    a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.

2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:

a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
b. Concrete Box: A box intended for use in poured concrete.
c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
e. Cutout Box: An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the enclosure.
f. Device Box: A box with provisions for mounting a wiring device directly to the box.
g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
o. Raised-Floor Box: A floor box intended for use in raised floors.
p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.

10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
11. Fault Limited: Providing or being served by a source of electrical power that is limited to not more than 100 W when tested in accordance with UL 62368-1.

    a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.

12. Jacket: A continuous nonmetallic outer covering for conductors or cables.
13. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
14. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
15. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
16. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
17. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
18. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
19. Sheath: A continuous metallic covering for conductors or cables.
20. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
21. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:

    a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
    b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
    c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
    d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
    e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.

f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to inflict bodily harm or injury.

22. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.4 INTERPRETATION OF CONTRACT DOCUMENTS

A. If during performance of work, there is a conflict, error, or discrepancy between or among Contract Documents and laws and regulations, provide the higher performance standard unless otherwise directed by Engineer.

B. Priority of Documents: Figured dimensions govern over scaled dimensions, detailed drawings govern over general drawing, larger scale drawings take precedence over smaller scale drawings, change order drawings supersede original contract drawings, and contract drawings govern shop drawings.

C. In general, Drawings do not show conduit routing. Plan and route conduits in compliance with specifications and drawing details. Coordinate installation with other trades and actual supplied equipment.

D. Ductbank routing shown on electrical site plans is diagrammatic in nature and may not include interferences that may be present.

1.5 COORDINATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

B. Arrange to provide temporary electrical service or power in accordance with requirements specified in Division 01.

1.6 PREINSTALLATION MEETINGS

A. Schedule Preconstruction Meeting and other Preinstallation Meetings in accordance with Project Meetings Section in Division 01.

1.7 SEQUENCING

A. Conduct and submit results of preliminary power system studies before submitting Product Data and Shop Drawings for electrical equipment.

B. Coordinate installation work with other trades.

1.8 ACTION SUBMITTALS

A. Submit Division 26 equipment and materials as specified in each Section at one time and not piecemeal. For example, all low voltage motor control centers on a project are to be submitted under one submittal number. Submittals that do not comply will be returned disapproved.

B. Subject to Engineer's approval, related items may be submitted together under one submittal. Contractor shall identify the multiple Sections included. For example, multiple Sections specify lighting fixtures and poles. A single submittal for lighting could be acceptable.

C. Electrical Installation Drawings:

1. Drawings in general do not show conduit routing other than major conduit and ductbank routes. Submit conduit layouts for exposed, concealed, and buried conduits.
2. Submit electrical room layouts using approved shop drawing dimensions for equipment.
3. Submit layouts at an appropriate scale for clarity.
4. Include type written conduit schedules for easy cross check.
5. Installation submittal drawing must be approved before concrete pours are made that will conceal conduits.

D. Training Plans: Submit instructional program outline for Engineer's review and approval, where demonstration and/or training is specified.

1.9 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Engineer including, but not limited to, milestone dates for the following activities:

1. Submission of power system studies.
2. Submission of specified coordination drawings.
3. Submission of action submittals specified in Division 26.
4. Orders placed for major electrical equipment.
5. Arrival of major electrical equipment on-site.
6. Preinstallation meetings specified in Division 26.
7. Utility service outages.
8. Utility service inspection and activation.
9. Closing of walls and ceilings containing electrical Work.
10. System startup, testing, and commissioning activities for major electrical equipment.
11. System startup, testing, and commissioning activities for emergency lighting.
12. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).

13. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
14. Requests for special inspections.
15. Requests for inspections by authorities having jurisdiction.

B. Delegated Design Drawings: As indicated in individual Division 26 Sections.

C. Seismic Qualification Data: In accordance with Section 260011 "Facility Performance Requirement for Electrical" and individual Division 26 Sections.

D. Wind-Load Performance Data: In accordance with Section 260011 "Facility Performance Requirement for Electrical" and individual Division 26 Sections.

E. Qualification Statements: In accordance with individual Division 26 Sections.

1.10 CLOSEOUT SUBMITTALS

A. Record Documents: Submit documentation to accurately show completed installation. Include modifications to Contract Documents (one line power diagrams, equipment elevations, panel schedules, elementary control diagrams, riser diagrams, plans, conduit and ductbank routing, etc.) along with additional drawings or sketches created to convey completed installation.

B. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device as specified in each Division 26 Section.

1.11 DELEGATED DESIGN / PROFESSIONAL ENGINEERING SERVICES

A. When engineering services are specified to be provided by Contractor, retain a licensed professional engineer to perform the services. Engineer shall be licensed at the time services are performed and licensed in the state in which project is located. If the state issues discipline specific licenses, Engineer shall be licensed in the applicable discipline. Engineer shall be experienced in the type of work being performed.

B. Engineering work shall be done according to the applicable regulations for professional engineers to include signing, sealing, and dating documents.

1.12 QUALIFICATIONS

A. Comply with Quality Assurance Articles within each Division 26 Section.

B. Electrical Contractor Minimum Requirements: Regularly engaged in the installation of industrial medium voltage systems for a minimum period of 10 years.

C. On Site Field Superintendent:

1. Minimum of 10 years of experience of industrial low and medium voltage projects of comparable size and complexity.

2. Be present (or designated substitute with minimum experience as above) during medium voltage cable pulling and testing, during medium voltage switching activity, and during medium voltage equipment change over or start-up activities.

1.13 MATERIALS AND EQUIPMENT

A. Provide new materials and equipment unless specifically noted otherwise.

B. NEMA enclosure types are listed on the Drawings and/or the specifications.

C. Electrical materials and equipment must be listed by Underwriter's Laboratories, Inc. (UL**)** and bear the appropriate listing or classification marking. Equipment not bearing a UL certification shall be field or factor UL certified prior to acceptance and use.

D. Provide major electrical equipment by a single manufacturer, i.e. unit substations, switchgear, motor control centers, disconnect switches, transformers, panelboards, etc.

E. Variable frequency controllers, when provided as a stand-alone package with the driven equipment and therefore not included in a motor control center are to be required to be by a single manufacturer.

1.14 HAZARDOUS AREAS

A. Drawings may indicate and define NEC hazardous classified locations.

B. Equipment and materials installed in hazardous areas shall be UL listed for the appropriate Class and Division and in accordance with NEC Articles 500, 501, 502, and 503 as applicable.

1.15 EQUIPMENT SIZE, HANDLING, AND STORAGE

A. Coordinate with equipment manufacturer shipping splits to permit safe handling and passage of equipment to final installation location.

B. Comply with manufacturer's instructions for upright equipment orientation during transportation.

C. Protect equipment from mechanical injury, or exposure to moisture, chemicals, or corrosive gases. Do not store indoor rated electrical equipment outdoors.

D. Provide and energize temporary space heaters if required to control moisture during storage.

1.16 FIELD CONDITIONS

A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."

B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards.

1.17 ELECTRICAL SYSTEM TESTING AND SETTINGS

A. Test electrical systems and equipment in accordance with individual sections. This includes motors or other electrical equipment which are not specified in Division 26.

B. Set and adjust controls, timers, relays, adjustable trip units, protective devices, and other electrical components in accordance with manufacturers instructions and the approved power system study. Do not energize equipment without correctly setting adjustable components.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place sleeves for conduits and slots for electrical work prior to concrete pour.

B. Use approved shop drawings and equipment vendor templates to determine exact locations for stub-ups and terminating concealed conduit and place before floor slab pour.

C. Seal openings, sleeves, penetration and slots.

3.2 CUTTING AND PATCHING

A. Cut and patch in a workmanlike manner as required to install electrical work.

B. Modify concrete in accordance with Division 3 “Concrete.”

C. Do not cut joists, beams, girders, columns, or other structural members.

D. Patch surfaces to restore to original integrity (waterproof or fireproof as required) and appearance.

E. Core drill holes in concrete floors and walls as required. Prior to coring concrete, scan slab or wall using radar to locate and identify rebar and/or conduit and wiring. Locate cores to avoid cutting or drilling through rebar and/or conduits. Space conduits to not weaken structural integrity. Notify Engineer immediately if rebar is cut or upon becoming aware of discrepancies within area of work.

3.3 DEMOLITION AND DISPOSITION OF EQUIPMENT

A. Drawings showing removal of major mechanical and electrical equipment is not intended to show all components to be demolished. Not all piping, conduits, ducts, equipment, ancillary devices, etc. are shown. Field verify existing conditions prior to bid.

B. Unless otherwise specifically noted, remove unused exposed conduit and support systems back to source and/or point of concealment including above accessible ceiling finishes. Wiring shall be removed.

C. Cut flush with slab, ceiling, or wall abandoned concealed conduit. Suitably plug conduits.

D. Repair and restore adjacent construction and finishes after demolition is complete.

E. Material and equipment indicated for removal or demolition is to become the Contractor’s property upon removal, unless noted otherwise. Removed material to be properly handled and disposed.

3.4 INSTALLATION OF ELECTRICAL WORK

A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Engineer for resolution of conflicting requirements.

3.5 FIELD QUALITY CONTROL

A. Field testing, startup services, and system functional testing may be provided by the Contractor, and/or the manufacturer’s factory-authorized service representative, and/or an independent testing agency. Provide testing and/or startup service as specified in the relevant section.

B. Submit Field Quality-Control Report as informational submittal within 14 days of each completed test or startup. Include within the report adjustments / as left settings.

3.6 CLEANING

A. Remove rubbish and debris from inside and around electrical equipment and enclosures.

B. Remove dirt, dust or concrete spatter from interior and exterior of equipment using brushes, vacuum cleaner, or clean lint-free rags. Do not use compressed air.

C. Waste Management:

1. Remove and dispose of electrical and electronic waste per local regulations.

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3.7 CLOSEOUT ACTIVITIES

A. Provide demonstration and training as specified in each section.

END OF SECTION 260010

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SECTION 260011 - FACILITY PERFORMANCE REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Field conditions and other facility performance requirements applicable to Work specified in Division 26.

1.3 FIELD CONDITIONS

A. Altitude:

1. Sea level to 1000 ft.

B. Ambient Temperature:

1. Minimum: 0 degrees F
2. Maximum: 90 degrees F.

C. Temperature Variation: Allow for thermal movements from the following differential temperatures:

1. Outdoor Ambient Temperature Differential: 120 degrees F.
2. Material Surface Temperature Differential: 180 degrees F.
3. Ground Surface Temperature Differential to 10 foot Depth: 60 degrees F.

D. Ground Water:

1. Assume ground-water level is at grade level unless a lower water table is noted on Drawings.

E. Hazardous and / or Corrosive Environmental Conditions: As indicated on the Drawings.

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PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260011

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire.
2. Connectors and splices.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

A. VFC: Variable-frequency controller. Used interchangeably with VFD.

B. VFD: Variable frequency drive. See VFC.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project. If multiple manufacturers of a wire or cable type are proposed, submit those cut sheets rather than stating “or equal.”

B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Stranding: Refer to CONDUCTOR APPLICATIONS Article in PART 3.

E. Conductor Insulation:

1. Type RHW-2: Comply with UL 44.
2. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
3. Type XHHW-2: Comply with UL 44.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Tin-plated copper.
2. Type:

a. One hole with long barrels for No. 8 AWG to No. 4/0 AWG.
b. Two holes with long barrels for 250 kcmil and larger.
c. Locking spade for No. 10 AWG and smaller.

3. Termination: Compression for No. 8 AWG and larger.

D. Connectors:

1. Solderless pressure type (wirenuts) for No. 10 AWG and smaller.
2. Pre-filled with silicone-based sealant for exterior, wet, or corrosive locations.
3. Split bolt type for No. 8 AWG and larger splices.

E. Motor Terminations: Mechanical compression ring type, secured with bolt, nut and spring washer.

PART 3 - EXECUTION

3.1 CONDUCTOR APPLICATIONS

A. Wires and Cables: Copper; stranded, except for lighting and receptacle wiring which may be solid. Minimum size for power circuits: No. 12 AWG.

B. Power Circuits: Single conductors in raceway. Type XHHW-2 for sizes up to 4/0 and Type RHW-2 for size 250 kcmil and larger.

C. Direct Burial Outdoor Lighting Circuits: Type RHW-2.

D. Grounding Conductors: Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

E. Control and Fire Alarm Circuits: Refer to Section 260523 “Control-Voltage Electrical Power Cables.”

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

G. VFC Output Circuits: Type TC-ER with shield.

3.2 INSTALLATION, GENERAL

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Use of steel fish tapes and/or steel pulling cables in PVC conduit or raceways that terminate into energized enclosures is prohibited.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors. Do not splice service or feeder cables without prior written approval of Engineer.

C. Wiring at Outlets:

1. Install conductor at each outlet, with at least 6 inch of slack.
2. Form solid wire into loop to fit around device terminal screw. Do not overlap wire.

3.4 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance, and feeder conductors, and 480V power circuit conductors for compliance with requirements.
2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.
2) Calibrated torque wrench.
3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.
d. Inspect for correct identification.
e. Inspect cable jacket and condition.
f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 1000 V(dc) for 600 V rated cable for a one-minute duration. Minimum wire insulation resistance: 100 Megohms.
g. Continuity test on each conductor and cable.
h. Uniform resistance of parallel conductors.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

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SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category 6a balanced twisted pair cable.
2. Balanced twisted pair cable hardware.
3. RS-232 cable.
4. RS-485 cable.
5. Control-circuit conductors.
6. Fire-alarm wire and cable.
7. Instrumentation cable.
8. Industrial Ethernet cable.
9. Termination products.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project. If multiple manufacturers of a cable type are proposed, submit those cut sheets rather than stating “or equal.”

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 CATEGORY 6a BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500 MHz.

B. Standard: Comply with TIA-568-C.2 for Category 6a cables.

C. Conductors: 100 ohm, No. 23 AWG solid copper.

1. Lead Content: Less than 300 parts per million.

D. Shielding/Screening: Shielded twisted pairs (FTP).

E. Cable Rating: Plenum.

F. Jacket: Yellow thermoplastic.

2.3 BALANCED TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.

B. General Requirements for Balanced Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6a.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.

D. Connecting Blocks: 110-style IDC for Category 6a. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

E. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.
b. Labeling areas adjacent to conductors.
c. Replaceable connectors.
d. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19 inch equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated.

G. Patch Cords: Factory-made, four-pair cables in 36 inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

H. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standards:

    a. IEC 60603-7-2.
    b. Category 6a, shielded balanced twisted pair cable shall comply with IEC 60603-7.51.

4. Marked to indicate transmission performance.

J. Faceplate:

1. Two port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
2. Eight port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
3. Metal Faceplate: Stainless steel, complying with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems."
4. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.

    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.4 CONTROL-CIRCUIT CONDUCTORS

A. Individual Conductors: Stranded copper, Type XHHW-2, complying with UL 44 in raceway.

B. Multi-conductor Control Cable: NEC type TC, stranded copper, Type XHHW-2, insulated color coded conductors including ground wire, overall PVC jacket. Rated for cable tray or direct burial use and sunlight resistant. Number of conductors as indicated on Drawings.

C. Minimum Size: No. 14 AWG for 120V circuits, No. 16 AWG for circuits 50V and less.

2.5 INSTRUMENTATION CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Belden.
2. Rockbestos-Suprenant Cable Corp.

B. Single or Multiple Paired Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for 4-20mA process instrumentation signals and use under NEC Article 727.

1. One or Multi-pair, twisted, shielded, No. 16 AWG, stranded, tinned-copper conductors.
2. Voltage Rating: 600V.
3. Insulation: PVC.
4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
5. Jacket: PVC with manufacturer's identification.
6. Standards: UL 1277 Type TC, UL 1581.
7. Single pair cable maximum overall diameter: 0.297-inches.

C. Triad (three conductor) Cable: NEC Type ITC (Instrumentation Tray Cable), UL Type TC for instrumentation signals and use under NEC Article 727.

1. Three conductor, twisted, shielded, No. 16 AWG, stranded, tinned-copper conductors.
2. Voltage Rating: 600V.
3. Insulation: PVC.
4. Shield: 100 percent aluminum/polyester foil with drain wire. Pairs individually shielded.
5. Jacket: PVC with manufacturer's identification.
6. Standards: UL 1277 Type TC, UL 1581.

2.6 TERMINATIONS

A. Termination connectors for instrumentation and control conductors:

1. Tin plated copper.
2. Vinyl insulated.
3. Flanged spade / locking fork with upturned leg ends.
4. Crimp / compression installation.

B. Termination connector for industrial Ethernet cable: match conductor count, RJ45 type, intended for shielded cable. Rockwell Automation Bulletin 1585J or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.

B. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for wireways as supplemented or modified in this Section.

C. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for raceway selection and installation requirements for boxes as supplemented or modified in this Section.

1. Outlet Boxes: No smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2. Outlet Boxes for Cables: No smaller than 4 inches square by 2-1/8 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
3. Flexible metal conduit is not allowed.

D. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

E. Install manufactured conduit sweeps and long-radius elbows if possible.

F. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

G. Backboards: Install backboards with 96 inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with requirements in Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for installation requirements and as supplemented or modified in this Section.

B. Instrumentation and Ethernet cables may not be spliced and are to be continuous from terminal to terminal.

C. Install instrumentation and Ethernet cabling in separate raceway from control or power wiring.

D. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.

E. Separation from EMI Sources:

1. Separation between open instrumentation cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment as follows:

a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.

c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

F. General Requirements for Telecommunications Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; cable cannot contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables: may not be spliced and is to be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Grounding: Ground wire must be copper. Comply with IEEE C2. Demonstrate ground resistance.

G. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

3.4 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

C. For instrumentation wiring, ground shield at one end only as recommended by instrument manufacturer and in accordance with Owner's standard.

3.6 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers comply with UL 969, for label stocks, laminating adhesives, and inks.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 260523

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding and bonding conductors.
2. Grounding and bonding materials and hardware.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Insulated Grounding and Bonding Conductor: Copper conductor, 600V with insulation type matching the circuit phase conductors called for in Section 260519 “Low-Voltage Electrical Power Conductors and Cables”, green color.

B. ASTM - Bare Copper Grounding and Bonding Conductor:

1. Referenced Standards: Complying with one or more of the following:

a. Soft or Annealed Copper Wire: ASTM B3.
b. Concentric-Lay Stranded Copper Conductor: ASTM B8.
c. Tin-Coated Soft or Annealed Copper Wire: ASTM B33.
d. 19-Wire Combination Unilay-Stranded Copper Conductor: ASTM B787/B787M.

2.2 GROUNDING AND BONDING MATERIALS AND HARDWARE

A. Performance Criteria:

1. Regulatory Requirements:

a. Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2. Listing Criteria:

a. Grounding and Bonding Equipment: UL CCN KDER; including UL 467.
b. Grounding and Bonding Equipment for Communications: UL CCN KDSH; including UL 467.

B. Ground Rods: Copper clad steel, 3/4-inch by 10-feet, sectionalized as required by Drawings.

C. Grounding Conduit Hubs: Malleable iron type.

D. Water Pipe Ground Clamps: Cast bronze saddle type.

E. Exothermic-welding Kits: CADWELD process or equal.

1. Manufacturer kits to include molds and powder recommended by kit manufacturer for materials being joined and installation conditions.
2. Welds used indoors in occupied buildings or confined space to be low emission type, CADWELD EXOLON or equal.

F. Ground Rod Test Wells: As detailed on the Drawings.

G. Ground Enhancement Material (GEM): Low-resistance, non-corrosive, carbon dust based material that improves grounding effectiveness. Contains cement, which hardens when set to provide a permanent, maintenance-free, low-resistant grounding system that never leaches or washes away. Suitable for installation in trenches or backfilling around ground rods. Resistivity of no more than 20 ohm-cm in cured state. ERICO Part No. GEM25A or equal.

H. Bus Bars: Rectangular bar of annealed copper. As detailed on the Drawings.

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PART 3 - EXECUTION

3.1 SELECTION OF GROUNDING AND BONDING CONDUCTORS

A. Conductors: Install solid conductor for 10 AWG and smaller, and stranded conductors for 8 AWG and larger unless otherwise indicated.

B. Bonding Cable: 28 kcmil, 14 strands of 17 AWG conductor, 1/4 inch in diameter.

C. Bonding Conductor: 4 AWG or 6 AWG, stranded conductor.

D. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inch wide and 1/16 inch thick.

E. Underground Grounding Conductors: Install bare copper conductor, size as indicated on Drawings.

1. Bury at least 30 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

3.2 SELECTION OF CONNECTORS

A. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.3 INSTALLATION

A. Comply with manufacturer's published instructions.

B. Reference Standards:

1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
2. Consult Engineer for resolution of conflicting requirements.

C. Special Techniques:

1. Grounding Electrode Conductors:

a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
b. Where conductors pass through floor slabs, walls, etc., install in conduit or sleeve.
c. When conductors need to be installed in conduit for mechanical protection, use non-ferrous conduit to avoid a choke effect for fault currents.

2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
b. Make connections with clean, bare metal at points of contact.
c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.

g. Grounding and Bonding for Piping:

1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

i. Grounding for Steel Building Structure: Install as indicated on Drawings.

1) Locate attachment points not subject to mechanical damage, but accessible for inspection.
2) Use exothermic weld process for wire sizes 1/0 AWG and larger. When wire size is smaller than 1/0 AWG, weld a pigtail of 1/0 AWG to structural steel then mechanically connect the two wires.

3. Electrodes:

a. Ground Rods: Drive rods until tops are 2 inch below finished floor or final grade unless otherwise indicated.

1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2) Use exothermic welds for below-grade connections.
3) Drive rods vertically and do not allow them to be deformed or driven at an angle. Where driving is difficult or rock is encountered, use purpose-designed drilling equipment, install rod into drilled hole and backfill around rod using ground enhancement material (GEM) mixed with water to form a slurry in accordance with manufacturer’s instructions.

b. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each steel column or other indicated item, extending around perimeter of building, area, or item indicated.

1) Bury ring electrode not less than 24 inch from building's foundation.
2) Lay underground conductors slack, and where exposed to mechanical injury, protect by pipes or other substantial guards. If guards are iron pipe or other magnetic material, electrically connect conductors to both ends of the guard.

c. Concrete-Encased Electrode (Ufer Ground): Fabricate in accordance with NFPA 70.

4. Grounding at Service:

a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.

5. Grounding Separately Derived Systems:

a. Transformers: Bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or as indicated on the Drawings.

b. Generators and UPS: When indicated on the Drawings as a separately derived system, bond neutral and ground with a bonding jumper at the equipment in accordance with NEC 250.102. Connect to the grounding electrode system via the electrode grounding conductor in accordance with NEC Table 250.66 or a indicated on the Drawings.
c. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.

6. Grounding Underground Distribution System Components:

a. Comply with IEEE C2 grounding requirements.

7. Grounding and Bonding of Raceways, Cable Trays, Boxes, and Enclosures:

a. Terminate metallic conduit into pressed steel boxes using double locknuts (same metal type as conduit) and insulated grounding bushings.
b. Terminate metallic conduit into metallic gasketed enclosures using Meyers grounding type conduit hubs.
c. Use insulated throat grounding bushings with lay-in type lugs to terminate metallic conduits containing equipment grounding conductors into sheet steel boxes.
d. Bond metallic electrical system components such as cable trays, supports, brackets, braces, boxes, etc. to the raceway system if they are not rigidly secured to and in contact with the raceway system or are subject to vibration and loosening.
e. Provide a bonding jumper across hinged metal panels or doors when electrical components in excess of 24 volts are mounted on the moveable panel.
f. Provide a grounding bushing at the end of metallic conduits that terminate in free air.
g. Provide 12 AWG insulated green wire bonding jumper for metal outlet boxes that contain receptacles. Connect wire from receptacle ground terminal to box using grounding screw.

8. Equipment Grounding:

a. Install insulated equipment grounding conductors with feeders and branch circuits.
b. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
c. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
d. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
e. Metallic Fences: Comply with requirements of IEEE C2.

1) Grounding Conductor: Bare copper, not less than 6 AWG.
2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
3) Barbed Wire: Strands must be bonded to grounding conductor.

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
    c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

B. Nonconforming Work:

1. Grounding system will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective components and retest.

C. Collect, assemble, and submit test and inspection reports.

1. Report measured ground resistances that exceed the following values:

    a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 Ω (ohms).
    b. Power and Lighting Equipment or System with Capacity over 500 kVA: 5 Ω (ohms).

3.5 PROTECTION

A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Support, anchorage, and attachment components.
2. Fabricated metal equipment support assemblies.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following: channel support systems, conduit support hardware, and accessories.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.4 DELEGATED DESIGN SUBMITTALS

A. For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified structural professional engineer, as defined in Section 014000 “Quality Requirements”, to design hanger and support system.

B. Surface-Burning Characteristics for Nonmetallic Channel Systems and Accessories: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Aluminum Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: 6063-T5 aluminum alloy.
3. Fittings and Accessories Material: 5052-H32 aluminum alloy.

B. Stainless Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.

C. Hot-dipped Galvanized Steel Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Material for Channel, Fittings, and Accessories: Hot-dipped galvanized steel.

D. Nonmetallic Channel:

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
2. Channel Material: Ultraviolet resistant FRP.
3. Fittings and Accessories Material: Stainless steel, Type 316 or compatible non-metallic.

E. Accessories: Conduit clamps, straps, hangers, rods, backplates, anchors, nuts, washers, etc. to correspond with channel material as listed in the SELECTION Article. Use of galvanized steel components is only allowed with galvanized steel channel.

F. Threaded Rod: 3/8-inch diameter, minimum.

G. Expansion Anchors: 3/8-inch minimum diameter. Equal to “Kwik Bolt”, manufactured by McCullock Industries; “Wej it” manufactured by Wej it Expansion Products; or “Kwik-Bolt II” manufactured by Hilti Fastening Systems.

PART 3 - EXECUTION

3.1 SELECTION OF CHANNEL

A. Dry, indoor, conditioned, non-process space: Hot dipped galvanized steel.

B. Outdoor, process areas, or areas indicated on Drawings as “DUST”, “DAMP”, or WET”: stainless steel.

C. Areas indicated on Drawings as “CORROSIVE”: Nonmetallic.

3.2 INSTALLATION

A. Comply with the following standards as applicable for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA NEIS 101: Standard for Installing Steel Conduits.
2. NECA NEIS 102: Standard for Installing Aluminum Rigid Metal Conduits.
3. NECA NEIS 105: Standard for Installing Metal Cable Tray Systems.
4. NECA NEIS 111: Standard for Installing Nonmetallic Raceways.

B. Attach support systems only to structural components. Use concrete expansion anchors for attachment to concrete surfaces.

C. Provide a minimum of 1/2-inch clearance between wall and equipment when installing surface mounted panel boxes, junction boxes, conduit, etc.

D. Space conduit supports, other than for underground raceways, at no more than 8 foot intervals, and as required to obtain rigid construction.

E. Remove burrs and grind smooth sharp edges from channel support ends. Fit ends with plastic end caps.

3.3 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.4 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

    a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

2. Comply with requirements in Section 099100 "Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

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SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Conduits and fittings.

B. Products Installed, but Not Furnished, under This Section:

1. Section 260553 "Identification for Electrical Systems" for conduit identification labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies, outlet and device boxes, pull boxes, and junction boxes.
4. Section 260529 “Hangers and Supports for Electrical Systems” for channel support systems and miscellaneous mounting components.
5. Section 260543 “Underground Ducts and Raceways for Electrical Systems” for underground construction requirements.

1.3 DEFINITIONS

A. Conduit: A structure containing one or more duct raceways.

B. Duct Raceway: A single enclosed raceway for conductors or cable.

C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer’s cut sheet for each type of product used on project. Note some conduit types listed may not be used on the project. Refer to the Conduit Selection Table in PART 3. Indicate in the submittal, the areas where specific materials are used. If multiple

manufacturers of a given type of conduit or fittings are proposed, submit those cut sheets rather than stating “or equal”.

B. Conduit Layouts: For Division 26 and 28 conduits installed underground and concealed within buildings and structures. Show equipment, boxes, handholes, manholes, routing, materials, and sizing. Provide layouts at an appropriate scale for clarity. Submission of separate drawings for power, lighting and control for one area is acceptable. Provide schedule for easy cross check.

PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 TYPE ERMC-A DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Description: Rigid aluminum 6063 alloy conduit, elbows, couplings, and nipples per NEC Article 344.

B. Listing Criteria: UL DYWV - Rigid Nonferrous Metallic Conduit, including UL 6A.

C. Long radius elbows as indicated in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.

D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMC-A-PVC).

2.3 TYPE ERMC-S DUCT RACEWAYS, ELBOWS, COUPLINGS, AND NIPPLES

A. Description: Galvanized rigid steel conduit, elbows, couplings, and nipples, with a hot-dipped galvanized finish inside and out and per NEC Article 344.

B. Listing Criteria:

1. UL DYIX – Rigid Ferrous Metal Conduit, including UL 6.
2. UL DYJC – Rigid Ferrous Metal Conduit with Polyvinyl Chloride Coating, including UL 6.

C. Long radius elbows as indicated in Section 260543 “Underground Ducts and Raceways for Electrical Systems.”

D. PVC Coated Type: 40 mil PVC on exterior and 2 mil urethane on interior. (ERMC-S-PVC).

2.4 TYPE FMC DUCT RACEWAYS

A. Description: Flexible metal conduit per NEC Article 348.

B. Listing Criteria: UL DXUZ - Flexible Metal Conduit, including UL 1.

C. Material: Hot-dipped galvanize steel (FMC-S).

2.5 TYPE LFMC DUCT RACEWAYS

A. Description: Liquidtight Flexible Metal Conduit, Type UA, per NEC Article 350.

B. Listing Criteria: UL DXHR – Liquid-tight Flexible Metal Conduit, including UL 360.

C. Material: Steel (LFMC-S).

D. Manufacturer: Sealtite®, Type UA, as manufactured by Anaconda, continuously interlocked flexible steel conduit with sunlight and chemical resistant PVC jacket.

2.6 TYPE PVC DUCT RACEWAYS AND FITTINGS

A. Description: Rigid Polyvinyl Chloride Conduit, sunlight resistant, rated for use with 90 degree C conductors in exposed and direct or concrete encased applications, per NEC Article 352.

B. Listing Criteria: UL DZYR – Rigid Nonmetallic PVC Conduit, including UL 651.

C. Type: Schedule 40 and Schedule 80.

2.7 FITTINGS FOR CONDUIT AND TUBING

A. General: Listed and labeled for type of conduit, location, and use.

1. ERMC-A: Use cast aluminum fittings.
2. ERMC-S: Use cast malleable iron fittings.

B. Listing Criteria as Applicable:

1. UL 514B – Conduit, Tubing, and Cable Fittings.
2. UL 1203 – Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
3. UL DWTT – Conduit Fittings.
4. UL FKAV – Electrical Metallic Tubing Fittings.
5. UL ILNR – Flexible Metallic Tubing Fittings.
6. UL DXAS – Liquid-tight Flexible Metal Conduit Assemblies.

C. Refer to Section 260533.16 “Boxes and Covers for Electrical Systems” for conduit bodies such as LB’s, T’s, and C’s.

D. Metal Fittings:

1. EMT Fittings: Die cast, rain and concrete tight, compression type. Set screw type not permitted.
2. RMC Fittings: Threaded type. Threadless fittings and split couplings are not permitted.

3. FMC Fittings: Malleable iron, zinc plated, insulated throat.
4. Fittings for PVC Coated Conduit: Minimum 40 mil thick PVC coating, with overlapping sleeves of one pipe diameter in length to protect threaded joints.
5. LFMC Fittings: Three-piece screw in type, malleable iron.
6. Expansion Fittings: Include flexible external bonding jumper.
7. FMT Bushings: Insulated.
8. Grounding and Bonding Hubs, Bushings, and Hardware:

    a. Grounding Hub: Meyers type.
    b. Locknuts: Cast steel or aluminum.
    c. Bushings: Insulated throat with lay-in type lugs.

E. Nonmetallic Fittings:

1. PVC Fittings: Comply with NEMA TC 3 and match conduit material.

F. Specialty Fittings:

1. Explosionproof Sealing Fitting: Crouse-Hinds EYS or equal.
2. Explosionproof Flexible Coupling: Crouse-Hinds ECGJH or equal.
3. Deflection/Expansion Fitting: OZ-Gedney Type DX or equal.
4. Expansion Coupling: Crouse-Hinds Type XJG with bonding jumper or equal.
5. Conduit Sealing Bushings: OZ-Gedney CSB Series or CSM Series, or equal, depending upon application.

2.8 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT.

A. Description: Cold galvanizing compound, 95 percent zinc rich paint.

B. Listing Criteria: UL CCN FOIZ; including UL Subject 2419.

2.9 SOLVENT CEMENTS

A. Description: Solvent cement to join Type PVC duct raceways and fittings.

B. Listing Criteria: UL CCN DWTT; including UL 514B.

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Refer to Attachment Table 260533.13-1 for conduit application requirements.

B. Minimum Raceway Size: 3/4-inch trade size.

3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following as applicable:

1. Relevant Article of NFPA 70.
2. NECA NEIS 101 – Standard for Installing Steel Conduits.
3. NECA NEIS 102 – Standard for Installing Aluminum Rigid Metal Conduit.
4. NECA NEIS 111 – Standard for Installing Nonmetallic Raceways.
5. NEMA FB 2.10 – Selection and Installation Guidelines for Fittings for Use with Non-Flexible Metallic Conduit or Tubing.
6. NEMA FB 2.20 – Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable.
7. NEMA FB 2.40 – Installation Guidelines for Expansion and Expansion/Deflection Fittings.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:

a. Complete duct raceway installation before starting conductor installation.
b. Underground Installations: Refer to additional requirements in Section 260543 “Underground Ducts and Raceways for Electrical Systems”.
c. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 feet above finished floor.
d. Coordinate stub-up locations with approved shop drawings for equipment to position stub-up directly below appropriate section of motor control center, switchboard, or switchgear.
e. Provide a 4 inch thick concrete housekeeping pad at slab and grade penetrations. Provide a 45 degree, 3/4 inch chamfer at exposed edges.
f. Install no more than equivalent of three 90-degree bends in conduit run. Support within 12 inches of changes in direction.
g. Maximum continuous conduit run: 300 feet. Reduce distance by 75 feet for each 90-degree elbow.
h. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
i. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
j. Support conduit within 12 inches of enclosures to which attached.
k. Drainage: Arrange conduit system to allow liquids such as water, condensation, etc. to drain away from equipment served. If conduit drainage is not possible, plug conduits using conduit seals.
l. Hazardous Areas: Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish

similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.

m. Moisture Control: Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways using "Duxseal" or seal fitting at the following points:

1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2) Where an underground service duct raceway enters a building or structure.
3) Conduit extending from interior to exterior of building.
4) Conduit extending into pressurized duct raceway and equipment.
5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
6) Where otherwise required by NFPA 70.

n. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.

o. Do not install conduits within 2 inches of the bottom side of a metal deck roof.

p. Keep duct raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.

q. Cut conduit perpendicular to the length. For conduits trade size 2 and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.

r. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than 200 lb. tensile strength. Leave at least 12 inches of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use. Use threaded cap.

s. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.

t. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to trade size 1-1/4 and insulated throat metal bushings on trade size 1-1/2 and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Install Meyers grounding type hubs when conduits terminate at NEMA 3R, 4, and 4X gasketed enclosures.

2. Do not install aluminum duct raceways or fittings in contact with concrete or earth.

3. Protect metallic finish conduit installed in contact with concrete or below grade with two coats of bitumastic paint, heat shrink tubing, or approved equivalent. Provide protection from 12 inches below bottom of concrete to not less than 6 inches above surface of concrete.

4. Rigid Metal Conduit (Type ERMC):

a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.

b. The use of running threads is prohibited. Where such threads are necessary, use a three piece union.

5. PVC Coated Rigid Metal Conduit (Type ERMC-A-PVC and ERMC-S-PVC):

   a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
   b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC-coated ERMC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on PVC-coated ERMC duct raceway.
   c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.

6. Flexible Conduit Connections (Types FMC, LFMC, and LFNC):

   a. Provide a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
   b. Include adequate slack to allow for thermal expansion and mechanical vibration.
   c. Orient outdoor flexible connections to provide drip loop to avoid accumulation of water at equipment connection points.

7. Non-Metallic Conduit (Type PVC):

   a. Do not install Type PVC conduit where ambient temperature exceeds 122 degrees F. Conductor ratings must be limited to 75 degrees C except where installed in a trench outside buildings with concrete encasement, where 90 degrees C conductors are permitted.
   b. Comply with manufacturer's published instructions for solvent welding and fittings.

8. Duct Raceways Embedded in Slabs:

   a. Comply with spacing requirements as noted on Structural Drawings.
   b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
   c. Arrange duct raceways to ensure that each is surrounded by minimum of 1 inch of concrete without voids.

9. Stub-ups at Slabs: Arrange stub-ups so curved portions of bends are not visible above finished slab.

10. Stub-ups to Above Recessed Ceilings:

    a. Provide EMT or ERMC for duct raceways.
    b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

11. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:

    a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. Install insulated throat metal grounding bushings on service conduits.

12. Duct Fittings: Use only fittings listed for use with each type of tubing or conduit and in accordance with specific fittings listed under PART 2.

    a. ERMC-A-PVC and ERMC-S-PVC: Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

13. Expansion-Joint Fittings: Install where necessary to compensate for thermal expansion and contraction and wherever conduits cross building or structure expansion joints.
14. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty.
15. Identification: Install identification tags at conduits in accordance with Section 260553 “Identification for Electrical Systems”.

D. Interfaces with Other Work:

1. Coordinate installation with other trades in advance of installation.
2. Restore walls, floor, and roof to original condition such as watertight, fire rating, smooth and/or painted finish after duct raceway penetration.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

3.4 Attachment Table 260533.13-1: Conduit Selection Guidelines

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Attachment A - Table 260533.13-1: Conduit Selection Guidelines

Table 260533.13-1 Conduit Selection Guidelines	
Raceway Type	Location / Application
ERMC-A	Indoor and outdoor applications, except where other types are listed. Exposed, non-corrosive areas. Concealed, non-corrosive areas. Under slabs in slab on grade construction / stub-ups. When installed underground or in contact with concrete, paint with two coats of bitumastic paint or use ERMC-A-PVC.
ERMC-A-PVC	Allowed for use in lieu of painting ERMC-A with two coats of bitumastic paint.
ERMC-S	Not used on this project.
ERMC-S-PVC	Not used on this project.
LFMC	Flexible connections used in conjunction with ERMC types.
LFNC-B	Flexible connections used in designated corrosive areas. Limited to 2-inch trade size.
PVC-40	Concrete encased duct banks. Embedded in concrete slabs or structures. Underground elbows are to be ERMC type.
PVC-80	Direct buried. Areas designated as corrosive. Protection of grounding electrode conductors. Protection of lightning conductors. Underground elbows are to be ERMC type.

END OF SECTION 260533.13

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SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Conduit bodies.
2. Metallic outlet boxes, device boxes, rings, and covers.
3. Nonmetallic outlet boxes, device boxes, rings, and covers.
4. Junction boxes and pull boxes.
5. Cover plates for device boxes.
6. Hoods for outlet boxes.

B. Products Installed, but Not Furnished, under This Section:

1. See Section 260553 "Identification for Electrical Systems" for electrical equipment labels.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 406733 “Panel Wiring” for additional analog and digital junction box requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product used on the project.

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PART 2 - PRODUCTS

2.1 PERFORMANCE CRITERIA

A. Regulatory Requirements: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

B. Listing Criteria as Applicable:

1. UL 514A – Metallic Outlet Boxes.
2. UL 514B – Conduit, Tubing, and Cable Fittings.
3. UL 514C – Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
4. UL 514D – Cover Plates for Flush-Mounted Wiring Devices.
5. UL BGUZ – Junction and Pull Boxes.
6. UL QCIT – Metallic Outlet Boxes.
7. UL QCMZ – Nonmetallic Outlet Boxes.

2.2 CONDUIT BODIES

A. Description: Means for providing access to interior of conduit or tubing system through one or more removable covers at junction or terminal point.

B. Listed and labeled for type of conduit, location, and use. Refer to Section 260533.13 “Conduits for Electrical Systems” for conduit types and fittings used on the project.

C. Use mogul type (with rollers) for metal conduit bodies sizes 2-1/2 inch and larger by Appleton Electric.

2.3 METALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes do not include provisions to mount devices. Device boxes include provisions to mount a device to the box.

B. Extension Ring Description: Ring intended to extend sides of outlet box or device box to increase box depth, volume, or both.

C. Pressed Steel Boxes: Hot dipped galvanized with hot-dipped galvanized tile rings. For use when recessed in walls or indoors exposed in non-process ceiling areas.

1. Lighting outlet boxes: 4-11/16 inch square, 2 1/8 inch deep, minimum.
2. Device boxes with electronics device (i.e., smart switch or receptacle, occupancy sensor, dimmer, etc.): Largest size for number of gangs required.

D. Cast Boxes: Type FD (deep) only. Type FS not permitted. malleable iron with zinc finish. PVC coated when used with PVC coated conduits. Gasketed cover when used outdoors. Stainless steel screws for covers.

E. Explosionproof Type Box for Class 1, Division 1 Areas: malleable iron with zinc finish. PVC coated when used with PVC coated conduits. Internal ground screw and O-ring. Pry notches on cover for bar or wrench.

F. Pedestal Device Boxes: Cast aluminum, polished finished. Used for laboratory bench receptacles.

G. Floor Boxes: Concrete tight. Number and type of devices as indicated on Drawings.

2.4 NONMETALLIC OUTLET BOXES, DEVICE BOXES, RINGS, AND COVERS

A. Outlet and Device Box Description: Box having pry out openings, knockouts, threaded entries, or hubs in either the sides of the back, or both, for entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting outlet box cover. Outlet boxes do not include provisions to mount devices. Device boxes include provisions to mount a device to the box.

B. Only allowed in conjunction with PVC schedule 80 exposed conduit installations.

C. Type FD (deep) box only. Type FS (shallow) box not allowed.

2.5 JUNCTION BOXES AND PULL BOXES

A. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

B. NEMA 1 and NEMA 12 Junction and Pull Boxes:

1. Material: Sheet steel, minimum 14 gauge, without knockouts.
2. Construction: Flanged box, galvanized with continuous weld seams that are ground smooth.
3. Cover: Gasketed, hinged, fastened with quick connect door clamp.

C. NEMA 4X Junction and Pull Boxes:

1. Material: Type 316 stainless steel, minimum 14 gauge, without knockouts.
2. Construction: Flanged box, continuous weld seams that are ground smooth.
3. Cover: Gasketed, hinged, fastened with quick connect door clamp.

D. NEMA 4X Chemical Area Junction and Pull Boxes: When Drawings classify the area as CORROSIVE, ultraviolet resistant fiberglass reinforced plastic (FRP) with stainless steel hardware and gasketed covers.

E. NEMA 6/6P Junction and Pull Boxes: When Drawings call out for NEMA 6 (temporary submersion at limited depth) or NEMA 6P (prolonged submersion at limited depth), die cast aluminum or nonmetallic, coordinated with conduit material.

F. NEMA 7/4 Junction and Pull Boxes: When Drawings classify the area for Class 1, Division 1, Group D hazardous area, cast aluminum , cover gasket to meet NEMA 4 requirements, stainless steel hinged cover, stainless steel bolts. Crouse-Hinds Type EJB or equal.

G. Analog and Digital Junction Boxes:

1. See Section 406733 “Panel Wiring” for internal construction and termination requirements.

2.6 COVER PLATES FOR DEVICES BOXES

A. Single Source: Obtain wall plates from same manufacturer of wiring device. Refer to Section 262726 “Wiring Devices” for requirements.

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Flush Mounted Devices in Indoor Administrative Spaces: Includes offices, conference rooms, break rooms, restrooms, and control rooms. Smooth, high impact thermoplastic or nylon. Color to match wiring device.
3. Material for Flush Mounted Devices in Indoor Industrial Spaces: Includes electrical rooms, mechanical rooms, janitor closets, and indoor process areas. Type 302 (18-8) high nickel stainless steel.
4. Material for Surface Mounted Devices: Match box material.

2.7 HOODS FOR OUTLET BOXES

A. Description: Hood to mount to box for to create weatherproof while in use condition.

B. Wet-Location, Weatherproof Cover Plates (Hoods) for Switches and Receptacles: NEMA 250, complying with Type 3R, in-use weather-resistance, die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Engineer for resolution of conflicting requirements.

1. NEMA 1 is general indoor dry locations.
2. NEMA 12 (gasketed) is DUST locations.
3. NEMA 4X stainless steel is damp, wet, or process locations.
4. NEMA 4X nonmetallic is CORROSIVE locations.
5. NEMA 7 is C1D1 hazardous areas.

B. Conduit bodies: Match associated conduit type.

C. Outlet boxes recessed in walls or indoors exposed in non-process ceiling areas: Pressed steel.

D. Exposed outlet and device boxes: Cast metal except where PVC-80 is used. Use PVC coated cast metal when conduit is PVC coated. Use non-metallic when PVC-80 is used.

E. Junction and pull boxes: Suitable for the location and conform to the NEMA enclosure ratings and material descriptions included on Drawings. Where no size is indicated, size in accordance with NEC Article 314.

3.2 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

A. Comply with manufacturer's published instructions.

B. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:

    a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
    b. Provide gaskets for wall plates and covers.

14. Identification: Install labels and nameplates in accordance with Section 260553 “Identification for Electrical Systems.”
15. Terminate/splice using UL materials listed for submersion. Install adhesive heat shrink over each individual conductor splice and an overall waterproof covering over the entire spliced cable to prevent wicking. Analog and Digital Junction Boxes shall have no splices, utilize terminal blocks to land instrumentation signals that are mounted to DIN rails on a backplate, in accordance with Section 406733 “Panel Wiring.”

3.3 CLEANING

A. Remove construction dust and debris from boxes before installing wall plates, covers, and hoods.

3.4 PROTECTION

A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Manholes, handholes, and duct accessories.

B. Products Installed, but Not Furnished, under This Section:

1. Section 260533.13 “Conduits for Electrical Systems” for conduits.
2. Section 260553 "Identification for Electrical Systems" for underground-line warning tape.

C. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Division 03 for concrete and reinforcing steel.
4. Division 31 for groundwater control, trenching, excavation and backfilling including gravel and sand bedding, and surface restoration.
5. Division 33 for additional requirements associated with manholes and utilities.

1.3 DEFINITIONS

A. Duct: A single raceway or multiple raceways, installed singly or as components of a duct bank.

B. Duct Bank: Two or more ducts installed in parallel, direct buried or with additional casing materials such as concrete.

C. Handhole: An underground chamber containing electrical cables, sized such that personnel are not required to enter in order to access the cables.

D. Manhole: An underground chamber containing electrical cables and equipment, sized to provide access with working space clearances.

E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include accessories for manholes and handholes.
3. Include underground-line warning tape.

B. Shop Drawings:

1. Handholes or Manholes:

a. Include plans, elevations, sections, details, and accessories.
b. Include duct entry provisions showing locations and duct sizes.
c. Include frame, cover, entry extensions if applicable, and grounding details.
d. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.

2. Underground Conduit Layouts: In accordance with Section 260533.13 “Conduits for Electrical Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Buoyancy calculations for manholes. Calculations must be signed and sealed by a qualified professional engineer.

B. Field quality control reports.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS

A. Comply with Section 260533.13 “Conduits for Electrical Systems” for conduits and fittings.

2.2 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape: In accordance with Section 260553 "Identification for Electrical Systems."

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover must form top of enclosure and must have load rating consistent with that of handhole or box.

1. Load Rating: Class H-20.
2. Cover Legend: “ELECTRIC”, unless otherwise indicated.
3. Comply with details shown on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Oldcastle Infrastructure.

C. Comply with ASTM C858 “Standard Specification for Underground Precast Concrete Utility Structures” for design and manufacturing process.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.4 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

A. Description: Molded of sand, concrete, and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or combination.

1. Load Rating: Class H-20.
2. Cover Legend: “ELECTRIC”, unless otherwise indicated.
3. Comply with details shown on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Oldcastle Polymer; Oldcastle Infrastructure.
2. Quazite; Hubbell Power Systems.

C. Standard: Comply with ANSI / SCTE 77 “Specification for Underground Enclosure Integrity”.

D. Color: Gray.

E. Configuration: Flush burial and open bottom unless otherwise indicated.

2.5 PRECAST MANHOLES

A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.

1. Load Rating: Class H-20.
2. Cover Legend: “ELECTRIC”, unless otherwise indicated.
3. Comply with details shown on Drawings.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Oldcastle Infrastructure Inc.

C. Comply with ASTM C858 for design and manufacturing process.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in field. Notify Engineer if there is conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Engineer.

C. Clear and grub vegetation to be removed, and protect vegetation to remain. Remove and stockpile topsoil for reapplication.

3.2 SELECTION OF UNDERGROUND DUCTS

A. Direct Buried Duct: Type PVC-80 rigid non-metallic conduit, with RMC long radius sweep elbows.

B. Concrete Encased Duct: Type PVC-40 rigid non-metallic conduit, with RMC long radius sweep elbows.

C. Rigid Metal Conduit (RMC) type in accordance with Section 260533.13 “Conduits for Electrical Systems” with two coats of bitumastic paint or PVC coated where:

1. Direct buried conduit enters buildings, structures, and vaults (except manholes and handholes) with not less than a 10-foot length of conduit.
2. Direct buried conduits run below floor slabs in slab-on-grade construction.
3. Stub-ups outdoors or through concrete slabs.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with Section 312000 "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restoration: Restore area immediately after backfilling is completed or after construction vehicle traffic in immediate area is complete.

C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses."

E. Cut and patch existing pavement in path of underground duct, duct bank, and underground structures.

3.4 INSTALLATION OF DUCTS AND DUCT BANKS

A. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NEMA TCB 2 for installation of underground ducts and duct banks.
2. Consult Engineer for resolution of conflicting requirements.

B. General Requirements:

1. Comply with installation requirements for conduits in Section 260533.13 “Conduits for Electrical Systems” and as supplemented herein.
2. Ductbank routing and manhole / handhole locations indicated on Drawings are diagrammatically depicted. Coordinate with other utilities, yard piping, yard structures and field conditions to determine required paths and depths at no additional cost to Owner.
3. Where conditions do not allow neat and consistent duct bank cross sections in accordance with Drawings due to existing underground conflicts, provide Engineer with proposed solution for approval that complies with minimum NEC installation cover requirements. For example, where the Drawings indicate direct buried PVC conduits are to be installed at a certain depth below finished grade, a concrete cap or concrete encasement may be permitted to achieve an equivalent protection. Do not deviate from Drawing details without Engineer approval.
4. Reinforce ductbanks as indicated on Drawings. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Separate underground copper signal conduits (instrumentation and telecommunication) from power conduits by a minimum of 12 inches unless noted otherwise. Keep crossing of these conduits to a minimum; cross at 90 degree angles.
6. Plug conduit ends during and after installation to prevent water, mud, and debris from entering conduit.

7. After duct installation is complete and before any cables are pulled, remove obstructions using appropriately sized mandrel for conduits 2 inch and larger. Swab clean interior of all sized conduits. Refer to CLEANING Article.

C. Special Techniques:

1. Where indicated on Drawings, install duct, spacers, and accessories into duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
2. Slope: Pitch duct minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from high point between two manholes to drain in both directions.
3. Curves and Bends: Use long radius elbows, sweeps, and offsets for 2 inch and larger conduits.
4. Joints: Use solvent-cemented joints in nonmetallic duct and fittings and make watertight in accordance with manufacturer's published instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
5. Terminations at Manholes: Use end bells for PVC conduit and insulated throat grounding bushings with lay-in type lugs for RMC.
6. Building Wall Penetrations: Make transition from underground duct to RMC at least 10 feet outside building wall, without reducing duct line slope away from building and without forming trap in line. Use fittings manufactured for transition to RMC type installed. Install RMC penetrations of building.
7. Underground-Line Warning Tape: Bury underground line specified in Section 260553 "Identification for Electrical Systems" above concrete-encased duct and direct buried duct banks as shown on detail Drawings. Align tape parallel to and within 3 inches of centerline of duct bank. Provide additional warning tape for each 12 inch increment of duct-bank width over nominal 18 inches. Space additional tapes 12 inches apart, horizontally across width of ducts.
8. Ground ducts and duct banks in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

D. Concrete-Encased Ducts and Duct Bank Special Techniques:

1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Earthwork" for pipes 6 inches or less in nominal diameter.
2. Depth: Install so top of duct envelope is as shown on detail Drawing.
3. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at other, allowing for expansion and contraction of duct as its temperature changes during and after pour. Use expansion fittings installed in accordance with manufacturer's published instructions, or use other specific measures to prevent expansion-contraction damage.
b. If more than one pour is necessary, terminate each pour in vertical plane and install 3/4 inch reinforcing-rod dowels extending minimum of 18 inches into concrete on both sides of joint near corners of envelope.

7. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033010 "Miscellaneous Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.
8. Concrete Color: Red. Dye color added to concrete during batching; or dye mixed with water and applied to top of ductbank with a sprayer while concrete is wet (prior to curing); or raked into the exposed top layer of concrete.

E. Direct-Buried Duct and Duct Bank Special Techniques:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Earthwork" for preparation of trench bottoms for pipes less than 6 inch in nominal diameter.
2. Depth: Install top of duct as shown on detail Drawing.
3. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
4. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during backfill. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
5. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earthwork" for installation of backfill materials.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Reference Standards:

1. Precast Concrete Handholes: Comply with ASTM C891 unless otherwise indicated.
2. Consult Engineer for resolution of conflicting requirements.

B. Special Techniques:

1. Precast Concrete Handholes and Manholes:

   a. Install units level and plumb and with orientation and depth coordinated with connecting duct to minimize bends and deflections required for proper entrances.
   b. Unless otherwise indicated, support units on level bed of crushed stone or gravel graded from 1 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
   c. Field-cut openings for conduits in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

2. Elevations:

   a. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
   b. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
   c. Install handholes with bottom below frost line, 36 inches below grade.
   d. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
   e. Where indicated, cast handhole cover frame integrally with handhole structure.

3. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
4. Manhole Access: Circular opening in manhole roof; sized to match cover size.

   a. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
   b. Install chimney, constructed of cast-iron collars and rings, and cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight joints and waterproof grouting for frame and chimney.
5. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
6. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
7. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in field. Use minimum of two anchors for each cable stanchion.
8. Ground manholes, handholes, and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Special Techniques:

1. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.

Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.

2. Unless otherwise indicated, support units on level bed of crushed stone or gravel, graded from 1/2 inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
3. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
4. Install handholes and boxes with bottom below frost line, 36 inches below grade.
5. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
6. Field cut openings for duct in accordance with enclosure manufacturer's published instructions. Cut wall of enclosure with tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
7. Ground handholes and boxes in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Nonconforming Work:

1. Underground ducts, raceways, and structures will be considered defective if they do not pass tests and inspections.
2. Correct deficiencies and retest as specified above to demonstrate compliance.

C. Field Quality-Control Reports: Collect, assemble, and submit test and inspection reports.

3.8 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump, and building interiors affected by Work.

1. Sweep floor, removing dirt and debris.
2. Remove foreign material.

END OF SECTION 260543

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Identification products along with color and legend requirements.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
3. Section 260573 “Power System Studies” for arc flash study labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Note that not all products listed may be utilized on this project.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following where applicable:

1. Fire-protection and fire-alarm equipment must be finished, painted, or suitably marked safety red.

2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 feet above finished floor.

C. Signs, labels, and tags required for personnel safety must comply with the following standards:

1. Safety Colors: NEMA Z535.1.
2. Facility Safety Signs: NEMA Z535.2.
3. Safety Symbols: NEMA Z535.3.
4. Product Safety Signs and Labels: NEMA Z535.4.
5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.

D. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 degrees F, ambient; 180 degrees F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed for conductors.

1. Color must be factory applied or field applied for sizes larger than 8 AWG.
2. Colors for 208Y/120 V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue.
d. Neutral: White.

3. Colors for 480Y/277 V Circuits:

a. Phase A: Brown.
b. Phase B: Orange.
c. Phase C: Yellow.
d. Neutral: Gray.

4. Colors for DC Circuits:

a. Positive: Red.
b. Negative: Black.

5. Color for Equipment Grounding Conductors: Green.

B. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

C. Warning labels and nameplates/signs must include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

D. Equipment Identification and Source Nameplate:

1. Color: Black letters on a white field.
2. Material: See NAMEPLATES Article.
3. Equipment furnished under Divisions 26 and 28 and equipment control panels furnished under other Divisions must include equipment identification nameplates. Equipment includes, but is not limited to switchgear, switchboards, motor control centers, panelboards, transformers, disconnect switches, separately mounted motor controllers, transfer switches, control panels, and named enclosures or cabinets. Nameplate to match designation indicated on Drawings.
4. Power source must be identified at all applicable equipment. Nameplate may be separate from identification nameplate or information may be contained on one nameplate. For example, a local disconnect switch for a pump motor could have one nameplate reading “EFFLUENT PUMP NO. 4” for the identification nameplate and a second nameplate reading “FED FROM MCC-2”. Or a two-line nameplate combining the information for both identification and source.

E. Device Identification Labels:

1. Color: Black letters on a white field..
2. Material: Self-adhesive type, machine generated, 1/4 inch high letters.
3. Devices to be labeled with panel and branch circuit number include receptacles, wall switches, lighting fixtures, photocells, emergency lights, exit lights, instruments, etc. For example, a light switch powered from panelboard LP-2 and branch circuit 4 would have the label “LP-2/4” or “LP-2/CKT 4”.

2.3 NAMEPLATES

A. Material:

1. Engraved, engraved plastic (lamicoid).
2. Minimum size: Not less than 1/16 inch thick by 3/4 inch high by 2-1/2 inches wide.
3. Lettering: Upper case, 3/16 inch high minimum.

2.4 LABELS, BANDS, TUBES, AND SLEEVES

A. Self-Adhesive Wraparound Labels: Machine-printed, 3 mil thick, polyester or vinyl flexible label with acrylic pressure-sensitive adhesive. Printed text is black, permanent, and waterproof.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.

B. Self-Adhesive Labels: Polyester or Vinyl, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

C. Heat-Shrink Preprinted Tubes (Sleeve Type): Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 degrees F. Comply with UL 224. Printed text is black, permanent, and waterproof.

2.5 TAPES

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
b. Printing on tape must be permanent and may not be damaged by burial operations.
c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".

3. Detectable Tape:

a. Detectable three-layer laminate, consisting of printed pigmented polyolefin film, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
b. Width: 6 inches.
c. Overall Thickness: 5 mil.
d. Foil Core Thickness: 0.35 mil.

2.6 TAGS

A. Metal Tags: Embossed, Type 316 stainless steel, 0.01 inch thick, punched for use with tie fastener. Secure with 0.048 inch diameter stainless steel band fastened with compression wire clamps

B. Nonmetallic Preprinted Tags: Polyester or Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory screened permanent designations; punched for use with self-locking cable tie fastener.

2.7 CABLE TIES

A. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 degrees F in accordance with ASTM D638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 degrees F.
4. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Nameplates/Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 SELECTION OF IDENTIFICATION PRODUCTS

A. Power-Circuit Conductor Identification, 1000 V or Less: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl tape if conductor is not factory colored to identify phase, neutral, and ground conductors. Use self-adhesive labels to identify circuit.

B. Power-Circuit Conductor Identification, More Than 1000 V: For conductors at termination points and in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive vinyl

tape to identify phase conductors. Use nameplate or nonmetallic tag secured with cable ties to indicate phase and indicate circuit designation.

C. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with conductor or cable designation, origin, and destination.

D. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with conductor designation.

E. Spare Conductors or Cables: Attach nonmetallic tags or self-adhesive labels to conductors and list source.

F. SCADA Systems, Communication Systems, Fire Alarm Systems or Other Auxiliary Electrical Systems Conductor Identification: For identification at terminations, provide heat-shrink preprinted tubes or self-adhesive labels with conductor designation.

G. Conduit Identification: For designated identification as indicated on Drawings provide self-adhesive labels.

H. Pull Boxes and Junction Boxes, 24 inches by 24 inches and Larger: For voltage identification provide self-adhesive warning labels.

I. Equipment Identification: For identification and source information provide nameplate(s) per COLOR AND LEGEND REQUIREMENTS Article.

J. Device Identification: For source and circuit information provide self-adhesive label per COLOR AND LEGEND REQUIREMENTS Article.

3.3 INSTALLATION

A. Install identification product in accordance with manufacturer’s instructions.

B. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Verify identity of item before installing identification products.

E. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Apply wire markers so entire designation is clearly visible.

H. Install Arc Flash Labels in accordance with Section 260573 “Power System Studies”.

I. Identify the system voltage (e.g. 208/120 VOLTS, 480 VOLTS, 4160 VOLTS) at the covers of large pull boxes or junction boxes.

J. Install field device (instruments, receptacles, switches, etc.) labels.

K. Install equipment nameplates. Nameplate fastening requirements:

1. NEMA 1 and 12 Enclosures: Screw mounted using stainless steel screws.
2. Other Enclosure Types: Bonded using epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable.

L. Panelboard and Transformer Panel Assembly Identification:

1. Provide equipment identification nameplates as previously described.
2. Label branch circuit phase and neutral wires with associated pole number using self-adhesive labels or type written sleeve type labels.
3. Install typed as built circuit directory listing with unique load identification.

M. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 18 inch overall.
2. Install underground-line warning tape for direct-buried cables and cables in raceways.

N. Install Tags. Fastening Requirements:

1. Secure metal tags using stainless steel ties.
2. Secure nonmetallic tags with UV-stabilized cable ties.

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SECTION 260573 - POWER SYSTEM STUDIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 SUMMARY

A. Section includes a computer-based study for:

1. Short circuit report.
2. Protective device coordination report.
3. Motor starting report.
4. Arc flash report.
5. Harmonic analysis report**.**

B. Study encompasses the power distribution system of the Client and Facility.

C. Study includes the electric utility company’s protective devices, emergency generators, service entrance equipment and distribution to lighting panelboards, pumps, and motors. All power distribution to that point whether existing or new is included. Equipment included, but not limited to:

1. Substations and distribution.
2. Switchgear, switchboards, and panelboards.
3. Motor control centers.
4. Variable frequency controllers.
5. Disconnect switches.
6. Transfer switches.
7. Control panels.
8. PLC’s.

D. The local electric utility is Eversource, contact Brian Mello (508) 441-5832 brian.mello@eversource.com.

E. Obtain all data necessary to perform the study. Data included, but not limited to:

1. Up to date one-line diagrams.
2. Equipment data.
3. Cable sizes and lengths.
4. Existing protective device settings.
5. Electric utility information: available fault current, protective device equipment information and settings, X/R ratios, transformer impedances and ratings.

1.3 DEFINITIONS

A. Boundary, Arc Flash: When an arc flash hazard exists, an approach limit from an arc source at which the incident energy equals 1.2 cal/cm² (5 J/cm²).

B. Boundary, Limited Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

C. Boundary, Restricted Approach: An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.

E. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

F. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

G. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

H. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

I. Preliminary Short Circuit Report: Report that includes the maximum available utility fault current, proposed equipment, and existing equipment to determine if new equipment may be released for manufacturing and existing equipment is adequate for the calculated short circuit levels.

J. Protective Device: A device that senses when an abnormal condition or current flow exists and then removes the affected portion of the circuit from the system.

K. SCCR: Short-circuit current rating.

L. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

M. Single-Line Diagram: See "One-Line Diagram."

N. Supplier: The person, firm or corporation identified as such to provide the power system study and means the Supplier or its authorized agent. See also Power Systems Analysis Specialist.

O. VFD: Variable frequency drive. Interchangeable with variable frequency controller.

1.4 ACTION SUBMITTALS

A. Supplier qualifications per Quality Assurance paragraph. Submit prior to starting study. Include the following:

1. Brief description of each qualifying study.
2. Name of owner of installation on which study was performed with address, telephone number, and contact person.
3. Date of study.
4. Any other information indicating the firm's experiences and ability to perform the work and business status.

B. Preliminary Power System Study Report. Report must be approved prior to release for manufacture of major electrical equipment including but not limited to switchgear, switchboards, distribution panels, and motor control centers. Fault data from the utility must be included and not assumed or submittal will be rejected.

C. Final Power System Study Report. Report must be approved prior to energization of new major electrical equipment. Revise study as required for changes during construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. If requested, Product Certificates: For power system study software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Final power system study updated with any changes made after equipment start-up.

B. Digital computer files with full read-write access of the complete power system model and library.

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1.7 QUALITY ASSURANCE

A. Perform Study using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications:

1. Design computer program to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
2. Develop computer program under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
3. Complies with IEEE 399, IEEE 141, IEEE 242, IEEE 519, IEEE 1015, and IEEE 1584 as applicable to the project scope.

E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located and has regularly engaged in this electrical engineering study specialty for minimum of five years and has performed at least three projects of similar complexity to this project within the last three years. Perform all elements of the study under the direct supervision and control of this professional engineer.

F. Power System Study Certification: Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
2. A member company of NETA.
3. Acceptable to authorities having jurisdiction.

1.8 POWER SYSTEM STUDY MEETINGS

A. Supplier's professional engineer responsible for the study to attend a meeting with the Engineer and Owner at the Owner's facility up to and including three times.

B. Purpose of the three meetings are:

1. Initial meeting discusses the study's scope and the Owner's operational and maintenance requirements prior to the preliminary study submittal.
2. Second meeting discusses the preliminary study and its recommendations. Based on this meeting, the Owner may request modifications to the studies' recommended protective settings to reduce the arc flash hazard or meet other operational objectives.
3. Third and final meeting presents the final study and its recommendations.

C. Provide a minimum of three-week notice to the Owner and Engineer in advance of all projected meeting dates.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

A. Acceptable Software:

1. SKM System Analysis, Inc.: Power*Tools.
2. Operation Technology, Inc.: ETAP (Electrical Transient Analyzer Program).
3. EasyPower, Inc.: EasyPower.
4. Or equal.

2.2 POWER SYSTEM STUDY REPORT GENERAL REQUIREMENTS

A. Except for one-line diagrams, standard 8 1/2-inch by 11-inch pages, with total pages numbered.

B. Electronic PDF format copy with electronic bookmarks for each section.

C. Signed and sealed by a professional engineer registered in the state in which the project is located.

D. Organized in the following order:

1. Executive Summary.
2. Short Circuit Analysis.
3. Short Circuit Computer Printout.
4. Protective Device Coordination.
5. Motor Starting.
6. Arc Flash Hazard Analysis.
7. Harmonic Analysis.
8. Utility Data.
9. Modeled One Line Diagrams.

E. Information on one-line diagrams, legible when printed at 11-inch x 17-inch. Show the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA), impedance, and voltage ratings.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
6. Derating factors and environmental conditions.
7. Any revisions to electrical equipment required by the study.

F. Identifiers between the one-line diagram, short circuit study, coordination study, and arc flash study to be the same.

G. Include copies of correspondence with electric utility under utility data section of report. Correspondence to include names and contact information.

2.3 EXECUTIVE SUMMARY

A. Include summary of distribution system, information received from electric utility, major assumptions, adequacy of equipment to safely clear or close on any fault, identify problem areas and recommendations for resolving problem areas.

2.4 SHORT CIRCUIT

A. Comply with IEEE 399 and IEEE 551 (new 3002 series).

B. Include normal utility powered configuration, on-site generation configuration, and alternate modes of operation (i.e. alternate utility configuration, bus ties closed).

C. Include minimum and maximum possible fault conditions. Address three-phase bolted as well as ground fault conditions.

D. Consider the fault contribution of all motors operating during the maximum demand condition of the motors.

E. Calculate short-circuit momentary duties and interrupting duties based on an assumed bolted three-phase short circuit at each high and medium voltage switchgear bus and controller, low voltage switchgear bus, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard and other significant locations throughout the systems. Include the X/R ratios, asymmetry factors, KVA and symmetrical fault-current in the short circuit tabulations. Provide a ground fault current study for the same system areas. Include in tabulations fault impedance, X/R ratios, asymmetry factors, motor contribution, short circuit KVA, and symmetrical and asymmetrical fault-currents.

F. Include representation of the site power system, the base quantities selected, impedance source data, calculation methods and tabulations, one-line diagrams, conclusions and recommendations.

G. Identify available fault current at each bus and evaluate system elements including but not limited to equipment, protective devices, and cables.

H. Base current transformers' ratio and burden calculations on a 10 percent maximum ratio error per IEEE C57.13. Identify current transformers that will not allow the protective devices to operate within acceptable IEEE error margins and recommend corrective action.

I. List momentary, interrupting, and/or withstand rating of all key elements of the distribution system along with the maximum available fault current in tabular form and clearly indicate the adequacy of the element with PASS / FAIL designation.

J. Short Circuit Computer Printout:

1. Calculations shall be in sufficient detail for easy review.
2. Back up calculations shall become part of the final report.

2.5 PROTECTIVE DEVICE COORDINATION

A. Comply with IEEE 242 (new 3004 series).

B. Utilize results from the short circuit study and balance the competing objectives of protection and continuity of service for the system specified, considering the basic factors of sensitivity, selectivity and speed. Include all system protective devices in the coordination analysis, not just overcurrent protective devices. This includes, but is not limited to under and over voltage protective relays, frequency relays, differential relays and reverse power relays.

C. Show graphic indication of coordination between protective devices in the form of full color time-current coordination (TCC) plots with each protective device curve in a unique color for easy review.

D. Provide separate TCC plots for each mode of operation. Provide separate TCC plots for "normal" and "stand by" operation. Show maximum fault values in each case. Both power sources shown on one plot is unacceptable.

E. Provide separate TCC for phase over-current and ground fault.

F. Show no more than six devices on one TCC. Of these six curves, two (the largest upstream device and the smallest downstream device) shall repeat curves shown on other coordination plots to provide cross-reference. Designate each TCC with a unique identifier and include each TCC identifier and descriptive title in the study's table of contents.

G. Include in each TCC the following as applicable:

1. TCC name and description.
2. One-line diagram.
3. Identifiers on one-line diagram and curves.
4. Significant motor starting characteristics.
5. Appropriate NEC protection points.
6. Appropriate ANSI/IEEE protection points.
7. Magnetizing inrush points of transformers.
8. Transformer damage curves.
9. Complete operating bands for low voltage circuit breaker trip devices and fuses.
10. Relay coil taps, time-dial settings and pickup settings.
11. Significant symmetrical and asymmetrical fault currents.
12. Power cable withstand curves.
13. Generator short circuit decrement and thermal limit curves.

H. Terminate device characteristic curve on TCC at a point reflecting the maximum symmetrical or asymmetrical fault current to which that device is exposed, based on the short circuit study.

I. Select each primary protective device for a delta-to-wye-connected transformer so the characteristic or operating band is within the transformer parameters; where feasible, include a parameter equivalent to 58 percent of the ANSI C37.91 withstand curve to afford protection for secondary line-to-ground faults.

J. Separate low voltage power circuit breakers from each other and the associated primary protective device, by a 16 percent current margin for coordination and protection in the event of line-to-line faults.

K. Separate protective relays by a 0.3-second time margin for the maximum 3 phase fault conditions to assure proper selectivity.

L. Optimize settings for breakers and relays to provide the most effective protection practicable for all modes and power sources.

M. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center and/or power distribution panelboard. Include all adjustable setting ground fault protective devices.

N. Provide tabulations of recommended settings for all protective devices. Where devices are existing, highlight any changes from the existing setting to the proposed recommended setting.

O. Provide all information required to program/set multifunction solid state relays.

2.6 MOTOR STARTING

A. Comply with IEEE 141 (new IEEE 3001 series) for recommended light flicker limits and IEEE 3002.7 for motor starting studies.

B. Provide motor starting study for all large electric drives (100 horsepower and larger). Include all operating modes.

C. Identify any concerns about voltage drop or power inrush limitations due to the starting of motors.

2.7 ARC FLASH HAZARD

A. Comply with IEEE 1584, NFPA 70, and NFPA 70E as applicable.

B. Utilize short circuit and protective device coordination results to provide arc flash hazard analysis. Perform calculations in accordance with IEEE 1584 or NFPA 70E with the method identified within the report.

C. Calculate the incident energy levels at each faulted bus for each mode of operation and for both maximum and minimum fault currents.

D. Include calculations at line side and load side of main breakers, where applicable.

E. Provide tabular report for all modes and conditions and include “worst case” summary. Use the “worst case” to generate the arc flash labels. Include:

1. Fault location.
2. Arcing fault magnitude.
3. Protective device clearing time.
4. Duration of the arc.

5. Arc flash boundary.
6. Working distance.
7. Incident energy.
8. Electrode configuration.

F. Highlight any available incident energy over 40 cal/cm² and provide recommendations to mitigate the hazard.

G. Arc Flash Labels:

1. Machine printed, 4-inches x 4-inches (nominal), thermal transfer, high adhesion polyester.
2. Provide UV resistant laminate for outdoor labels.

H. Arc Flash Label Information:

1. Equipment name.
2. Identifier LINE or LOAD where equipment has potential different energy levels.
3. Arc flash hazard information: arc flash boundary and incident energy in cal/cm².
4. Shock hazard information: limited approach and restricted approach boundaries.
5. Personal Protective Equipment (PPE) requirements.
6. Study Supplier, project number, and date.

I. Provide arc flash label sample with preliminary report.

J. Do not be print the labels until equipment is energized and protective devices set according to the approved final protective device coordination study.

2.8 HARMONIC ANALYSIS

A. Comply with IEEE 519 and IEEE 3002.8.

B. Provide a harmonic analysis for all major harmonic producing equipment to determine the harmonic currents and voltages of the electrical distribution system. Include utility and alternate power sources, if applicable. Major harmonic producing equipment includes: Variable Frequency Controllers (Variable Frequency Drives), Uninterruptible Power Supplies (UPS).

C. Provide a harmonic current and voltage profile for the complete electrical distribution system. At a minimum, the voltage profile shall include voltage values at the utility service point, and at each switchgear/switchboard and motor control center bus.

D. Provide calculations for all operating modes and the following conditions:

1. One profile for all duty equipment running with variable frequency controllers at full speed.
2. One profile for all duty equipment running with variable frequency controllers at 60% speed.

E. Include in the analysis:

1. Explanation of analysis method.
2. Explanation of analysis and recommendations to meet the specified limits.
3. Calculations and/or computer printouts.
4. Harmonic current and voltage profiles up to the fiftieth harmonic.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the study.

1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Engineer's attention.
2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
3. For equipment that is existing to remain, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.

B. Gather and tabulate the required input data to support the power system study.

C. Field data gathering for existing systems shall be under direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

D. Data included, but are not limited to, the following:

1. Product data for overcurrent protective devices and existing settings.
2. Electrical power utility information. Information required may include:

    a. Available minimum and maximum three-phase fault current and X/R ratio.
    b. Available minimum and maximum single-line-to-ground fault current and X/R ratio.
    c. Service transformer voltage, kVA, and impedance ratings, winding configuration, and grounding method.
    d. Upstream protective device data.

3. Power sources and ties.
4. For switchgear, switchboards, panelboards, and motor control centers, ampacity and SCCR in amperes RMS symmetrical.
5. For transformers, kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
6. For reactors, manufacturer and model designation, voltage rating, and impedance.
7. For circuit breakers, trip units, and fuses, manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.

8. For generators, short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For busways, manufacturer and model designation, current rating, impedance, lengths, and conductor material.
10. For motors, horsepower and NEMA MG 1 code letter designation.
11. Conductor sizes, lengths, number, conductor material, shield parameters for medium voltage cable, and conduit material (magnetic or nonmagnetic).
12. For relays, manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
13. For transfer switches, withstand and closing ratings (WCR) with time duration.
14. Derating factors.

3.2 FIELD QUALITY CONTROL

A. Do all testing and adjustment prior to the energization of new equipment.

B. Test existing adjustable protective devices in accordance with NETA MTS.

C. Test new adjustable protective devices in accordance with NETA ATS.

D. Adjust existing and new protective devices according to approved coordination study.

E. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.

F. After successful testing and adjustment, install calibration sticker with Field Adjusting Agency name, employee initials, and date of calibration at each relay or protective device.

G. After energization, minor adjustments to settings may be required to commission the equipment.

H. Submit field report and list any changes made during field adjustment or commissioning for update for record submittal of study.

3.3 ARC FLASH LABELING

A. After the field adjustment of relays and protective devices, apply arc flash study labels.

B. Apply arc flash labels on the front covers of the following equipment:

1. Substations and distribution transformers.
2. Medium voltage switches.
3. Switchgear, switchboards, and panelboards.
4. Motor control centers.
5. Variable frequency controllers.
6. Disconnect switches.
7. Transfer switches.
8. Control panels.
9. PLC’s.

C. Apply arc-flash labels at each section for large equipment such as switchgear and motor control centers.

D. Install LINE and LOAD arc-flash labels as applicable.

E. Remove any previous arc flash study labels as applicable and install new labels under the direction of the Power System Analysis Specialist.

END OF SECTION 260573

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Two-winding transformers.
2. Shielded transformers.
3. Autotransformers.
4. Buck-and-boost transformers.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-In-Place Concrete”: Housekeeping pads.
2. Section 260526 “Grounding and Bonding for Electrical Systems”.
3. Section 260529 “Hangers and Supports for Electrical Systems”.
4. Section 260533.13 “Conduits for Electrical Systems”.
5. Section 260553 “Identification for Electrical Systems”.

1.3 ACTION SUBMITTALS

A. Refer to Section 013300 “Submittal Procedures” for submittal procedures.

B. Product Data: Submit outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, NEMA rating of the enclosure, compliance with the latest energy efficiency standard certification, tap configurations, insulation system type, and rated temperature rise.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

B. Source Quality Control Submittals: Indicate results of factory tests and inspections.

C. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 017700 “Closeout Procedures” for closeout procedures.

B. Record Documentation: Record actual locations of transformers.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. Eaton
2. ABB
3. Square D

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers**,** ratings as indicated on Drawings.

C. Operation:

1. Primary Voltage: as indicated on Drawings.
2. Secondary Voltage: as indicated on Drawings.
3. Insulation system and average winding temperature rise for rated kVA as follows:
4. 1-15 kVA: Class 180 with 115 degrees C rise.
5. 16-500 kVA: Class 220 with 150 degrees C rise.
6. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
7. Winding Taps:

    a. Transformers Less than 15 kVA: Two 2.5 percent below and two 2.5 percent above rated voltage, full capacity taps on primary winding.
    b. Transformers 15 kVA and Larger: Four 2.5 percent below and two 2.5 percent above rated voltage, full capacity taps on primary winding.

8. Sound Levels: NEMA ST 20.
9. Mounting:

    a. 1-15 kVA: Suitable for wall mounting or as shown on drawings.
    b. 16-75 kVA: Suitable for wall, or trapeze mounting.
    c. Larger than 75 kVA: Suitable for floor or trapeze mounting.

D. Materials:

1. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.
2. Coil Conductors: Continuous copper windings with terminations brazed or welded.
3. Enclosure: NEMA ST 20, Type 1 ventilated and suitable for the environment in which the transformer is installed as indicated on the electrical area classification drawings. Furnish lifting eyes or brackets.

E. Fabrication:

1. Isolate core and coil from enclosure using vibration-absorbing mounts.
2. Nameplate: Stainless steel name plate showing all the data required by the applicable codes and standards. Include the following data as minimum:

    a. Manufacturer’s name.
    b. Rated kVA.
    c. Frequency (in Hz).
    d. Primary and secondary Voltage.
    e. Connection data.
    f. Insulation Class.
    g. Temperature Rise.
    h. Percent Impedance.

2.2 SOURCE QUALITY CONTROL

A. Production test each unit according to NEMA ST20.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Refer to Section 017300 “Execution” for requirements for installation examinations.

B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.2 PREPARATION

A. Refer to Section 017300 “Execution” for requirements for installation preparations.

B. Provide concrete pads under provisions of Section 033010 “Miscellaneous Cast-In Place Concrete”.

3.3 DEMOLITION

A. Disconnect and remove abandoned transformers.

B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.

3.4 INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, in accordance with Section 260533.13 “Conduits for Electrical Systems”, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Support transformers in accordance with Section 260529 “Hangers and Supports for Electrical Systems”.

1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.
2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
3. Mount trapeze-mounted transformers as indicated on Drawings.

D. Provide seismic restraints.

E. Install grounding and bonding in accordance with Section 260526 “Grounding and Bonding for Electrical Systems”.

3.5 FIELD QUALITY CONTROL

A. Refer to Section 017300 “Execution” for requirements for testing, adjusting and balancing.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.6 ADJUSTING

A. Refer to Section 017300 “Execution” for testing, adjusting and balancing.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

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3.7 CLEANING

A. Refer to Section 017300 “Execution” and Section 017700 “Closeout Procedures” for requirements for cleaning.

B. Clean existing transformers to remain or to be reinstalled.

END OF SECTION 262200

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.3 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.
5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 3R.
    c. Corrosive Areas: NEMA 250, Type 4X, stainless steel.
    d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches maximum.
3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    b. Back Boxes: Same finish as panels and trim.
    c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

   a. Plating shall run entire length of bus.
   b. Bus shall be fully rated the entire length.

2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
5. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.
6. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
7. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.

J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures,

wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.

1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.3 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Circuit breaker.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers or Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

G. Branch Overcurrent Protective Devices: Fused switches.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Square D; Schneider Electric USA.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB, Electrification Business.
2. Eaton.
3. Square D; Schneider Electric USA.

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

    a. Inverse time-current element for low-level overloads.
    b. Instantaneous magnetic trip element for short circuits.
    c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

    a. RMS sensing.
    b. Field-replaceable rating plug or electronic trip.
    c. Digital display of settings, trip targets, and indicated metering displays.
    d. Multi-button keypad to access programmable functions and monitored data.
    e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
    f. Integral test jack for connection to portable test set or laptop computer.
    g. Field-Adjustable Settings:

        1) Instantaneous trip.
        2) Long- and short-time pickup levels.
        3) Long and short time adjustments.
        4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Breaker handle indicates tripped status.
    c. UL listed for reverse connection without restrictive line or load ratings.
    d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
    f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    g. Rating Plugs: Three-pole breakers with ampere ratings greater than 100 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
    h. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.

i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
j. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
k. Multipole units enclosed in a factory assembled to operate as a single unit.
l. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
m. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.6 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

C. Circuit Directory: Directory card inside panelboard door, mounted in transparent card holder.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."
2. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements.

G. Mount top of trim 90 inches above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch 1-1/4 inch in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Engineer of effect on phase color coding.

1. Measure loads during period of normal facility operations.
2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Engineer. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

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SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Hazardous (classified) location receptacles.
4. Toggle switches, 120/277 V, 20 A.
5. Wall plates.

1.3 DEFINITIONS

A. AFCI: Arc-fault circuit interrupter.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Essential Electrical System: Red.
3. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two-pole, three-wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two-pole, three-wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498.
4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

C. Weather- and Corrosion-Resistant Receptacles, 120V, 20A:

1. Manufacturers: Pass & Seymour; Crouse-Hinds; Appleton.
2. Description: Two-pole, three-wire, with cover.
3. Configuration: NEMA WD 1 and WD 5, Configuration 5-20R.
4. Standards: Comply with UL 514A; NEMA FB-1.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet and Corrosive Locations" Article.

D. Corrosion-Resistant Receptacles, 120V, 20A:

1. Manufacturers: Hubbell, Eaton, Legrand.
2. Description: Two-pole, three-wire, and self-grounding. High visibility yellow nylon face, nickel plated brass or copper alloy power contacts.
3. Configuration: WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Corrosive Locations" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: Feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two-pole, three-wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: Feed through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Hazardous (Classified) Locations Receptacles:

1. Description: Pin and sleeve receptacle with matching connector.
2. Classified as indicated on the drawings.
3. Raintight.
4. Voltage: 600 V ac.
5. Hertz: 60 Hz.
6. Amperage: 20 A.
7. Wires and Poles: Two wire, three pole.
8. Standards: Comply with NEMA FB 11 and UL 1203.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Hubbel, Legrand, Leviton.
2. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Hubbel, Legrand, Leviton.
2. Comply with UL 20 and FS W-S-896.

2.6 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Steel with white baked enamel, suitable for field painting.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

D. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. In healthcare facilities, prepare reports that comply with NFPA 99.
2. Test Instruments: Use instruments that comply with UL 1436.
3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

F. Wiring device will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 262726

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SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

B. Section includes manufacturer’s programming, configuration, and startup services as it relates to interfacing with the SCADA control system.

C. Related Requirements:

1. Section 406121.20 “Process Control System Testing” for submittal requirements and factory and field-testing requirements as it relates to interfacing with the SCADA control system.
2. Section 406196 "Process Control Descriptions" for requirements related to interfacing with the SCADA control system, including general controls and monitoring requirements, alarming and equipment failure requirements, automatic control requirements, and individual control descriptions and control sequences.
3. Section 406866 “Configuration of Controller Software” for submittal requirements as it relates to interfacing with the SCADA control system over Ethernet.
4. Refer to the ‘I’ Drawings for SCADA control system I/O requirements.

1.3 DEFINITIONS

A. CE: Conformite Europeene (European Compliance).

B. CPT: Control power transformer.

C. DDC: Direct digital control.

D. EMI: Electromagnetic interference.

E. I/O: Input/Output

F. LED: Light-emitting diode.

G. NC: Normally closed.

H. NO: Normally open.

I. OCPD: Overcurrent protective device.

J. PID: Control action, proportional plus integral plus derivative.

K. RFI: Radio-frequency interference.

L. SCADA: Supervisory Control and Data Acquisition.

M. VFC: Variable-frequency motor controller. See VFD.

N. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

1.4 ACTION SUBMITTALS

A. Testing Submittals:

1. Submit testing submittals, testing procedures, and testing documentation in accordance with Section 406121.20 “Process Control System Testing.”

B. Control System Communication Submittal:

1. Submit a “memory map” in accordance with Section 406866 “Configuration of Controller Software” for interfacing with the SCADA control system over Ethernet.

C. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

D. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. The VFD supplier shall submit written confirmation that the motor characteristics (i.e. torque type, FLA, etc.) have been coordinated with the supplier of the driven equipment and that the VFDs being supplied are matched properly for the driven load.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for setting field-adjustable overload relays.
b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
c. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.
f. Manufacturer’s as-built “memory map” updated to reflect changes in the field during commissioning as it relates to signals communicated to the SCADA control system. Refer to Section 406866 “Configuration of Controller Software” for “memory map” requirements.
g. Manufacturer’s written instructions for replacing and configuring the Ethernet communications card. Instructions for configuring the Ethernet communications card shall be customized to satisfy the needs of this system and shall include all

steps necessary to completely configure the card. Manufacturer's standard documentation shall not be provided.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.
6. Network Card: Furnish one spare Ethernet communication card.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB, Electrification Business.
2. Rockwell Automation, Inc.
3. Schneider Electric USA, Inc.

2.2 SYSTEM DESCRIPTION

A. General Requirements for VFCs:

1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508A.

B. Application: Constant torque and variable torque.

C. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.

1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
4. Active front end technology

D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

E. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.

F. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of VFC input voltage rating.
2. Input AC Voltage Unbalance: Not exceeding 3 percent.
3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
4. Minimum Efficiency: 96 percent at 60 Hz, full load.

5. Minimum Displacement Primary-Side Power Factor: 98 percent under any load or speed condition.
6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
8. Humidity Rating: Less than 95 percent (noncondensing).
9. Altitude Rating: Not exceeding 3300 feet.
10. Vibration Withstand: Comply with NEMA ICS 61800-2.
11. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
13. Speed Regulation: Plus or minus 10 percent.
14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.

G. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.

H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.

1. Signal: Electrical.

I. Internal Adjustability Capabilities:

1. Minimum Speed: 5 to 25 percent of maximum rpm.
2. Maximum Speed: 80 to 100 percent of maximum rpm.
3. Acceleration: 0.1 to 999.9 seconds.
4. Deceleration: 0.1 to 999.9 seconds.
5. Current Limit: 30 to minimum of 150 percent of maximum rating.

J. Self-Protection and Reliability Features:

1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
2. Surge Suppression: Field-mounted surge suppressors complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits," UL 1449 SPD, Type 2.
3. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
4. Under- and overvoltage trips.
5. Inverter overcurrent trips.
6. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
7. Critical frequency rejection, with three selectable, adjustable deadbands.
8. Instantaneous line-to-line and line-to-ground overcurrent trips.
9. Loss-of-phase protection.
10. Reverse-phase protection.
11. Short-circuit protection.
12. Motor-overtemperature fault.

K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.

L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.

M. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

N. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.

O. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.

P. Integral Input Disconnecting Means and OCPD: UL 489, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.

1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
3. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
5. NC alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

A. Controls shall, as a minimum, perform the control logic indicated on the Contract Drawings, described in Section 406196 “Process Control Descriptions”, and as specified herein.

B. Status Lights: Door-mounted LED indicators displaying the following conditions:

1. Power on.
2. Run.
3. Overvoltage.
4. Line fault.

5. Overcurrent.
6. External fault.
7. Leak
8. High Temp

C. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.

    a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.

D. Historical Logging Information and Displays:

1. Real-time clock with current time and date.
2. Running log of total power versus time.
3. Total run time.
4. Fault log, maintaining last four faults with time and date stamp for each.

E. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:

1. Output frequency (Hz).
2. Motor speed (rpm).
3. Motor status (running, stop, fault).
4. Motor current (amperes).
5. Motor torque (percent).
6. Fault or alarming status (code).
7. PID feedback signal (percent).
8. DC-link voltage (V dc).
9. Set point frequency (Hz).
10. Motor output voltage (V ac).

F. Control Signal Interfaces:

1. Ethernet interface:

    a. Refer to “I” drawings for signals to interface with the SCADA control system over Ethernet.

2. Electric Input Signal Interface:

    a. Programmable 4- to 20-mA dc analog inputs: quantity as shown on the ‘I’ drawings.

b. Programmable 4- to 20-mA dc analog outputs: quantity as shown on the 'I' drawings.
c. Programmable digital inputs: quantity as shown on the 'I' drawings.
d. Programmable digital outputs: quantity as shown on the 'I' drawings.

3. Pneumatic Input Signal Interface: 3 to 15 psig.
4. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the SCADA system for HVAC or other control systems:

a. 0- to 10-V dc.
b. 4- to 20-mA dc.
c. Potentiometer using up/down digital inputs.
d. Fixed frequencies using digital inputs.

5. Output Signal Interface: A minimum of three programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:

a. Output frequency (Hz).
b. Output current (load).
c. DC-link voltage (V dc).
d. Motor torque (percent).
e. Motor speed (rpm).
f. Set point frequency (Hz).

6. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

a. Motor running.
b. Set point speed reached.
c. Fault and warning indication (overtemperature or overcurrent).
d. PID high- or low-speed limits reached.

G. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for level, flow, or temperature regulation.

1. Number of Loops: One.

2.5 LINE CONDITIONING AND FILTERING

A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.

B. Input Rectifier: Use a transistor-based Active Front End that uses a Selective Harmonic Elimination algorithm, mitigating the harmonics enough to meet IEEE-519 without the need for phase shifting transformers and multi-pulse diode rectifiers.

1. Total current harmonic distortion shall not exceed 5% at the VFC input terminals in all load conditions.
2. Insensitive to phase rotation, tolerant of line voltage imbalance up to 10% without affecting the harmonic mitigation or VFC output, and capable of operating the motor at full output with a 10% drop on input voltage.
3. Use an LCL filter assembly to filter up to and including the 50th harmonic to reduce EMI/RFI emissions.
   a. Include Passive Dampening in LCL filter assembly.
4. Provide Active Resonance Detection and Protection to minimize any damage to the drive from supply side resonance.

C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2.

D. Communication Ports:

1. RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.
2. CAT-6 port capable of connecting the VFD to a control system network.

2.6 ENCLOSURES

A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.

B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.7 ACCESSORIES

A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.

1. Push Buttons: Lockable.
2. Pilot Lights: Push to test.
3. Selector Switches: Rotary type.

B. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

C. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

D. Supplemental Digital Meters:

1. Elapsed-time meter.
2. Kilowatt meter.
3. Kilowatt-hour meter.

E. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with composite intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.

F. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

G. Spare control-wiring terminal blocks; unwired.

2.8 ADDITIONAL CONSTRUCTION REQUIREMENTS

A. Disconnect handle height shall not exceed NEC requirements with VFC is located on 4-inch high housekeeping pad.

B. VFC's shall utilize 115 VAC control power for operator devices, cooling fans, motor space heaters and external control circuits. Control power transformer shall be fused on the primary and secondary. Control circuits shall be isolated from power circuits.

C. VFC shall include a copper ground bus.

D. All bus and exposed copper shall be tin plated.

E. All floor mounted enclosures shall have complete 18" (minimum) clear space in bottom of the cubical for line, motor and field cable terminations. All wall mounted enclosures shall have complete 12" (minimum) clear space in bottom of the enclosure for line, motor and field cable terminations.

F. A switchable fluorescent light shall be provided within each floor mounted section of the enclosure.

G. Barriers shall be provided on terminals that remain energized with the power disconnect OFF.

H. All circuit boards shall be conformal coated to help protect them from hydrogen sulfide gases.

I. Identification

1. All wiring shall be numbered at each end with typed sleeve type labels at each termination. Labels shall correspond to the wiring diagrams. Wiring less than 6 inches may be numbered at only one end.
2. Provide warning signs on terminals that are energized with the power disconnect OFF.
3. Provide 2-inch by 5-inch, nominal, engraved three-layer laminated plastic master nameplates on each VFD fastened with stainless steel screws or rivets. Nameplates shall be black letters with white background core, 3/8-inch high lettering and shall indicate equipment designation as shown on the Drawings.

4. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of pilot devices and meters.
5. Provide permanent warning signs as follows:

    a. "DANGER - HIGH VOLTAGE - KEEP OUT" on all enclosure doors.
    b. "WARNING - HAZARD OF ELECTRIC SHOCK - DISCONNECT POWER BEFORE OPENING OR WORKING ON THIS UNIT".

2.9 SOURCE QUALITY CONTROL

A. Testing:

1. Test and inspect VFCs according to requirements in NEMA ICS 61800-2.

    a. Test each VFC while connected to its specified motor.
    b. Verification of Performance: Rate VFCs according to operation of functions and features specified.

2. Test and inspect Ethernet communications card programming and configuration. Verify all networked signals are programmed in the data array registers approved in the Control System Communication Submittal.

B. VFCs will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."

B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in each fusible-switch VFC.

E. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."

F. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.

G. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

H. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each VFC with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Test network connectivity and programming and configuration of the Ethernet communications card.

C. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Perform factory and field-testing as it relates to interfacing with the SCADA control system in accordance with Section 406121.20 “Process Control System Testing.” Copies of approved status sign-off forms and testing procedures shall be made available to all parties during testing.
8. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
9. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

10. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. VFCs will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

F. Prepare test documentation and evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service. The factory-authorized representative shall be capable of making any and all programming and configuration changes to the VFD as required to meet the design intent, including making changes to Ethernet communication programming and configuration.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Field test all the hardwired discrete and analog connections and any software communication (Ethernet, Profibus, ControlNet, Modibus etc) that are connect to remote control equipment when the VFC is placed in remote. The manufacturer shall at a minimum verify with the proper testing equipment that the following can be achieved:

a. The drive can be started and stopped remotely.
b. The drive can have its speed changed remotely.
c. The remote equipment can read the VFC discrete status information.
d. The remote equipment can read the VFC speed feedback information.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable pressure switches.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

3.10 CLEANING

A. Remove all rubbish and debris from inside and around the equipment. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

B. Replace all cabinet ventilation filters upon commencement of the Contract warranty period.

END OF SECTION 262923

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SECTION 263213.16 - GASEOUS EMERGENCY ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes packaged engine generators for emergency use with the following features:

1. Natural gas engine.
2. Gaseous fuel system.
3. Control and monitoring.
4. Generator overcurrent and fault protection.
5. Generator, exciter, and voltage regulator.
6. Outdoor engine generator enclosure.
7. Remote radiator motors.
8. Vibration isolation devices.
9. Finishes.

B. Related Requirements:

1. Section 263600 "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine generators.

1.3 DEFINITIONS

A. EPS: Emergency power supply.

B. EPSS: Emergency power supply system.

C. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Include thermal damage curve for generator.
3. Include time-current characteristic curves for generator protective device.

4. Include fuel consumption in cubic feet per hour s at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
5. Include generator efficiency at 0.8 power factor at 0.5, 0.75, and 1.0 times generator capacity.
6. Include airflow requirements for cooling and combustion air in cubic feet per minute at 0.8 power factor, with air-supply temperature of 95, 80, 70, and 50 deg F. Provide Drawings indicating requirements and limitations for location of air intake and exhausts.
7. Include generator characteristics, including, but not limited to, kilowatt rating, efficiency, reactances, and short-circuit current capability.

B. Shop Drawings:

1. Include plans and elevations for engine generator and other components specified.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Identify fluid drain ports and clearance requirements for proper fluid drain.
4. Design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and supported equipment. Include base weights.
6. Include diagrams for power, signal, and control wiring. Complete schematic, wiring, and interconnection diagrams showing terminal markings for EPS equipment and functional relationship between all electrical components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturer and testing agency.

B. Seismic Qualification Data: Certificates, for engine generator, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: With engine and generator mounted on rails, identify center of gravity and total weight, and each piece of equipment not integral to the engine generator, and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source Quality-Control Reports: Including, but not limited to, the following:

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.

5. Report of sound generation.
6. Report of exhaust emissions showing compliance with applicable regulations.
7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

D. Field quality-control reports.

E. Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
b. Operating instructions laminated and mounted adjacent to generator location.
c. Training plan.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.
4. Tools: Each tool listed by part number in operations and maintenance manual.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 1 years from date of Substantial Completion.

1.10 UNIT PERFORMANCE

A. Submit calculations for review based on the criteria for each generator set below. The calculations shall meet all criteria listed in Part 2 of this specification.

B. Long Pond Drive Pump Station No.4 – 480V 3-Phase – 60Hz

1. The generator shall have a continuous duty rating of not less than 125kW.
2. The generator shall be provided with skin-tight outdoor enclosure.
3. The Generator shall be capable of starting the following loads. Generator shall be capable of accepting load from each step with a maximum frequency dip of 10 percent and a maximum voltage dip of 15 percent.

    a. Step 1: Building Loads (HVAC, Lighting, etc).
    b. Step 2: Shall consist of one 40 HP (Submersible Pump) operated on an active front-end VFD.
    c. Step 3: Shall consist of one 40 HP (Submersible Pump) operated on an active front-end VFD.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kohler Power Systems.
2. Caterpillar, Inc.; Electric Power Division.
3. Cummins Power Generation.

B. Source Limitations: Obtain packaged engine generators and auxiliary components from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Engine generator housing, engine generator, batteries, battery racks, silencers, sound attenuating equipment, accessories, and components shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Shake-table testing shall comply with ICC-ES AC156. Testing shall be performed with all fluids at worst-case normal levels.
3. Component Importance Factor: 1.5.

B. B11 Compliance: Comply with B11.19.

C. NFPA Compliance:

1. Comply with NFPA 37.
2. Comply with NFPA 70.
3. Comply with NFPA 110 requirements for Level 2 EPSS.

D. UL Compliance: Comply with UL 2200.

E. Engine Exhaust Emissions: Comply with applicable federal, state, and local emissions requirements (including Mass DEP) in effect at the time of installation..

F. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by engine generator, including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

G. Environmental Conditions: Engine generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

1. Ambient Temperature: 5 to 104 deg F.
2. Relative Humidity: Zero to 95 percent.
3. Altitude: Sea level to 1000 feet.

H. Unusual Service Conditions: Engine generator equipment and installation are required to operate under the following conditions:

1. High salt-dust content in the air due to sea-spray evaporation.

2.3 ENGINE GENERATOR ASSEMBLY DESCRIPTION

A. Factory-assembled and -tested, water-cooled engine, with brushless generator and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Power Rating: Prime.

D. Overload Capacity: 110 percent of service load for 1 hour in 12 consecutive hours.

E. Service Load: As shown on Drawings.

F. Power Factor: 0.8, lagging, unless otherwise noted on Drawings.

G. Frequency: 60 Hz.

H. Voltage: -480V ac.

I. Phase: Three-phase, four-wire wye.

J. Induction Method: Naturally aspirated.

K. Governor: Adjustable isochronous, with speed sensing.

L. Mounting Frame: Structural-steel framework to maintain alignment of mounted components without depending on concrete foundation. Provide lifting attachments sized and spaced to prevent deflection of base during lifting and moving.

1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and engine generator center of gravity.

M. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated at 0.8 power factor excluding power required for the continued and repeated operation of the unit and auxiliaries, with capacity as required to operate as a unit as evidenced by records of prototype testing.
2. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

N. Engine Generator Performance for Sensitive Loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

    a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage, from no load to full load.
3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency, from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
7. Output Waveform: At no load, harmonic content, measured line to neutral, shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a three-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.

    a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

O. Parallel Engine Generators:

1. Automatic reactive output power control and load sharing between engine generators operated in parallel.
2. Automatic regulation, automatic connection to a common bus, and automatic synchronization, with manual controls and instruments to monitor and control paralleling functions.
3. Protective relays required for equipment and personnel safety.
4. Paralleling suppressors to protect excitation systems.
5. Reverse power protection.
6. Loss of field protection.

2.4 ENGINE

A. Fuel: Natural gas.

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: Engine or skid mounted.

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Jacket Coolant Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with UL 499.

E. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine generator mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant, from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant-system pressure for engine used. Equip with gage glass and petcock.
4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, UV-, and abrasion-resistant fabric.

a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

F. Muffler/Silencer: Commercial type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 12 dB at 500 Hz.
2. Sound level measured at a distance of 25 feet from exhaust discharge after installation is complete shall be 70 dBA or less.

G. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

H. Starting System: 24-V electric, with negative ground.

1. Components: Sized so they are not damaged during a full engine-cranking cycle, with ambient temperature at maximum specified in "Performance Requirements" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: 60 seconds.
4. Battery: Nickel cadmium, with capacity within ambient temperature range specified in "Performance Requirements" Article to provide specified cranking cycle at least three times without recharging.
5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 50 deg F regardless of external ambient temperature within range specified in "Performance Requirements" Article. Include accessories required to support and fasten batteries in place. Provide ventilation to exhaust battery gases.
7. Battery Stand: Factory-fabricated, two-tier metal with acid-resistant finish designed to hold the quantity of battery cells required and to maintain the arrangement to minimize lengths of battery interconnections.
8. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
9. Battery Charger: Current-limiting, automatic-equalizing and float-charging type designed for nickel-cadmium batteries. Unit shall comply with UL 1236 and include the following features:

    a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
    b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 to 140 deg F to prevent overcharging at high temperatures and undercharging at low temperatures.
    c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
    d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
    e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either

condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.5 GASEOUS FUEL SYSTEM

A. The packaged generator, including the gas train components, shall have an approval code from the Division of Occupational Licensure Accepted Plumbing Products Public Portal.

B. Fuel: Natural Gas. Comply with requirements in Section 231123 "Facility Natural Gas Piping."

C. Operating Pressure: 7” WC – 11” WC.

D. Fuel Consumption at 100% Load: Refer to Plumbing drawings.

E. Gas Train: Comply with NFPA 37.

F. Engine Fuel System:

1. Natural Gas, Vapor-Withdrawal System:

   a. Carburetor.
   b. Fuel-Shutoff Solenoid Valves: NRTL-listed, normally closed, safety shutoff valves; one for each fuel source.

2. Fuel Filters: One for each fuel type.
3. Manual Fuel Shutoff Valves: One for each fuel type.
4. Flexible Fuel Connectors: Minimum one for each fuel connection.

2.6 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of engine generator. When mode-selector switch is switched to the on position, engine generator starts. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

B. Manual Starting System Sequence of Operation: Switching On-Off switch on the generator control panel to the on position starts engine generator. The off position of same switch initiates engine generator shutdown. When engine generator is running, specified system or equipment failures or derangements automatically shut down engine generator and initiate alarms.

C. Provide minimum run-time control set for 15 minutes, with override only by operation of a remote emergency-stop switch.

D. Comply with UL 508A.

E. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the engine generator. Mounting method shall isolate the control panel from engine generator vibration. Panel shall be powered from the engine generator battery.

F. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common wall-mounted control and monitoring panel. Panel shall be powered from the engine generator battery.

G. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel shall be powered from the engine generator battery. Panel features shall include the following:

1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6.

H. Control and Monitoring Panel:

1. Digital controller with integrated LCD display, controls, and microprocessor, capable of local and remote control, monitoring, and programming, with battery backup.
2. Analog control panel with dedicated gages and indicator lights for the instruments and alarms indicated below.
3. Instruments: Located on the control and monitoring panel and viewable during operation.

    a. Engine lubricating-oil pressure gage.
    b. Engine-coolant temperature gage.
    c. DC voltmeter (alternator battery charging).
    d. Running-time meter.
    e. AC voltmeter, connected to a phase selector switch.
    f. AC ammeter, connected to a phase selector switch.
    g. AC frequency meter.
    h. Generator-voltage adjusting rheostat.

4. Controls and Protective Devices: Controls, shutdown devices, and common visual alarm indication as required by NFPA 110 for Level 2 system, including the following:

    a. Cranking control equipment.
    b. Run-Off-Auto switch.
    c. Control switch not in automatic position alarm.
    d. Overcrank alarm.
    e. Overcrank shutdown device.
    f. Low water temperature alarm.
    g. High engine temperature pre-alarm.
    h. High engine temperature.
    i. High engine temperature shutdown device.
    j. Overspeed alarm.
    k. Overspeed shutdown device.
    l. Low-fuel main tank.

1) Low-fuel-level alarm shall be initiated when the level falls below that required for operation for the duration required for the indicated EPSS class.

m. Coolant low-level alarm.
n. Coolant low-level shutdown device.
o. Coolant high-temperature prealarm.
p. Coolant high-temperature alarm.
q. Coolant low-temperature alarm.
r. Coolant high-temperature shutdown device.
s. EPS load indicator.
t. Battery high-voltage alarm.
u. Low-cranking voltage alarm.
v. Battery-charger malfunction alarm.
w. Battery low-voltage alarm.
x. Lamp test.
y. Contacts for local and remote common alarm.
z. Low-starting air pressure alarm.
aa. Low-starting hydraulic pressure alarm.
bb. Remote manual-stop shutdown device.
cc. Air shutdown damper alarm when used.
dd. Air shutdown damper shutdown device when used.
ee. Hours of operation
ff. Engine generator metering including voltage, current, Hz. kW, kVA, and power factor.
gg. Generator overcurrent-protective-device not-closed alarm.

I. Connection to Datalink:

1. A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication.
2. Provide connections for datalink transmission of indications to remote data terminals via Ethernet.

J. Common Remote Panel with Common Audible Alarm: Comply with NFPA 110 requirements for Level 2 systems. Include necessary contacts and terminals in control and monitoring panel. Remote panel shall be powered from the engine generator battery.

K. Remote Alarm Annunciator: Comply with NFPA 99. An LED indicator light labeled with proper alarm conditions shall identify each alarm event, and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated.

1. Overcrank alarm.
2. Coolant low-temperature alarm.
3. High engine temperature pre-alarm.
4. High engine temperature alarm.
5. Low lube oil pressure alarm.
6. Overspeed alarm.
7. Low-fuel main tank alarm.

8. Low coolant level alarm.
9. Low-cranking voltage alarm.
10. Contacts for local and remote common alarm.
11. Audible-alarm silencing switch.
12. Air shutdown damper when used.
13. Run-Off-Auto switch.
14. Control switch not in automatic position alarm.
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. Lamp test.
18. Low-cranking voltage alarm.
19. Generator overcurrent-protective-device not-closed alarm.

L. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator unless otherwise indicated.

M. Remote Emergency-Stop Switch: Flush; wall mounted unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.7 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Overcurrent protective devices for the entire EPSS shall be coordinated to optimize selective tripping when a short circuit occurs. Coordination of protective devices shall consider both utility and EPSS as the voltage source.

1. Overcurrent protective devices for the EPSS shall be accessible only to authorized personnel.

B. Generator Circuit Breaker: Molded-case, electronic-trip type; 100 percent rated; complying with UL 489.

1. Tripping Characteristics: Adjustable long-time and short-time delay and instantaneous.
2. Trip Settings: Selected to coordinate with generator thermal damage curve.
3. Shunt Trip: Connected to trip breaker when engine generator is shut down by other protective devices.
4. Mounting: Adjacent to or integrated with control and monitoring panel.

2.8 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required. Provide six-lead alternator.

E. Range: Provide limited range of output voltage by adjusting the excitation level.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: Dripproof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified and as required by NFPA 110.

1. Adjusting Rheostat on Control and Monitoring Panel: Provide plus or minus 5 percent adjustment of output-voltage operating band.
2. Maintain voltage within 20 percent on one step, full load.
3. Provide anti-hunt provision to stabilize voltage.
4. Maintain frequency within 10 percent and stabilize at rated frequency within two seconds.

J. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

K. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

L. Subtransient Reactance: 12 percent, maximum.

2.9 OUTDOOR ENGINE GENERATOR ENCLOSURE

A. Description: Vandal-resistant, sound-attenuating, weatherproof aluminum housing, wind resistant up to 180 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

1. Sound Attenuation Level71 dbA at 23ft.

B. Description: Prefabricated or preengineered, integral structural- -framed,; erected on concrete foundation.

C. Structural Design and Anchorage: Comply with ASCE/SEI 7 for wind loads up to 180 mph.

D. Hinged Doors: With padlocking provisions.

E. Space Heater: Thermostatically controlled and sized to prevent condensation.

F. Thermal Insulation: Manufacturer's standard materials and thickness selected in coordination with space heater to maintain winter interior temperature within operating limits required by engine generator components.

G. Muffler Location: Within enclosure.

H. Engine-Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for two hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine, cooling-air inlet and discharge. Stormproof and drainable louvers prevent entry of rain and snow.

2.10 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Material: Standard neoprene separated by steel shims.
2. Minimum Deflection: 1 inch.

B. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment-mounting and -leveling bolt that acts as blocking during installation.
2. Outside Spring Diameter: Not less than 80 percent of compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Minimum Deflection: 1 inch.

C. Comply with requirements in Section 232116 "Hydronic Piping Specialties" for vibration isolation and flexible connector materials for steel piping.

D. Comply with requirements in Section 233113 "Metal Ducts" for vibration isolation and flexible connector materials for exhaust shroud and ductwork.

E. Vibration isolation devices shall not be used to accommodate misalignments or to make bends.

2.11 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.12 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine generator using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine generator and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Test generator, exciter, and voltage regulator as a unit.
3. Full-load run.
4. Maximum power.
5. Voltage regulation.
6. Transient and steady-state governing.
7. Single-step load pickup.
8. Safety shutdown.
9. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
10. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine generator performance.

B. Examine roughing-in for piping systems and electrical connections to verify actual locations of connections before packaged engine generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two working days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's or Owner's written permission.

3.3 INSTALLATION

A. Comply with NECA 1 and NECA 404.

B. Comply with packaged engine generator manufacturers' written installation and alignment instructions and with NFPA 110.

C. Equipment Mounting:

1. Install packaged engine generators on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."
2. Coordinate size and location of concrete bases for packaged engine generators. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
3. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch on 4-inch high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

E. Gaseous Fuel Piping:

1. Natural gas piping, valves, and specialties for gas distribution are specified in Section 221123 "Facility Natural Gas Piping."

F. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect cooling-system water piping to engine generator and heat exchanger with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Gaseous Fuel Connections:

1. Connect fuel piping to engines with a gate valve and union and flexible connector.
2. Install manual shutoff valve in a remote location to isolate gaseous fuel supply to the generator.
3. Vent gas pressure regulators outside building a minimum of 60 inches from building openings.

F. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

G. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Provide a minimum of one 90-degree bend in flexible conduit routed to the engine generator from a stationary element.

H. Balance single-phase loads to obtain a maximum of 10 percent unbalance between any two phases.

3.5 IDENTIFICATION

A. Identify system components according to Section 230553 "Identification for HVAC Piping and Equipment" and Section 260553 "Identification for Electrical Systems."

B. Install a sign indicating the generator neutral is bonded to the main service neutral at the main service location.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Perform tests recommended by manufacturer and each visual and mechanical inspection and electrical and mechanical test listed in first two subparagraphs below, as specified in NETA ATS. Certify compliance with test parameters.

    a. Visual and Mechanical Inspection:

        1) Compare equipment nameplate data with Drawings and the Specifications.
        2) Inspect physical and mechanical condition.
        3) Inspect anchorage, alignment, and grounding.
        4) Verify that the unit is clean.

    b. Electrical and Mechanical Tests:

        1) Perform insulation-resistance tests according to IEEE 43.

            a) Machines Larger Than 200 hp: Test duration shall be 10 minutes. Calculate polarization index.
            b) Machines 200 hp or Less: Test duration shall be one minute. Calculate the dielectric-absorption ratio.

        2) Test protective relay devices.
        3) Verify phase rotation, phasing, and synchronized operation as required by the application.
        4) Functionally test engine shutdown for low oil pressure, overtemperature, overspeed, and other protection features as applicable.
        5) Perform vibration test for each main bearing cap.

6) Conduct performance test according to NFPA 110.
7) Verify correct functioning of the governor and regulator.

2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.

    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.
7. Exhaust Emissions Test: Comply with applicable government test criteria.
8. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
9. Harmonic-Content Tests: Measure harmonic content of output voltage at 25 and 100 percent of rated linear load. Verify that harmonic content is within specified limits.
10. Noise Level Tests: Measure A-weighted level of noise emanating from engine generator installation, including engine exhaust and cooling-air intake and discharge, at four locations 25 feet from edge of the generator enclosure, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the past 12 months, traceable to NIST Calibration Services, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge exhaust, coolant, and fuel systems and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation for generator and associated equipment.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations, and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after final acceptance, perform an infrared scan of each power wiring termination and each bus connection while running with maximum load. Remove all access panels, so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan, 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's authorized service representative. Include quarterly preventive maintenance and exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Parts shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators.

END OF SECTION 263213.16

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SECTION 263600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes automatic and nonautomatic transfer switches rated 600 V and less, including the following:

1. Bypass/isolation switches.
2. Remote annunciator and control system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for transfer switches.
2. Include rated capacities, operating characteristics, electrical characteristics, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, details showing minimum clearances, conductor entry provisions, gutter space, and installed features and devices.
2. Include material lists for each switch specified.
3. Single-Line Diagram: Show connections between transfer switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.
4. Riser Diagram: Show interconnection wiring between transfer switches, bypass/isolation switches, annunciators, and control panels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer-authorized service representative.

B. Seismic Qualification Data: Certificates, for transfer switches, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Features and operating sequences, both automatic and manual.
b. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. Member company of NETA.

a. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of transfer switch or transfer switch components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA ICS 1.

C. Comply with NFPA 99.

D. Comply with NFPA 110.

E. Comply with UL 1008 unless requirements of these Specifications are stricter.

F. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

G. Tested Fault-Current Closing and Short-Circuit Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.
2. Short-time withstand capability for 0.5 seconds.

H. Repetitive Accuracy of Solid-State Controls: All settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

I. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.62. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

J. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism. Switches for emergency or standby purposes shall be mechanically and electrically interlocked in both directions to prevent simultaneous connection to both power sources unless closed transition.

K. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

L. Battery Charger: For generator starting batteries.

1. Float type, rated 10 A.
2. Ammeter to display charging current.
3. Fused ac inputs and dc outputs.

M. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels shall have communication capability matched with remote device.

N. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, by color-code or by numbered or lettered wire and cable with printed markers at terminations. Color-coding and wire and cable markers are specified in Section 260553 "Identification for Electrical Systems."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.
4. Accessible via front access.

O. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.2 CONTACTOR-TYPE AUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASCO
2. Kohler Power Systems.
3. Russelectric, Inc.

B. Comply with Level 1 equipment according to NFPA 110.

C. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are unacceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Contactor-style automatic transfer-switch units, rated 600 A and higher, shall have separate arcing contacts.
4. Conductor Connectors: Suitable for use with conductor material and sizes.
5. Material: Hard-drawn copper, 98 percent conductivity.
6. Main and Neutral Lugs: Mechanical type.
7. Ground Lugs and Bus-Configured Terminators: Mechanical type.
8. Ground bar.
9. Connectors shall be marked for conductor size and type according to UL 1008.

D. Automatic Delayed-Transition Transfer Switches: Pauses or stops in intermediate position to momentarily disconnect both sources, with transition controlled by programming in the automatic transfer-switch controller. Interlocked to prevent the load from being closed on both sources at the same time.

1. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals for alternative source. Adjustable from zero to six seconds, and factory set for one second.
2. Sources shall be mechanically and electrically interlocked to prevent closing both sources on the load at the same time.
3. Fully automatic break-before-make operation with center off position.
4. Fully automatic break-before-make operation with transfer when two sources have near zero phase difference.

E. Electric Switch Operation: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. Automatic Transfer-Switch Controller Features:

1. Controller operates through a period of loss of control power.
2. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage shall be adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from zero to 30 minutes, and factory set for 10 minutes. Override shall automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods shall be adjustable from 10 to 30 minutes. Factory settings shall be for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is unavailable.

H. Large-Motor-Load Power Transfer:

1. In-Phase Monitor: Factory-wired, internal relay controls transfer so contacts close only when the two sources are synchronized in phase and frequency. Relay shall compare

phase relationship and frequency difference between normal and emergency sources and initiate transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer shall be initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

2. Motor Disconnect and Timing Relay Controls: Designated starters in loss of power scenario shall disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters shall be through wiring external to automatic transfer switch. Provide adjustable time delay between 1 and 60 seconds for reconnecting individual motor loads. Provide relay contacts rated for motor-control circuit inrush and for actual seal currents to be encountered.

2.3 NONAUTOMATIC TRANSFER SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASCO Power Technologies.
2. Eaton.
3. Russelectric, Inc.

B. Electrically Operated: Electrically actuated by push buttons designated "Normal Source" and "Alternative Source." Switch shall be capable of transferring load in either direction with either or both sources energized.

C. Double-Throw Switching Arrangement: Incapable of pauses or intermediate position stops during switching sequence.

D. Pilot Lights: Indicate source to which load is connected.

E. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and alternative-source sensing circuits.

1. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
2. Emergency Power Supervision: Red light with nameplate engraved "Alternative Source Available."

F. Unassigned Auxiliary Contacts: Switch shall have one set of normally closed contacts for each switch position, rated 10 A at 240-V ac.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Switch Action: Double throw; mechanically held in both directions.
2. Contacts: Silver composition or silver alloy for load-current switching.
3. Conductor Connectors: Suitable for use with conductor material and sizes.
4. Material: Hard-drawn copper, 98 percent conductivity.
5. Main and Neutral Lugs: Mechanical type.
6. Ground Lugs and Bus-Configured Terminators: Mechanical type.
7. Connectors shall be marked for conductor size and type according to UL 1008.

2.4 TRANSFER SWITCH ACESSORIES

A. Bypass/Isolation Switches:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Comply with requirements for Level 1 equipment according to NFPA 110.
3. Description: Manual type, arranged to select and connect either source of power directly to load, isolating transfer switch from load and from both power sources. Include the following features for each combined automatic transfer switch and bypass/isolation switch:

    a. Means to lock bypass/isolation switch in the position that isolates transfer switch with an arrangement that permits complete electrical testing of transfer switch while isolated. Interlocks shall prevent transfer-switch operation, except for testing or maintenance, while automatic transfer switch is isolated.
    b. Provide means to make power available to transfer-switch control circuit for testing and maintenance purposes.
    c. Drawout Arrangement for Transfer Switch: Provide physical separation from live parts and accessibility for testing and maintenance operations. Transfer switch and bypass/isolation switch shall be in isolated compartments.
    d. Transition: Provide open-transition operation when transferring between power sources.
    e. Bypass/Isolation Switch Current, Voltage, Closing, and Short-Circuit Withstand Ratings: Equal to or greater than those of associated automatic transfer switch, and with same phase arrangement and number of poles.
    f. Contact temperatures of bypass/isolation switches shall not exceed those of automatic transfer-switch contacts when they are carrying rated load.
    g. Manual Control: Constructed so load bypass and transfer-switch isolation can be performed by one person in no more than two operations in 15 seconds or less. Operating handles shall be externally operated.
    h. Legend: Manufacturer's standard legend for control labels and instruction signs shall describe operating instructions.
    i. Maintainability: Fabricate to allow convenient removal of major components from front without removing other parts or main power conductors.

4. Interconnection of Bypass/Isolation Switches with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

B. Remote Annunciator and Control System:

1. Source Limitations: Same manufacturer as transfer switch in which installed.
2. Include the following functions for indicated transfer switches:

    a. Indication of sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
    b. Indication of switch position.
    c. Indication of switch in test mode.
    d. Indication of failure of digital communication link.
    e. Key-switch or user-code access to control functions of panel.
    f. Control of switch-test initiation.

g. Control of switch operation in either direction.
h. Control of time-delay bypass for transfer to normal source.

3. Malfunction of annunciator, annunciation and control panel, or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically shall revert to standalone, self-contained operation. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation.
4. Remote Annunciation and Control Panel: Solid-state components. Include the following features:

a. Controls and indicating lights grouped together for each transfer switch.
b. Label each indicating light control group. Indicate transfer switch it controls, location of switch, and load it serves.
c. Digital Communication Capability: Matched to that of transfer switches supervised.
d. Mounting: Flush, modular, steel cabinet unless otherwise indicated.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect components, assembled switches, and associated equipment according to UL 1008. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

B. Prepare test and inspection reports.

1. For each of the tests required by UL 1008, performed on representative devices, for emergency systems. Include results of test for the following conditions:

a. Overvoltage.
b. Undervoltage.
c. Loss of supply voltage.
d. Reduction of supply voltage.
e. Alternative supply voltage or frequency is at minimum acceptable values.
f. Temperature rise.
g. Dielectric voltage-withstand; before and after short-circuit test.
h. Overload.
i. Contact opening.
j. Endurance.
k. Short circuit.
l. Short-time current capability.
m. Receptacle withstand capability.
n. Insulating base and supports damage.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Floor-Mounting Switch: Anchor to floor by bolting.

1. Install transfer switches on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033010 "Miscellaneous Cast-in-Place Concrete."
2. Comply with requirements for seismic control devices."
3. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
4. Provide workspace and clearances required by NFPA 70.

B. Annunciator and Control Panel Mounting: Flush in wall unless otherwise indicated.

C. Identify components according to Section 260553 "Identification for Electrical Systems."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

E. Comply with NECA 1.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to generator sets, control, and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Wiring Method: Install cables in raceways and cable trays except within electrical enclosures. Conceal raceway and cables except in unfinished spaces.

1. Comply with requirements for raceways and boxes specified in Section 260533.13 "Conduits for Electrical Systems."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

F. Connect twisted pair cable according to Section 260523 "Control-Voltage Electrical Power Cables."

G. Route and brace conductors according to manufacturer's written instructions. and Section 260529 "Hangers and Supports for Electrical Systems." Do not obscure manufacturer's markings and labels.

H. Brace and support equipment."

I. Final connections to equipment shall be made with liquidtight, flexible metallic conduit no more than 18 inches in length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. After installing equipment, test for compliance with requirements according to NETA ATS.
2. Visual and Mechanical Inspection:

    a. Compare equipment nameplate data with Drawings and Specifications.
    b. Inspect physical and mechanical condition.
    c. Inspect anchorage, alignment, grounding, and required clearances.
    d. Verify that the unit is clean.
    e. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
    f. Verify that manual transfer warnings are attached and visible.
    g. Verify tightness of all control connections.
    h. Inspect bolted electrical connections for high resistance using one of the following methods, or both:

        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data.

    i. Perform manual transfer operation.
    j. Verify positive mechanical interlocking between normal and alternate sources.
    k. Perform visual and mechanical inspection of surge arresters.
    l. Inspect control power transformers.

        1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
        2) Verify that primary and secondary fuse or circuit-breaker ratings match Drawings.
        3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

3. Electrical Tests:

    a. Perform insulation-resistance tests on all control wiring with respect to ground.
    b. Perform a contact/pole-resistance test. Compare measured values with manufacturer's acceptable values.
    c. Verify settings and operation of control devices.
    d. Calibrate and set all relays and timers.
    e. Verify phase rotation, phasing, and synchronized operation.
    f. Perform automatic transfer tests.
    g. Verify correct operation and timing of the following functions:

1) Normal source voltage-sensing and frequency-sensing relays.
2) Engine start sequence.
3) Time delay on transfer.
4) Alternative source voltage-sensing and frequency-sensing relays.
5) Automatic transfer operation.
6) Interlocks and limit switch function.
7) Time delay and retransfer on normal power restoration.
8) Engine cool-down and shutdown feature.

4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.

5. After energizing circuits, perform each electrical test for transfer switches stated in NETA ATS and demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and retransfer from emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for one pole deviating by more than 50 percent from other poles.
   g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

   a. Verify grounding connections and locations and ratings of sensors.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Transfer switches will be considered defective if they do not pass tests and inspections.

E. Remove and replace malfunctioning units and retest as specified above.

F. Prepare test and inspection reports.

G. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment.

B. Training shall include testing ground-fault protective devices and instructions to determine when the ground-fault system shall be retested. Include instructions on where ground-fault sensors are located and how to avoid negating the ground-fault protection scheme during testing and circuit modifications.

C. Coordinate this training with that for generator equipment.

END OF SECTION 263600

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SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following types of LED luminaires:

1. Linear industrial.
2. Strip light.
3. Surface mount, linear.
4. Suspended, linear.

B. Related Requirements:

1. Section 262726 "Wiring Devices" control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
6. Photometric data and adjustment factors based on laboratory tests IES LM-79 and IES LM-80.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
    b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One of each type and rating installed. Furnish at least one of each type.
2. Globes and Guards: One of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Engineer's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

C. Ambient Temperature: 5 to 104 deg F.

1. Relative Humidity: Zero to 100 percent.

D. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles.

1. Label shall include the following lamp characteristics:

C. Recessed luminaires shall comply with NEMA LE 4.

D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

F. California Title 24 compliant.

2.3 LINEAR INDUSTRIAL.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Axlen LED Lighting.
2. Cooper Lighting Solutions; Signify North America Corp.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Lamp:

1. Dimmable from 100 percent to 0 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

C. Housings:

1. Extruded-aluminum or die-cast aluminum housing and heat sink.
2. powder-coat finish.

D. Housing and Heat Sink Rating:

1. NEMA 4X.
2. IP 66.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. With integral mounting provisions.

G. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.

H. Refer to contract drawings for additional requirements.

2.4 STRIP LIGHT.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting Solutions; Signify North America Corp.
2. Flexfire LEDs, Inc.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Nominal Operating Voltage: 120 V ac.

C. Lamp:

1. Dimmable from 100 percent to 0 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum or die-cast aluminum housing and heat sink.
2. powder-coat finish.
3. With integral mounting provisions.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping of luminaire without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

G. Refer to contract drawings for additional requirements.

2.5 SURFACE MOUNT, LINEAR.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Lighting Works.
2. Cooper Lighting Solutions; Signify North America Corp.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Nominal Operating Voltage: 120 V ac.

C. Lamp:

1. Dimmable from 100 percent to 0 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum or die-cast aluminum housing and heat sink.
2. powder-coat finish.
3. With integral mounting provisions.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

G. Refer to contract drawings for additional requirements.

2.6 SUSPENDED, LINEAR

A. Nominal Operating Voltage: 120 V ac.

B. Lamp:

1. Dimmable from 100 percent to 0 percent of maximum light output.
2. Internal driver.
3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

C. Housings:

1. Extruded-aluminum or die-cast aluminum housing and heat sink.
2. powder-coat finish.
3. With integral mounting provisions.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Standards:

1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

F. Refer to contract drawings for additional requirements.

2.7 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

2.8 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.9 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

3.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

E. Wall-Mounted Luminaires:

1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaires:

1. Ceiling Mount:

a. Two 5/32-inch-diameter aircraft cable supports adjustable to 3 feet.
b. Pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 3 feet.
c. Hook mount.

2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 265119

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SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for control of lighting.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-80.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Sustainable Design Submittals:

1. BUG Ratings: Product Data indicating BUG ratings of all installed exterior luminaires.
2. Luminaire Calculations: Product Data indicating lumen emittance and vertical illuminance.
3. Product Data: Indicating luminaire is certified by ENERGY STAR.

D. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

E. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For luminaire supports.

1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Structural members to which equipment and luminaires will be attached.
3. Underground utilities and structures.
4. Existing underground utilities and structures.
5. Above-grade utilities and structures.
6. Existing above-grade utilities and structures.
7. Building features.
8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Source quality-control reports.

G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: One of each type and rating installed. Furnish at least one of each type.
2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: One of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: One of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

F. Mockups: For exterior luminaires, complete with power and control connections.

1. Obtain Engineer's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Engineer prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including luminaire support components.
b. Faulty operation of luminaires and accessories.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Period: 2 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. Lamp base complying with ANSI C81.61.

F. Lamps dimmable from 100 percent to 0 percent of maximum light output.

G. Internal driver.

H. Nominal Operating Voltage: 120 V ac.

I. Lamp Rating: Lamp marked for outdoor use.

J. Source Limitations: Obtain luminaires from single source from a single manufacturer.

K. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting Solutions; Signify North America Corp.
2. Eaton.
3. Lithonia Lighting; Acuity Brands Lighting, Inc.

B. Comply with UL 773 or UL 773A.

C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

A. Area and Site:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Cooper Lighting Solutions; Signify North America Corp.
b. Juno Lighting Group by Schneider Electric.
c. Lithonia Lighting; Acuity Brands Lighting, Inc.

2. Housings:

a. Extruded-aluminum or die-cast aluminum housing and heat sink.
b. powder-coat finish.

3. Refer to contract drawings for additional requirements.

2.5 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:

1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

G. Housings:

1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
2. Provide filter/breather for enclosed luminaires.

H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage and coating.
c. CCT and CRI for all luminaires.

2.6 FINISHES

A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

    a. Color: Black.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As selected from manufacturer's standard catalog of colors.
    b. Color: Match Engineer's sample of manufacturer's standard color.
    c. Color: As selected by Engineer from manufacturer's full range.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Support luminaires without causing deflection of finished surface.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

F. Wall-Mounted Luminaire Support:

1. Attached to a minimum 1/8 inch backing plate attached to wall structural members.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):

   a. IES LM-5.
   b. IES LM-50.
   c. IES LM-52.
   d. IES LM-64.
   e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied

conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Engineer.

END OF SECTION 265619

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SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Category 6 twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cabling identification products.
4. Grounding provisions for twisted pair cable.
5. Source quality control requirements for twisted pair cable.

B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems"
2. Section 262726 "Wiring Devices."
3. Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors
4. Section 270553 "Identification for Communications Systems."

1.3 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. FTP: Shielded twisted pair.

D. F/FTP: Overall foil screened cable with foil screened twisted pair.

E. F/UTP: Overall foil screened cable with unscreened twisted pair.

F. IDC: Insulation displacement connector.

G. LAN: Local area network.

H. Jack: Also commonly called an "outlet," it is the fixed, female connector.

I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.

J. RCDD: Registered Communications Distribution Designer.

K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.

M. S/FTP: Overall braid screened cable with foil screened twisted pair.

N. S/UTP: Overall braid screened cable with unscreened twisted pairs.

O. UTP: Unscreened (unshielded) twisted pair.

1.4 COPPER HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.

1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration Drawings and printouts.
4. Wiring diagrams and installation details of telecommunications equipment, to show location and layout of telecommunications equipment, including the following:

    a. Telecommunications rooms plans and elevations.
    b. Telecommunications pathways.
    c. Telecommunications system access points.
    d. Telecommunications grounding system.
    e. Telecommunications conductor drop locations.
    f. Typical telecommunications details.
    g. Mechanical, electrical, and plumbing systems.

C. Twisted pair cable testing plan.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, installation supervisor, and field inspector.

B. Product Certificates: For each type of product.

C. Source quality-control reports.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For splices and connectors to include in maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Connecting Blocks: One or 10% of each type, whichever is greatest.
2. Faceplates: One or 10% of each type, whichever is greatest.
3. Jacks: Ten of each type.
4. Multiuser Telecommunications Outlet Assemblies: One or 10% of each type, whichever is greatest.
5. Patch-Panel Units: One of each type.
6. Plugs: Ten of each type.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, cabling administration Drawings, and field testing program development by a RCDD or Technician.
2. Installation Supervision: Installation shall be under the direct supervision of Technician or Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

1.11 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.12 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.

2.2 GENERAL CABLE CHARACTERISTICS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP complying with UL 1685 or Type CMP in listed plenum communications raceway.
2. Communications, Non-plenum: Type CMR complying with UL 1666.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. RoHS compliant.

2.3 CATEGORY 6 TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250MHz.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Berk-Tek, a Leviton Company
2. General Cable; Prysmian Group North America
3. Hitachi Cable America Inc
4. Or equal

C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Shielded twisted pairs (FTP).

F. Cable Rating: Riser or Plenum rating to match application.

G. Jacket: Blue thermoplastic.

2.4 TWISTED PAIR CABLE HARDWARE

A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Berk-Tek, a Leviton Company
2. General Cable; Prysmian Group North America
3. Leviton Manufacturing Co., Inc
4. Or equal

C. General Requirements for Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.

E. Connecting Blocks:

1. 110-style IDC for Category 6.
2. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

F. Patch Cords: Factory-made, four-pair cables in 36-inchlengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

G. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Standard: Comply with TIA-568-C.2.

H. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.

I. Faceplate:

1. Two port, vertical single gang faceplates designed to mount to single gang wall boxes.
2. Eight port, vertical double gang faceplates designed to mount to double gang wall boxes.
3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
5. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.

    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

J. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 IDENTIFICATION PRODUCTS

A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test cables on reels according to TIA-568-C.1.

C. Factory test twisted pair cables according to TIA-568-C.2.

D. Cable will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

B. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF PATHWAYS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems."

B. Drawings indicate general arrangement of pathways and fittings.

3.3 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

A. Comply with NECA 1 and NECA/BICSI 568.

B. General Requirements for Cabling:

1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
5. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
6. Consolidation points may be used only for making a direct connection to equipment outlets:

    a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
    b. Locate consolidation points for twisted-pair cables at least 49 feet from communications equipment room.

7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.

9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified by the manufacturer. Use lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
13. Pulling Cable: Comply with manufacturer recommendations. Monitor cable pull tensions.

C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

D. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."

1. Administration Class: Class 1.
2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-B for Class 2 level of administration.

C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if wire color is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
4. Label each terminal strip, and screw terminal in each cabinet, rack, or panel.

a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group, extended from a panel or cabinet to a building-mounted device, with the name and number of a particular device.
b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and -connecting hardware.

Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type, with a printing area and font color that contrast with cable jacket color but still comply with TIA-606-B requirements for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 271513

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SECTION 283100 - INTRUSION DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Intrusion detection with communication links to perform monitoring, alarm, and control functions.
2. Integration of other electronic and electrical systems and equipment.

B. Related Sections:

1. Section 271513 "Communications Copper Horizontal Cabling" for Category 5e, 6, and 7 horizontal (general use, riser-, and plenum-rated) cabling.

1.3 DEFINITIONS

A. CCTV: Closed-circuit television.

B. PIR: Passive infrared.

C. RFI: Radio-frequency interference.

D. UPS: Uninterruptible power supply.

E. Control Unit: System component that monitors inputs and controls outputs through various circuits.

F. Master Control Unit: System component that accepts inputs from other control units and may also perform control-unit functions. The unit has limited capacity for the number of protected batters and is installed at an unattended location or at a location where it is not the attendant's primary function to monitor the security system.

G. Monitoring Station: Facility that receives signals and has personnel in attendance at all times to respond to signals. A central station is a monitoring station that is listed.

H. Protected Zone: A protected premises or an area within a protected premises that is provided with means to prevent an unwanted event.

I. Standard Intruder: A person who weighs 100 lb or less and whose height is 60 inches or less; dressed in a long-sleeved shirt, slacks, and shoes unless environmental conditions at the site require protective clothing.

J. Standard-Intruder Movement: Any movement, such as walking, running, crawling, rolling, or jumping, of a "standard intruder" in a protected zone.

K. Systems Integration: The bringing together of components of several systems containing interacting components to achieve indicated functional operation of combined systems.

L. Zone: A defined area within a protected premises. It is a space or area for which an intrusion must be detected and uniquely identified. The sensor or group of sensors must then be assigned to perform the detection, and any interface equipment between sensors and communication must link to master control unit.

1.4 ACTION SUBMITTALS

A. Product Data: Components for sensing, detecting, systems integration, and control, including dimensions and data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: Detail assemblies of standard components that are custom assembled for specific application on this Project.

1. Functional Block Diagram: Show single-line interconnections between components including interconnections between components specified in this Section and those furnished under other Sections. Indicate methods used to achieve systems integration. Indicate control, signal, and data communication paths and identify programmable logic controllers networks and control interface devices and media to be used. Describe characteristics of network and other data communication lines.

    a. Indicate methods used to achieve systems integration.
    b. Indicate control, signal, and data communication paths and identify PLCs, networks, control interface devices, and media to be used.
    c. Describe characteristics of network and other data communication lines.
    d. Describe methods used to protect against power outages and transient voltages including types and ratings of isolation and surge suppression devices used in data, communication, signal, control, and ac and dc power circuits.

2. Raceway Riser Diagrams: Detail raceway runs required for intrusion detection and for systems integration. Include designation of devices connected by raceway, raceway type and size, and type and size of wire and cable fill for each raceway run.
3. UPS: Sizing calculations.
4. Master Control-Unit Console Layout: Show required artwork and device identification.
5. Device Address List: Coordinate with final system programming.
6. System Wiring Diagrams: Include system diagrams unique to Project. Show connections for all devices, components, and auxiliary equipment. Include diagrams for equipment and for system with all terminals and interconnections identified.
7. Details of surge-protection devices and their installation.
8. Sensor detection patterns and adjustment ranges.

C. Design Data: Include method of operation and supervision of each component and each type of circuit. Show sequence of operations for manually and automatically initiated system or equipment inputs. Description must cover this specific Project; manufacturer's standard descriptions for generic systems are unacceptable.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

B. Product Warranty: Sample of special warranty.

C. Field Test Reports: Test plan and report defining all tests required to ensure that system meets technical, operational, and performance specifications within 60 days of date of Contract award.

D. Evaluation Reports: Examination reports documenting inspections of substrates, areas, and conditions.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For intrusion detection system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Data for each type of product, including features and operating sequences, both automatic and manual.
2. Master control-unit hardware and software data.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Intrusion Detection Devices: Furnish quantity equal to five percent of the number of units of each type installed, but no fewer than one of each type.
2. Fuses: Three of each kind and size.
3. Tool Kit: Provide six sets of tools for use with security fasteners, each packaged in a compartmented kit configured for easy handling and storage.
4. Security Fasteners: Furnish no fewer than 1 box for every 50 boxes or fraction thereof, of each type and size of security fastener installed.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. An employer of workers, at least one of whom is a Certified Alarm Technician, Level 1.
2. Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
3. Layout Responsibility: Preparation of Shop Drawings and cabling administration Drawings , cabling administration Drawings, and field testing program development by a Technician.
4. Installation Supervision: Installation shall be under the direct supervision of Technician, who shall be present at all times when Work of this Section is performed at Project site.
5. Testing Supervisor: Currently certified by BICSI as a Technician to supervise on-site testing.

B. Intrusion Detection Systems Integrator Qualifications: An experienced intrusion detection equipment supplier who has completed systems integration work for installations similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

1. At least one of whom is a Certified Systems Integrator.

C. Testing Agency Qualifications: Certified by BICSI.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: Capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Altitude: Sea level to 4000 feet.
2. Master Control Unit: Rated for continuous operation in an ambient of 60 to 85 deg F and a relative humidity of 20 to 80 percent, noncondensing.
3. Interior, Controlled Environment: System components, except master control unit, installed in temperature-controlled interior environments shall be rated for continuous operation in ambients of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
4. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambients of 0 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
5. Exterior Environment: System components installed in locations exposed to weather shall be rated for continuous operation in ambients of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Comply with UL 294 and UL 639 for outdoor-use equipment. Rate for continuous operation when exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.
6. Hazardous Environment: System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible

dust, or ignitable fibers or flyings shall be rated, listed, and installed according to NFPA 70.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of intrusion detection devices and equipment that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FUNCTIONAL DESCRIPTION OF SYSTEM

A. Description: Hard-wired, modular, microprocessor-based controls, intrusion sensors and detection devices, and communication links to perform monitoring, alarm, and control functions.

B. Supervision: System components shall be continuously monitored for normal, alarm, supervisory, and trouble conditions. Indicate deviations from normal conditions at any location in system. Indication includes identification of device or circuit in which deviation has occurred and whether deviation is an alarm or malfunction.

1. Alarm Signal: Display at master control unit and actuate audible and visual alarm devices.
2. Trouble Condition Signal: Distinct from other signals, indicating that system is not fully functional. Trouble signal shall indicate system problems such as battery failure, open or shorted transmission line conductors, or control-unit failure.
3. Supervisory Condition Signal: Distinct from other signals, indicating an abnormal condition as specified for the particular device or control unit.

C. System Control: Master control unit shall directly monitor intrusion detection units and connecting wiring.

D. System Control: Master control unit shall directly monitor intrusion detection devices, perimeter detection units,, control units associated with perimeter detection units, and connecting wiring in a multiplexed distributed control system or as part of a network.

E. System shall automatically reboot program without error or loss of status or alarm data after any system disturbance.

F. Operator Commands:

1. Help with System Operation: Display all commands available to operator. Help command, followed by a specific command, shall produce a short explanation of the purpose, use, and system reaction to that command.
2. Acknowledge Alarm: To indicate that alarm message has been observed by operator.

3. Place Protected Zone in Access: Disable all intrusion-alarm circuits of a specific protected zone. Tamper circuits may not be disabled by operator.
4. Place Protected Zone in Secure: Activate all intrusion-alarm circuits of a protected zone.
5. Protected Zone Test: Initiate operational test of a specific protected zone.
6. System Test: Initiate system-wide operational test.
7. Print reports.

G. Timed Control at Master Control Unit: Allow automatically timed "secure" and "access" functions of selected protected zones.

H. Automatic Control of Related Systems: Alarm or supervisory signals from certain intrusion detection devices control the following functions in related systems:

1. Switch selected lights.
2. Shift elevator control to a different mode.
3. Open a signal path between certain intercommunication stations.
4. Shift sound system to "listening mode" and open a signal path to certain system speakers.
5. Switch signal to selected monitor from CCTV camera in vicinity of sensor signaling an alarm.

I. Response Time: Two seconds between actuation of any alarm and its indication at master control unit.

J. Circuit Supervision: Supervise all signal and data transmission lines, links with other systems, and sensors from master control unit. Indicate circuit and detection device faults with both protected zone and trouble signals, sound a distinctive audible tone, and illuminate an LED. Maximum permissible elapsed time between occurrence of a trouble condition and indication at master control unit is 20 seconds. Initiate an alarm in response to opening, closing, shorting, or grounding of a signal or data transmission line.

K. Programmed Secure-Access Control: System shall be programmable to automatically change status of various combinations of protected zones between secure and access conditions at scheduled times. Status changes may be preset for repetitive, daily, and weekly; specially scheduled operations may be preset up to a year in advance. Manual secure-access control stations shall override programmed settings.

L. Manual Secure-Access Control: Coded entries at manual stations shall change status of associated protected zone between secure and access conditions.

2.2 SYSTEM COMPONENT REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Control Units, Devices, and Communications with Monitoring Station: Listed and labeled by a qualified testing agency for compliance with SIA CP-01.

C. FM Global Compliance: FM-Approved and -labeled intrusion detection devices and equipment.

D. Comply with NFPA 70.

E. Compatibility: Detection devices and their communication features, connecting wiring, and master control unit shall be selected and configured with accessories for full compatibility with the following equipment:

1. Door hardware specified in Section 087100 "Door Hardware."

F. Surge Protection: Protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads. Include surge protection for external wiring of each conductor entry connection to components.

1. Minimum Protection for Power Lines 120 V and More: Auxiliary panel suppressors.
2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Listed and labeled by a qualified testing agency for compliance with NFPA 731.

G. Intrusion Detection Units: Listed and labeled by a qualified testing agency for compliance with UL 639.

H. Interference Protection: Components shall be unaffected by radiated RFI and electrical induction of 15 V/m over a frequency range of 10 to 10,000 MHz and conducted interference signals up to 0.25-V rms injected into power supply lines at 10 to 10,000 MHz.

I. Tamper Protection: Tamper switches on detection devices, control units, annunciators, pull boxes, junction boxes, cabinets, and other system components shall initiate a tamper-alarm signal when unit is opened or partially disassembled and when entering conductors are cut or disconnected. Master control-unit alarm display shall identify tamper alarms and indicate locations.

J. Self-Testing Devices: Automatically test themselves periodically, but not less than once per hour, to verify normal device functioning and alarm initiation capability. Devices transmit test failure to master control unit.

K. Antimasking Devices: Automatically check operation continuously or at intervals of a minute or less, and use signal-processing logic to detect blocking, masking, jamming, tampering, or other operational dysfunction. Devices transmit detection of operational dysfunction to master control unit as an alarm signal.

L. Addressable Devices: Transmitter and receivers shall communicate unique device identification and status reports to master control unit.

M. Remote-Controlled Devices: Individually and remotely adjustable for sensitivity and individually monitored at master control unit for calibration, sensitivity, and alarm condition.

2.3 ENCLOSURES

A. Interior Sensors: Enclosures that protect against dust, falling dirt, and dripping noncorrosive liquids.

B. Interior Electronics: NEMA 250, Type 12.

C. Exterior Electronics: NEMA 250, Type 4X, stainless steel.

D. Corrosion Resistant: NEMA 250, Type 4X, stainless steel.

E. Screw Covers: Where enclosures are readily accessible, secure with security fasteners of type appropriate for enclosure.

2.4 SECURE AND ACCESS DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bosch Security Systems, Inc.
2. DAQ Electronics, Inc.
3. Honeywell International Inc.

B. Keypad and Display Module: Arranged for entering and executing commands for system-status changes and for displaying system-status and command-related data.

C. Key-Operated Switch: Change protected zone between secure and access conditions.

2.5 DOOR AND WINDOW SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aleph America Corporation.
2. Honeywell International Inc.
3. Interlogix; Carrier Global Corporation.

B. Description: Balanced-magnetic switch, complying with UL 634, installed on frame with integral overcurrent device to limit current to 80 percent of switch capacity. Bias magnet and minimum of two encapsulated reed switches shall resist compromise from introduction of foreign magnetic fields.

C. Flush-Mounted Switches: Unobtrusive and flush with surface of door and window frame.

D. Overhead Door Switch: Balanced-magnetic type, listed for outdoor locations, and having door-mounted magnet and floor-mounted switch unit.

E. Remote Test: Simulate movement of actuating magnet from master control unit.

2.6 MASTER CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Bosch Security Systems, Inc.
2. Honeywell International Inc.
3. Interlogix; Carrier Global Corporation.

B. Description: Supervise sensors and detection subsystems and their connecting communication links, status control (secure or access) of sensors and detector subsystems, activation of alarms and supervisory and trouble signals, and other indicated functions.

1. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
2. Include a real-time clock for time annotation of events on the event recorder and printer.
3. Addressable initiation devices that communicate device identity and status.
4. Control circuits for operation of mechanical equipment in response to an alarm.

C. Comply with UL 609.

D. Console Controls and Displays: Arranged for interface between human operator at master control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: LCD, two line(s) of 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
3. Control-Unit Network: Automatic communication of alarm, status changes, commands, and other communications required for system operation. Communication shall return to normal after partial or total network interruption such as power loss or transient event. Total or partial signaling network failures shall identify the failure and record the failure at the annunciator display and at the system printer.
4. Field Device Network: Communicate between the control unit and field devices of the system. Communications shall consist of alarm, network status, and status and control of field-mounted processors. Each field-mounted device shall be interrogated during each interrogation cycle.
5. Operator Controls: Manual switches and push-to-test buttons that do not require a key to operate. Prevent resetting of alarm, supervisory, or trouble signals while alarm or trouble condition persists. Include the following:

    a. Acknowledge alarm.
    b. Silence alarm.
    c. System reset.
    d. LED test.

6. Timing Unit: Solid state, programmable, 365 days.
7. Confirmation: Relays, contactors, and other control devices shall have auxiliary contacts that provide confirmation signals to system for their on or off status. Software shall interpret such signals, display equipment status, and initiate failure signals.

E. Protected Zones: Quantity of alarm and supervisory zones as indicated, with capacity for expanding number of protected zones by a minimum of 25 percent.

F. Power Supply Circuits: Master control units shall provide power for remote power-consuming detection devices. Circuit capacity shall be adequate for at least a 25 percent increase in load.

G. UPS: UPS shall be sized to provide a minimum of six hours of master control-unit operation.

H. Cabinet: Lockable, steel enclosure arranged so operations required for testing, normal operation, and maintenance are performed from front of enclosure. If more than a single cabinet is required to form a complete control unit, provide exactly matching modular enclosures. Accommodate all components and allow ample gutter space for field wiring. Identify each enclosure by an engraved, laminated, phenolic-resin nameplate. Lettering on enclosure nameplate shall not be less than 1 inch high. Identify, with permanent labels, individual components and modules within cabinets.

I. Transmission to Monitoring Station: A communications device to automatically transmit alarm, supervisory, and trouble signals to the monitoring station, operating over a standard voice grade telephone leased line. Comply with UL 1635.

J. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of intrusion detection.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of intrusion detection connections before intrusion detection installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of intrusion detection.

D. Inspect built-in and cast-in anchor installations, before installing intrusion detection, to verify that anchor installations comply with requirements. Prepare inspection reports.

1. Remove and replace anchors where inspections indicate that they do not comply with requirements. Reinspect after repairs or replacements are made.
2. Perform additional inspections to determine compliance of replaced or additional anchor installations. Prepare inspection reports.

E. For material whose orientation is critical for its performance as a ballistic barrier, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SYSTEM INTEGRATION

A. Integrate intrusion detection system with the following systems and equipment:

1. Electronic door hardware.
2. Elevators.
3. Network lighting controls.
4. Intercommunications and program systems.
5. Public address and mass notification systems.
6. Access control.
7. Fire-alarm system.
8. Perimeter security system.
9. Video surveillance.

3.3 SYSTEM INSTALLATION

A. Comply with UL 681 and NFPA 731.

B. Equipment Mounting: Install master control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.

C. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.

D. Security Fasteners: Where accessible to inmates, install intrusion detection components using security fasteners with head style appropriate for fabrication requirements, strength, and finish of adjacent materials except that a maximum of two different sets of tools shall be required to operate security fasteners for Project. Provide stainless-steel security fasteners in stainless-steel materials.

3.4 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceways according to Section 260543 "Underground Ducts and Raceways for Electrical Systems." Conceal raceway except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

B. Wiring Method: Install wiring in metal raceways according to Section 260543 " Underground Ducts and Raceways for Electrical Systems," except in accessible indoor ceiling spaces and in interior hollow gypsum board partitions where cable may be used. Conceal raceways and wiring except in unfinished spaces and as indicated. Minimum conduit size shall be 1/2 inch. Control and data transmission wiring shall not share conduit with other building wiring systems.

C. Wiring Method: Cable, concealed in accessible ceilings, walls, and floors when possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Use lacing bars and distribution spools. Separate power-limited and non-power-limited conductors as recommended in writing by manufacturer. Install conductors parallel with or at right angles to sides and back of enclosure. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with intrusion system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Wires and Cables:

1. Conductors: Size as recommended in writing by system manufacturer unless otherwise indicated.
2. 120-V Power Wiring: Install according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables" unless otherwise indicated.
3. Control and Signal Transmission Conductors: Install unshielded, twisted-pair cable unless otherwise indicated or if manufacturer recommends shielded cable, according to Section 270513 "Conductors and Cables for Communications Systems."

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

G. Install power supplies and other auxiliary components for detection devices at control units unless otherwise indicated or required by manufacturer. Do not install such items near devices they serve.

H. Identify components with engraved, laminated-plastic or metal nameplate for master control unit and each terminal cabinet, mounted with corrosion-resistant screws.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals.

B. Install instructions frame in a location visible from master control unit.

3.6 GROUNDING

A. Ground the master control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to master control unit.

B. Ground system components and conductor and cable shields to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding. Provide 5-ohm ground. Measure, record, and report ground resistance.

D. Install grounding electrodes of type, size, location, and quantity indicated.

3.7 FIELD QUALITY CONTROL

A. Pretesting: After installation, align, adjust, and balance system and perform complete pretesting to determine compliance of system with requirements in the Contract Documents. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

1. Report of Pretesting: After pretesting is complete, provide a letter certifying that installation is complete and fully operable; include names and titles of witnesses to preliminary tests.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

E. Tests and Inspections: Comply with provisions in NFPA 731, Ch. 9, "Testing and Inspections."

1. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.
2. Test Methods: Intrusion detection systems and other systems and equipment that are associated with detection and accessory equipment shall be tested according to Table "Test Methods" and Table "Test Methods of Initiating Devices."

F. Documentation: Comply with provisions in NFPA 731, Ch. 4, "Documentation."

G. Tag all equipment, stations, and other components for which tests have been satisfactorily completed.

3.8 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other-than-normal occupancy hours for this purpose. Visits for this purpose shall be in addition to any required by warranty.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain the intrusion detection system. Comply with documentation provisions in NFPA 731, Ch. 4, "Documentation and User Training."

END OF SECTION 283100

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SECTION 310515 - SOILS AND AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Soils: Soil materials and topsoil materials.
2. Aggregates: Coarse aggregate materials and fine aggregate materials.

B. Related Sections:

1. Section 312000 “Earthwork.”
2. Section 312333 “Trenching and Backfilling”
3. Section 312500 “Erosion and Sedimentation Control.”
4. Section 321123 “Aggregate Base Courses.”
5. Section 333113 “Public Sanitary Utility Sewerage Piping.”
6. Section 333400 “Sanitary Utility Sewerage Force Mains.”

1.3 ACTION SUBMITTALS

A. Section 013300 “Submittal Procedures” for requirements of submittals.

B. Samples - Soils: Submit in 5-gallon air-tight containers, 25 lbs. sample of each type of soil to testing laboratory.

C. Samples - Aggregates: Submit, in 5-gallon air-tight containers, 25 lbs. sample of each type of aggregate to Engineer at least 15 days prior to placement of backfill or fill.

D. Quality Control Testing: Submit conformance testing performed by a certified independent laboratory engaged by Contractor for all fill materials. Verify maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria at least 72 hours prior to importing or placing any fill. Perform additional conformance testing at a minimum frequency of 1 per every 1000 cubic yards or change in material.

1.4 INFORMATIONAL SUBMITTALS

A. Materials Source: Submit name and location of imported materials suppliers.

B. Source’s Certificate: Certify materials meet or exceed specified requirements.

C. Material Test Reports: For each on-site and borrow soil and aggregate material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698 or ASTM D1557.
3. Test Reports: Submit any test reports required by this Section to the Engineer.

1.5 QUALITY ASSURANCE

A. Furnish each subsoil and topsoil material from single source throughout the Work, unless an alternate source is approved by the Engineer.

B. Furnish each coarse and fine aggregate material from single source throughout the Work, unless an alternate source is approved by the Engineer.

C. Perform Work according to Massachusetts Department of Transportation (Mass DOT) standards.

D. Quality Control and Quality Assurance consists of laboratory conformance testing of samples supplied from each coarse and fine aggregate source and quality control during installation.

1. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

E. Maintain one copy of each standard affecting Work of this Section on Site.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Tree and Plant Protection Zones: Comply with requirements and measures specified in Section 015000 "Temporary Facilities and Controls."

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Common Fill:

1. Approved on site excavated material or imported fill material that is composed of durable soil free of debris, organic matter, or other deleterious materials.
2. Does not contain stones larger than 6 inches in largest diameter.

3. Maximum of 75 percent passing the No. 200 sieve.
4. Maximum dry density of at least 90 pounds per cubic foot (pcf) as determined by ASTM D698.
5. Does not contain granite blocks, broken concrete, masonry rubble, or other similar materials and with physical properties such that it can be readily spread and compacted during filling.

B. Select Common Fill:

1. As specified above for common fill, except contains no stones larger than 2 inches in largest diameter.

C. Structural Fill:

1. Consist of mineral soil free of organic material, loam, debris, frozen soil or other deleterious material which may be compressible, or which cannot be properly compacted,
2. Liquid Limit: 40 percent maximum.
3. Plasticity Index: 10 percent maximum.
4. Dry Density: 95 pcf maximum, as determined by ASTM D698 or ASTM D1557.
5. Meets the following gradation for Sieve Size and Percent Fines by Weight:

a. 3-inch: 100.
b. No. 4: 20 to 70.
c. No. 40: 5 to 35.
d. No. 200: 0 to 10.

2.2 TOPSOIL MATERIALS

A. Topsoil: Conforming to Mass DOT standards.

B. Use of Existing Topsoil

1. Contractor may utilize existing topsoil excavated from within the site to meet the requirements of this Section. Contractor shall be responsible for screening existing topsoil excavated from on site to create suitable topsoil at his/her own expense. Contractor shall screen topsoil with a 1-in screen prior to reuse. Screening shall only be required for material to be utilized for topsoil operations for landscaped or loamed and seeded areas as shown on the Drawings.

C. Imported Topsoil

1. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of 6.4-7.0; organic matter to exceed 1.5 percent, magnesium to exceed 100 units; phosphorus to exceed 150 units; potassium to exceed 120 units; soluble salts/conductivity not to exceed 900 ppm/0.9 mmhos/cm in soil.

2.3 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate - Crushed Stone: Natural stone; washed**,** free of clay, shale, organic matter; conforming to Mass DOT standards.

1. Coarse Aggregate Designation: Mass DOT M2.01.4 (3/4 inch)

B. Coarse Aggregate - Screened Gravel: Natural stone; washed, hard, durable, rounded, or sub-angular particles of proper size and gradation, and shall be free from sand, loam, clay, excess fines, and other deleterious materials; to the following limits:

1. Percent Passing per Sieve Size:

a. 5/8- inch: 100 percent.
b. 1/2-inch: 40 to 100 percent.
c. 3/8-inch: 15 to 45 percent.
d. No. 10 : 0 to 5 percent.

C. Coarse Aggregate - Pea Gravel (Type A5): Natural stone; washed, free of clay, shale, organic matter; graded according to ASTM C136 or ASTM D2487 Group Symbol [GM] [GC]; to the following limits:

1. Percent Passing per Sieve Size:

a. 1/2- inch: 100 percent.
b. 3/8-inch: 90 percent.
c. No. 4: 30 percent.
d. No. 8: 10 percent.
e. No. 16: 5 percent.

2.4 FINE AGGREGATE MATERIALS

A. Fine Aggregate - Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded according to ASTM C33; within the following limits:

1. Percent Passing per Sieve Size:

a. No. 4: 95 to 100.
b. No. 8: 80 to 100.
c. No. 16: 50 to 85.
d. No. 30: 25 to 60.
e. No. 50: 10 to 30.
f. No. 100: 2 to 10.

2.5 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Testing and inspection services. Submit test result reports to the Engineer.

B. Subsoil Material - Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, or AASHTO T180.

C. Topsoil Material - Testing and Analysis: Perform in accordance with ASTM D698, ASTM D1557, AASHTO T180.

D. Coarse Aggregate Material - Testing and Analysis: Perform according to ASTM D698, ASTM D1557, AASHTO T180, ASTM D4318, or ASTM C136.

E. Fine Aggregate Material - Testing and Analysis: Perform according to ASTM D698, ASTM D1557, AASHTO T180, ASTM D4318, or ASTM C136.

F. When tests indicate materials do not meet specified requirements, change material and retest.

G. Furnish materials of each type from same source throughout the Work.

PART 3 - EXECUTION

3.1 EXCAVATION - SOILS

A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.

B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.

C. Remove excess excavated materials, subsoil, and topsoil not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 EXCAVATION - AGGREGATES

A. Coordinate excavation of aggregate materials from on-site locations if indicated on the plans or as specified in Section 312000 “Earthwork.”

B. Stockpile excavated material meeting requirements for coarse aggregate materials and fine aggregate materials.

C. Remove excess excavated materials, coarse aggregate materials, and fine aggregate materials not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for coarse aggregate materials and fine aggregate materials from site.

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3.3 STOCKPILING

A. Stockpile materials on site at locations indicated on Drawings or designated by Engineer.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate different soil and aggregate materials with dividers or stockpile individually to prevent mixing. Prevent intermixing of soil types or contamination.

D. Stockpile topsoil high maximum.

E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

F. Stockpile unsuitable or hazardous materials on impervious liner and cover to prevent erosion and leaching, until disposed of.

3.4 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

B. Leave unused materials in neat, compact stockpile.

C. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 310515

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SECTION 310519.13 - GEOTEXTILES FOR EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Nonwoven geotextile material.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for fill and grading materials.
2. Section 312000 “Earthwork” for excavation and backfilling procedures.
3. Section 312333 “Trenching and Backfilling” for trenching and backfilling procedures.
4. Section 312500 “Erosion and Sedimentation Controls” for erosion and sedimentation control devices.

1.3 ACTION SUBMITTALS

A. Submit items in this Article at least 30 days prior to installation.

B. Product Data: Submit certified test results from the manufacturer including tensile strength, elongation, thickness, UV resistance, and other material properties.

C. Samples for Verification:

1. Submit samples, full width by 12 inches long, for each type and weight of geotextile used on Project, illustrating thickness, color, and texture.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures and quality control and quality assurance.

C. Manufacturer’s quality control program and manual, including a description of laboratory facilities.

D. Source Quality-Control Submittals: Provide results of factory tests and inspections, including test results that indicate materials meet the requirements of PART 2.

E. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.

1.5 QUALITY ASSURANCE

A. Perform Work according to Massachusetts Department of Transportation Standard Specifications for Highways and Bridges (SSHB) standards and the recommendations of the Manufacturer.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging that identifies the manufacturer/supplier’s name, style, and roll number. Inspect for damage.

B. Comply with ASTM D4873.

C. Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture, dust, chemicals, UV radiation or other environmental conditions that might damage the geotextile by storing at least 3 inches off the ground in a clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.8 WARRANTY

A. Special Warranty: Installer agrees to repair or replace geotextile related products that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1

2.1 MATERIALS - NONWOVEN GEOTEXTILES

A. Manufacturers:

1. Furnish materials according to Massachusetts Department of Transportation SSHB and Town of Yarmouth standards.

B. Description:

1. Non-biodegradable, non-reactive (for pH of three to eleven), UV-resistant, insect/rodent-resistant nonwoven needle punched material consisting of filaments formed into a stable network.
2. Edges: Selvaged to prevent separation of outer material.

C. Performance and Design Criteria:

1. When tested in accordance with ASTM D4759, test results from any sampled roll in the lot shall meet or exceed the values listed in Table 1. Strength values are in the weaker principal direction.

TABLE 1: NONWOVEN GEOTEXTILE MINIMUM AVERAGE ROLL VALUES

PROPERTIES	TEST METHOD	UNIT	4 oz
Mass per Unit Area	ASTM D5261	oz/yd2 (g/sm)	4.8
Thickness	ASTM D5199	mils (mm)	40
Grab Strength	ASTM D4632	lbs (kg)	120
Grab Elongation	ASTM D4632	percent	50
Trapezoid Tear Strength	ASTM D4533	lbs (kg)	50
Puncture Strength	ASTM D4833/ D6241	lbs (kg)	310
Water Flow Rate	ASTM D4491	gpm/ft2 (lpm/m2)	135
Permittivity	ASTM D4491	sec-1	1.7
Apparent Opening Size (Max)	ASTM D4751	inch (mm) US Std. Sieve	0.008 70
UV Resistance	ASTM D4355	percent strength retained	70

2.2 MATERIALS - ACCESSORIES

A. Use products to secure geotextile fabrics as recommended by geotextile manufacturer.

2.3 SOURCE QUALITY CONTROL

A. If requested by the Owner, provide materials for Quality Assurance Laboratory (QAL) testing by an independent GRI accredited laboratory to confirm conformance testing results.

B. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. The Engineer shall inspect subgrade to verify that underlying surface is smooth and free of ruts or protrusions that could damage geotextile material and that subgrade has been properly prepared.

B. Subgrade Material and Compaction Requirements: As specified in Section 312333 “Trenching and Backfilling” and 312000 “Earthwork”.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's published installation instructions. Do not install damaged materials.

B. Geotextile Material:

1. Lay and maintain smooth and free of tensile stresses, folds, wrinkles, or creases.
2. Ensure that material is in direct contact with subgrade.
3. Orientate with long dimension of each sheet parallel to direction of slope and in accordance with the manufacturer’s recommendations and approved shop drawings.
4. Minimum Unseamed Joints Overlap: 18 inches.

C. Repairing Damaged Geotextiles:

1. Repair torn or damaged geotextile by placing patch of same type of geotextile over damaged area minimum of 18 inches beyond edge of damaged area and fasten as recommended by geotextile manufacturer.
2. Remove and replace geotextile rolls which cannot be repaired.

D. Fill and Cover:

1. Place fill to prevent tensile stress or wrinkles in geotextile.
2. Place fill from bottom of side-slopes upward.

3. Do not drop fill from height greater than 3 feet.

3.3 PROTECTION

A. Ballast: Adequate to prevent uplift of material by wind.

B. UV Exposure: Do not leave material uncovered for more than 14 days after installation.

C. Do not use staples or pins to hold geotextiles in place where located adjacent to other geosynthetic layers that could be damaged.

D. Do not operate equipment directly on top of geotextile.

END OF SECTION 310519.13

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SECTION 310900 - GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes performing pre-construction surveys and installing and monitoring geotechnical instrumentation and survey markers to measure:

1. Performance of excavation support systems.
2. Groundwater levels inside and outside excavation limits.
3. Vertical deformation of ground surface adjacent to and directly over the Work.
4. Vertical and horizontal deformation of existing utilities and structures adjacent to and over the Work.
5. Ground vibration levels at adjacent facilities due to Contractor activities, including but not limited to demolition and pile installation.

B. Related Requirements:

1. Section 312000 "Earthwork."
2. Section 312319 "Dewatering."
3. Section 312333 “Trenching and Backfilling.”
4. Section 315000 "Excavation Support and Protection" for temporary procedures.
5. Various Sections in Division 02 relating to different types of demolition.
6. Various Sections in Division 31 relating to different types of piles.

1.3 DEFINITIONS

A. Crack Gauges: Transducers mounted across cracks identified on existing structures during the preconstruction survey to monitor the crack width.

B. Deformation Monitoring Points (DMPs): Fixed markers placed on existing utilities and structures to measure both vertical and horizontal movement. Initial coordinate locations and vertical controls are determined by optical survey methods.

C. Excavation Support Monitoring Points (ESMPs): Inscribed marking or fixed makers placed on excavation support systems to measure horizontal movement of the excavation support system.

D. Groundwater Observation Wells: Screened or slotted pipe with solid riser pipe installed in a drilled hole with the annulus around the pipe backfilled with sand. Near surface groundwater levels are measured in the well.

E. Seismographs: Electronic recording device with vibration transducer capable of monitoring and recording ground vibrations induced by construction activity.

F. Surface Monitoring Points (SMPs): Inscribed marking or approved surveyor's nail installed to measure vertical (elevation) movement.

G. Utility Monitoring Points (UMPs): Steel rod inside fully cased hole that is resting on existing utilities or underground structures to measure movement of the existing underground structure or utility.

1.4 ACTION SUBMITTALS

A. Submit in accordance with Section 013300 “Submittal Procedures”.

B. Submit for the Engineer’s review four weeks prior to instrument installation:

1. Installation Plan and Schedule: Full details and plan/layout of proposed instruments/points, schedule for installing and monitoring instruments/points, equipment types, installation methods, reference points, and monitoring and data reporting schedule for instruments/points, and instrumentation protection.
2. Description of methods for installing and protecting all instrumentation including but not limited to seismographs, observation wells, crack gauges, monitoring points, and reference points.
3. Groundwater observation well construction details including casing type, filter gradation, screen interval, grout mix, drilling methods, and well depths.
4. For instrumentation installed in borings, submit a detailed procedure for installation, including post-installation acceptance test, together with a sample installation record sheet that include:

    a. Method to be used for cleaning inside of casing or augers.
    b. Drill casing or auger type and size.
    c. Depth increments for backfilling boreholes with sand and bentonite.
    d. Method for overcoming buoyancy of instrumentation components during grouting.
    e. Method of sealing joints in pipe casing to prevent ingress of grout.

C. Installations Records: Within five working days of installing each instrument, submit to the Engineer, specified as-built instrument location and its corresponding installation record sheet.

1. Include in installation record sheet, location with instrument identification numbers, established elevations, initial elevations and coordinates (baseline readings), boring log, installation, and monitoring date and time.
2. Furnish details of installed instruments showing dimensions, materials used, and as-built drawings of each instrument.
3. Submit field calibrations.

D. Reports and Records: Provide reports of monitoring data to the Engineer and include following minimum information:

1. Preconstruction survey.
2. As-installed location plan, installation records, and baseline values for instrumentation.

3. Monitoring data for instruments with plots against threshold values.
4. Weekly records of crack monitors and including photographs with readings.
5. Event reports and summary from vibration monitoring.
6. Discussion and associated action related to results exceeding threshold values.

E. Submit proposed remedial measures to the Engineer of action to be taken in event that instrument Threshold Values are reached.

1.5 INFORMATIONAL SUBMITTALS

A. Submit names, qualifications, and experience of personnel who will install instruments, perform optical level survey and vibration monitoring, read instruments, and report data to the Engineer demonstrating compliance with “Quality Assurance” Article in this Section.

B. Certificates: Submit for each seismograph or other necessary instrument that manufacturer has inspected and tested each instrument before it leaves the factory confirming that it is working correctly without defects or missing parts and current calibration records.

1.6 QUALITY ASSURANCE

A. Geotechnical Instrumentation Engineer Qualifications: Professional engineer registered in the State in which the work is performed with at least 5 years’ experience in installation of specified instrumentation and will supervise and direct technicians and be responsible for instrument installation. Be present at installation sites to direct and supervise installations, oversee instrumentation reading, and supervise geotechnical instrumentation data interpretations.

B. Surveyor Qualifications: Professional Land Surveyor registered in State in which the work is performed with at least 3 years’ experience in surveying of similar instruments. Establish Deformation Monitoring Points, Surface Monitoring Points, Utility Monitoring Points, and Excavation Support Monitoring Points and take baseline readings.

C. Manufacturer Qualifications: Provide instruments and components from an approved manufacturer currently engaged in manufacturing specified geotechnical instrumentation hardware.

D. Preconstruction Survey Engineer Qualifications: Professional engineer registered in State in which the work is performed with at least 5 years’ experience in structural evaluations and condition surveys.

E. Technicians Qualifications:

1. Minimum 3 years’ experience for personnel responsible for optical level surveys, instrument readings, and report data.
2. Trained in use of seismograph along with reporting results of analyzing and reporting frequency content of seismograph record.
3. Experienced in installation and reading of specified geotechnical instrumentation and equipment.

F. Factory Calibration: Conduct factory calibration on instruments prior to shipment with certification submitted to indicate that test equipment used for this purpose is calibrated and maintained in accordance with test equipment manufacturer's calibration requirements and that, where applicable, calibrations are traceable to U.S. National Institute of Standards and Technology.

1. Include a calibration curve with data points clearly indicated and a tabulation of data. Mark each instrument with a unique identification number.

G. Perform instrument installations in presence of the Engineer.

H. Be responsible for installation, maintenance, and monitoring of geotechnical instrumentation.

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

A. Project Requirements:

1. Install geotechnical instrumentation to monitor ground conditions, ground response, and facilities to achieve specified project requirements and prevent damage to facilities potentially affected.
2. Install instrumentation in accordance with approved Instrumentation Schedule.
3. Engineer's monitoring of installed instruments does not relieve Contractor of its obligation to complete project within the requirements specified herein taking necessary additional measurements.

B. Pre-Construction Survey:

1. Prior to start of demolition, excavation work, installation of excavation support and dewatering work, engage the services of an independent licensed professional engineer, to conduct a pre-construction survey of existing structures and conditions within 100 feet of the anticipated demolition, excavation work, installation of excavation support, and dewatering work at the pumping station sites and where dewatering wells are located within 25 feet of existing structures including residences, businesses, and any other structures that in use for any portion of the year.

a. Coordinate activities, issue notices, obtain clearances and provide photographic and secretarial assistance necessary to accomplish the survey.
b. Give notice in writing, to property owners and representatives of local authorities required to be present at such survey. Notify in writing the dates on which surveys are planned so that representatives are present during the examination. Provide copies of notices to Owner and the Engineer

2. Record observations of the existing conditions for residences, buildings and other structures, which are affected.

a. Provide the survey consisting of a description of interior and exterior conditions. Locate cracks, damage or other defects existing and include information to make it

possible to determine the effect, if any, of the construction operations on the defect. Where significant cracks or damage exists, or for defects too complicated to describe in words, photographs shall be taken and made part of the record.

b. Records of each property examined must be signed by the representatives present and, if practicable, by property owners, whether or not they are present at the examinations.

3. Record of the pre-construction survey shall consist of written documentation, video and photographs of the conditions identified. At the completion of the survey, submit copies of the documentation to Owner.
4. Upon completion of all excavation work, installation of excavation support and dewatering work, the complete a similar examination of properties and structures where complaints of damage have been received or damage claims have been filed. Give notice to interested parties so that they may be present during the final examinations. Records of the final examination shall be signed and distributed as the original pre-construction survey.
5. Retain records in Contractor's file for at least 3 years after completion of the Contract. In the event of damage claims, prepare a report on the particular structures as requested by the Engineer from those notes and photographs and submitted to Owner. Repair damage attributed to Contractor’s activity promptly and completely to property owners’ satisfaction to restore the conditions of the property to that existing prior to work.

C. Secure required permits prior to the installation or removal of observation wells.

D. Provide and facilitate safe access to the instruments at all times. Engineer may perform additional monitoring in a manner that will minimize unnecessary work delays. Allow and facilitate instrument monitoring as required by the Engineer. No claim for lost production time due to this activity will be allowed.

E. Maintain instrumentation. Report damaged or non-functional instrumentation to the Engineer within 24 hours. Replace damaged instruments within 24 hours.

F. Availability of Data:

1. Instrumentation readings shall be collected by the Contractor’s Geotechnical Instrumentation Monitoring Firm. Contractor may take their own supplementary readings in addition to those specified.
2. Monitoring data is the property of Owner and is not to be disclosed or published to third parties without Owner’s written permission.
3. Contractor is expected to make their own interpretations for their own purposes without additional compensation.
4. Coordinate with the Engineer to verify consistency of collected data.

2.2 INSTRUMENTATION - GENERAL

A. Instruments and materials, including readout units, installation tools, materials, and miscellaneous instrumentation components.

B. Provide surface protection for instruments flush with surface in paved or other ground surface areas at the time that work is completed.

C. Minimum Quantity of Instruments: While quantities in following Paragraph are considered minimums, obtain data from instrumentation in quantity to monitor construction, performance, and safety aspects of the Work.

D. Following subparagraphs identify instrument type, minimum number to be provided, and approximate installed depth from of excavation / tunnel invert:

	Instrument Type:	Number:	Depth:
1.	Observation Wells:	N/A	N/A
2.	Seismographs:	2	N/A.
3.	Surface Monitoring Points:	6	N/A.
4.	Deformation Monitoring Points:	4	N/A.
5.	Utility Monitoring Points:	4	N/A.
6.	Excavation Support Monitoring Points:	4	N/A.
7.	Crack Gauges	(as req'd to monitor existing cracks)	

E. Locate instruments and obtain approval from the Engineer.

2.3 GROUNDWATER OBSERVATION WELLS

A. Pipe: ASTM D1785, Schedule 40 PVC pipe, 1 inch minimum inside diameter.

B. Maximum Screen Size: 0.020 inch, unless otherwise approved by the Engineer.

C. Use observation wells to monitor groundwater levels outside excavations.

2.4 MONITORING POINTS

A. Surface Monitoring Points (SMPs):

1. Use to monitor vertical deformation at or near ground surface, clearly identifying points with permanent easily readable letters and numbers as approved by the Engineer.
2. Paved Areas: 2 inches long masonry nail, manufactured from hardened zinc–plated steel and driven into an asphalt covered surface. Identify each nail individually with an identification tag or surface marking.
3. Non-Paved Areas: 3 feet 3/4 inch diameter steel rod driven into ground or set in concrete such that no more than 3 inches of rod is exposed above ground surface. Round top of rod and punch-mark it at its center. Identify each rod with a surface marking.
4. Utility Manholes: Observable cross mark or welded bead on top horizontal surface of manhole rim. Clean surface within 3 inches of point and mark it using fluorescent spray paint adjacent to point to permit easy identification of exact location.

B. Deformation Monitoring Points (DMPs):

1. Use to monitor vertical and horizontal movement of adjacent utilities and structures with following approved by the Engineer.
2. Materials: Nails, screws, reinforcing bars, bolts, and similar materials with well-defined measurement points.

3. Firmly attach and protect from damage and vandalism. Remove or cover points protruding more than 1/4 inch with a protective box or cap.
4. Clearly identify with permanent easily readable letters and numbers.

C. Utility Monitoring Points (UMPs):

1. Use to monitor vertical and horizontal deformation of selected utilities and underground structures. Include following at a minimum:

   a. Steel Pipe: ASTM A53/A53M Grade B, 3-1/2 inch extra strong steel sleeve and 1 inch extra strong steel riser, threaded and coupled.
   b. PVC Centralizers: ASTM D1785, Schedule 40 PVC pipe, sized to provide a tight fit on riser pipe, and spring-formed to a larger diameter to provide a loose fit in sleeve pipe.

2. Install to top of utility or underground structure by vacuum excavation method. Set monitoring rod with centralizers on top of the utility or underground structure and extending to within 1 foot of ground surface.
3. Install with a flush mount road-box casing at grade, clearly identified by surface marking.

D. Excavation Support Monitoring Points (ESMPs):

1. Use as fixed markers on vertical elements of excavation support system and to monitor horizontal deformation of excavation support system designed by Contractor.
2. Clearly identified points with permanent easily readable letters and numbers as approved by the Engineer.
3. Clean surface within 3 inches of each point and clearly identify using fluorescent spray paint adjacent to point.

E. Non-Shrink Cement Grout: Suitable for intended application.

2.5 SEISMOGRAPHS

A. Portable for monitoring ground vibrations velocities resulting from construction activities, calibrated within the previous six months, and having following characteristics:

1. Measure three mutually perpendicular components of particle velocity in directions vertical, radial, and perpendicular to vibration source.
2. Measure and display maximum peak particle velocity continuously during vibration-generating activities.
3. Have a low frequency omnidirectional transducer for measuring air blast overpressure with a flat frequency response within the limits of 2 Hertz to 200 Hertz with a tolerance equal to or better than plus or minus 10 percent.
4. Seismic Range: 0.01 inch to 4 inches per second with an accuracy of plus or minus 5 percent of measured peak particle velocity or better at frequencies between 10 Hertz and 100 Hertz, and with a resolution of 0.01 inch per second or less.
5. Acoustic Range: 110 dB to 140 dB (referenced to 20 micro-Pascals) with an accuracy and resolution of plus or minus 1 dB.
6. Frequency Response (plus or minus 3 dB): 2 Hertz to 200 Hertz.

7. Two Power Sources: Internal rechargeable battery and charger capable of supplying power to monitor vibrations continuously for up to 24 hours at 115 volts AC.
8. Self-triggering wave form capture mode that provides plot of wave forms, peak particle velocities, peak overpressure, and frequencies of peaks.
9. Continuous monitoring mode capable of recording single-component peak particle velocities and frequency of peaks with an interval of 1 minute or less.

B. Provide for full-time use on the project during vibration causing construction activities.

2.6 CRACK MONITORS

A. Crack Gauges:

1. Threaded Anchors: Include ball joints which can be grouted to each side of crack in any orientation.
2. Transducer: Range of at least 1 inch and an accuracy of less than 0.1 percent and a non-linearity of no more than 0.5 percent.
3. Gauge: Capable of operating in temperatures ranging from minus 68 degrees F to 176 degrees FProvide a solid steel cover over each gauge which does not touch or otherwise interfere with gage operation.

B. Basis-of-Design Manufacturer - Crack Gauges: Provide Model 4420 as manufactured by Geokon, Inc., or equal for monitoring width of existing cracks and joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with the Engineer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Existing Conditions: Locate vaults, structures, conduits and underground utilities in areas where wells are to be drilled and installed. Conduct utility clearance and contact utility companies prior to any drilling.

1. Modify instrument locations, as approved by the Engineer, to avoid interference with existing vaults, structures, conduits and utilities.
2. Repair damage to existing facilities resulting from instrument installations without additional compensation.

B. Prior to commencing installation of excavation support, excavation, sheet pile installation and dewatering work, furnish instrumentation and related components that are to be installed during construction and conduct pre-construction surveys.

C. Protect from damage and maintain instruments. Repair or replace damaged instruments.

D. Drilling from Ground Surface: Obtain necessary permits for each instrument and conform to permit requirements during drilling and installation.

E. Implement remedial measures based on interpretations of monitoring data program.

3.3 GENERAL REQUIREMENTS

A. Perform a pre-construction survey prior to any dewatering, excavation, or installation of excavation support.

B. Install instruments at the Engineer approved locations in accordance with approved installation procedures. Engineer may modify instrument locations depending on field conditions and monitoring objectives. Install instrumentation in accordance with approved installation schedule. Install instruments and obtain baseline data before construction starts.

C. Allow the Engineer access to instrument locations and assistance required in obtaining monitoring data.

D. Clearly mark and label instruments and protected to avoid being obstructed or otherwise damaged by construction operations or general public. Immediately following installation, survey location and top of instruments to provide horizontal and vertical coordinates.

1. Re-survey if the Engineer questions instrument locations

E. Assign a unique identification number to each instrument and each point that is clearly marked in a non-destructible manner.

F. Initial Reading: Immediately following instrument installation take two sets of initial readings in the Engineer’s presence to provide baseline readings and to demonstrate adequacy of completed installation.

3.4 MONITORING POINTS

A. Monitoring Points: Include but not be limited to SMPs, DMPs, UMPs and ESMPs. Monitor these control points using surveying methods. Modify locations to meet site constraints with the Engineer’s approval.

B. SMPs, DMPs and UMPs: Install as described below near excavations, sheet pile installation locations, and open trench locations. Additional SMPs, DMPs, and UMPs may be required by the Engineer.

C. Additional SMPs:

1. Install in pavement or ground surface within 10 feet along each side of trench excavations that is over 12 feet deep and that is within 50 feet of structures. Install at spacing not exceeding 50 feet.
2. Install on rim of utility manhole covers located within 50 feet of trenchless crossings or within 30 feet of open excavations.

D. DMPs:

1. Install on exterior walls of buildings or structures located within 30 feet of open excavations, 100 feet of pile installation, or 50 feet of shafts or trenchless crossing alignments. Preferred installations are on supporting walls or columns. Avoid installation in brick, unless no other option exists.
2. As a minimum, install on exterior wall corners of buildings, structures, or property boundary walls at not more than 50 feet spacing. Install additional DMPs to monitor building movement at other locations when determined by the Engineer.
3. Install DMPs in cooperation with property Owners so that installations are inconspicuous and acceptable to them. Existing features of building foundations that are permanent and can be repeatedly surveyed may be substituted for DMPs, if approved by the Engineer.

E. UMPs: Install on existing utility over 36 inch in diameter and located within 15 feet from excavation or directly over trenchless crossing. Locate at a spacing of not more than 25 feet.

F. ESMPs:

1. Install on excavation support systems other than trench box along support walls at spacing not more than 25 feet.
2. Install prior to excavation within exaction support system.
3. Read results at least daily during associated excavation and twice a week until backfill is completed.

G. SMPs, UMPs, and DMPs:

1. Obtain two sets of measurements for each monitoring point to establish baseline data within three days of installation. Make at least 24 hours apart, but not more than 48 hours.
2. Check monitoring points with initial surveyed elevations or offsets as appropriate differing by more than 0.08 inch for secure installation and resurvey.
3. Read monitoring points prior to installing excavation support, beginning, excavation, operation of groundwater control system, or start of sheet pile installation at the site.
4. Read daily during, excavation, dewatering, filling and backfilling, and excavation support installation located within 50 feet of the work, then at least twice a week until excavation, dewatering, and backfill has been completed.

H. Crack Gauges:

1. Install on exterior walls of buildings or structures with existing cracks located within 30 feet of open excavations.
2. Install DMPs in accordance with manufacturer’s recommendations and in cooperation with property Owners so that installations are inconspicuous and acceptable to them.

3.5 VIBRATION MONITORING

A. Take seismograph readings during excavation, compaction, and excavation support installation or other activities causing ground vibrations within 50 feet of existing structures to document that peak particle velocities do not exceed specified limit criteria.

B. Install seismographs near existing structures when vibratory or impact hammers are used for the installation of excavation support within 50 feet of existing structures, and as directed by the Engineer.

3.6 GROUNDWATER OBSERVATION WELLS

A. Install at least one monitoring well at site if no existing monitoring wells are present.

B. Existing wells may be used if appropriate and approved by the Engineer.

C. Set screened interval of each well to monitor groundwater levels.

D. Drill 4 inch minimum diameter holes for observation wells of required size and depth and case with temporary casing. Do not use bentonite drilling mud in drilling holes for observation wells.

E. Flush cased holes with clean water through an approved bit. Flush until discharge water is free of soil particles.

F. Construct observation well with 10 feet of slotted PVC well screen, filter sand, bentonite seal, couplings, a pipe cap, and a locking cover.

1. Place two feet of filter sand in bottom of drilled hole. Then place well screen and surround it with filter sand, as temporary casing is carefully withdrawn.
2. Insert solid PVC casing and cap and fill annular space with bentonite pellets then non-shrink cement grout.
3. Protect observation wells at ground surface by providing a roadway box or outer protective casing with lockable top and padlock. Design surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.

    a. Provide two keys for each padlock to the Engineer for access to each well.
    b. Develop observation wells to provide a reliable indication of groundwater levels. Re-developed wells if well clogging is observed, in event of apparent erroneous readings, or as directed by the Engineer.
    c. Submit observation well installation logs, top of casing elevation, and well locations to the Engineer within 24 hours of completion of well installation.

G. Observation Well Maintenance:

1. Maintain observation well until adjacent structures, and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed. Maintain observation wells and repair or replace them without additional compensation, whether or not observation wells are damaged by Contractor's operations or by third parties.

H. Monitoring and Reporting of Observation Well Data:

Begin daily monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Continue daily monitoring in areas where groundwater control is

in operation until time that adjacent structures and pipelines are completed and backfilled and until time that groundwater control systems are turned off.

1. Be responsible for processing and reporting observation well data to the Engineer daily. Submit data to the Engineer on a form that includes following information.

    a. Observation well number.
    b. Depth to groundwater.
    c. Top of casing elevation.
    d. Groundwater level elevation.
    e. Date and time of reading.

I. Following construction, abandon new and existing observation wells as directed by the Engineer.

1. Abandon observation wells by removing materials within original borehole, including casing, filter, and grout seal in accordance with applicable permits.
2. Using approved tremie methods, completely fill hole and voids with non-shrink cement grout prior to removal of drill casing, such that formation materials do not move into hole prior to grouting.
3. Restore ground surface to its original condition.
4. Abandon wells within paved areas by removing vaults and well caps to pavement subgrade.
5. Remove wells with as discussed above and repair or patch pavement with same surface type.

3.7 INSTRUMENT PROTECTION, MAINTENANCE AND REPAIR

A. Protect instruments from damage. Replace damaged or destroyed instruments within 72 hours of damage, without additional compensation. If necessary, suspend work in areas being monitored by damaged instrument and take remedial action.

B. Maintain instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed at all times.

3.8 MONITORING

A. Collect, tabulate, plot, and interpret survey monitoring data and provide the Engineer with tabulated and plotted data. Report status of excavation, bracing, groundwater levels, compaction, and backfilling at time of data collection with each report.

B. Monitoring frequency may be modified as directed and approved by the Engineer.

C. Submit data from readings of monitoring points to the Engineer within 24 hours of reading. Communicate verbally with the Engineer immediately after visual observations or data collection if excessive movements or other anomalies are indicated.

D. For seismograph data, submit a summary report with event summary of peak particle velocity and frequency. Submit a strip chart indicating time and magnitude of maximum single-

component peak particle velocity measured during each 5-minute interval of monitoring period. List a summary of vibration producing activities for that week along with specific events causing anomalous readings.

E. Make visual observations of ground conditions and building conditions in site vicinity and communicate immediately with the Engineer if signs of ground or building movements are observed.

F. Engineer may take independent instrumentation measurements. Cooperate with the Engineer during instrumentation monitoring by providing access to instrumentation locations in a timely manner and by providing and maintaining safe means of access to instrumentation locations for data collection. Data acquired by the Engineer will be made available to Contractor in a timely manner.

G. Contractor may make their own interpretations of monitoring data for their own purposes. Do not publish or disclose data or interpretations shall to other parties without advance written permission of Owner.

H. For data collected from an instrument that has been installed to replace a damaged instrument, use formal initial reading as an initial reading for replacement instrument so that data are continuously plotted, without an offset at time of damage. Note time of damage and replacement on plot.

3.9 INTERPRETATION AND RESPONSE VALUES

A. Make interpretations of data resulting from monitoring programs.

B. Threshold and Limiting Values for Instruments:

Instrument	Threshold Value	Limiting Value
Seismographs:	1.0 in/sec over 40 Hz	2.0 in/sec over 40 Hz
	0.75 in/sec at 30 to 40 Hz	1.5 in/sec at 30 to 40 Hz
	0.50 in/sec at 20 to 30 Hz	1.0 in/sec at 20 to 30 Hz
	0.25 in/sec under 20 Hz	0.5 in/sec under 20 Hz
	25 mm/sec over 40 MHz	50 mm/sec over 40 MHz
	19 mm/sec at 30 to 40 MHz	38 mm/sec at 30 to 40 MHz
	12 mm/sec at 20 to 30 MHz	25 mm/sec at 20 to 30 MHz
	6 mm/sec under 20 MHz	12 mm/sec under 20 MHz
Surface Monitoring Points:	0.5 inch	1.0 inches
Deformation Monitoring Points:	0.25 inch	0.5inches

Utility Monitoring Points:	0.25 inch	0.5inches
Excavation Support:	1.0 inch	2.0 inches
Observation Wells	2 feet	2 feet below bottom of excavation

C. Values are subject to adjustment by the Engineer as indicated by prevailing conditions or project circumstances. Crack Gauge criteria will be established based upon existing conditions identified during preconstruction survey.

D. If a Threshold Value is reached:

1. Engineer and Contractor will meet to discuss remedial measures.
2. Increase instrument monitoring frequency as directed by the Engineer.
3. Install and monitor additional instruments as directed by the Engineer.
4. Implement remedial measures in event Threshold Value is reached, so Limiting Value is not reached.

E. Take necessary steps so Limiting Value is not exceeded. Engineer may direct Contractor to suspend activities in affected area with exception of those actions necessary to avoid exceeding Limiting Value.

3.10 TOLERANCES

A. Survey Measurements: Initial location of each instrumentation elements consisting of determining elevation and horizontal positions with respect to the Engineer approved benchmarks.

B. Monitoring Points (SMPs, DMPs, UMPs and ESMPs):

1. Instrumentation Elevations: Determine to accuracy of plus/minus 0.01 footHorizontal Position of Surface Monitoring Points: Determine to accuracy of plus/minus 0.1 footHorizontal Position of Deformation Monitoring Points and Excavation Support Monitoring Points: Determine to accuracy of plus/minus 0.01 foot

C. If actual field conditions prohibit installation at location and specified elevations, obtain prior acceptance from the Engineer for new instrument location and elevations.

3.11 DISPOSITION OF INSTRUMENTS

A. Monitoring Points and Crack Gauges: Remove monitoring points and crack gauges during cleanup and restoration work, unless directed otherwise by the Engineer.

B. Observation Wells and Utility Monitoring Points: When required by the Engineer, abandon and remove protective housings and caps in accordance with required permits. Restore surfaces affected by installation of instruments to their original condition prior to completion of work.

1. Leave in place any casings located within plan limits of new or existing structures or pipelines or within zone below 1H:1V planes extending downward and out from edges of

foundation elements, from downward vertical footprint of pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities or structures.

2. Where casings are pulled, fill holes with sand. Where left in place, fill casings with non-shrink cement grout and cut off a minimum of 3 feetbelow finished ground level or 1 footbelow foundation level so as not to interfere with finished structures or pipelines.
3. Following backfilling, remove precast boxes or vaults and reconstruct pavement in paved areas. Restore surface to conditions existing prior to instrument installation.

C. Seismographs: Remove units following completion of compaction, removal of excavation support, and excavation.

END OF SECTION 310900

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and removing site utilities abandoning site utilities in place.
6. Temporary erosion and sedimentation control.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 312500 “Erosion and Sedimentation Controls” for temporary protection of erosion and sedimentation.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than one percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Submit, in accordance with specifications, copies of all permits required prior to clearing, grubbing and stripping work.

C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed roadways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Engineer.

C. Utility Locator Service: Notify Dig Safe System for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earthwork."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

D. Call Local Utility Line Information service not less than three working days before performing Work.

1. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.

1. Verify that utilities have been disconnected and capped before proceeding with site clearing.

B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies to shut off indicated utilities.
2. Owner will arrange to shut off indicated utilities when requested by Contractor.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer’s written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 1-1/2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and stockpile in areas approved by Engineer.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than one foot across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

B. Stockpile rock away from edge of excavations without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.

1. Limit height of rock stockpiles to 36 inches.
2. Do not stockpile rock within protection zones.
3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
4. Stockpile surplus rock to allow later use by Owner.

3.8 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

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2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

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SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. General: Earthwork includes clearing and stripping, procurement of on-site and imported fill material, excavating, placing, and compacting fill and backfill, structural excavating and backfilling, transportation and storage of excess earthwork materials; disposal of unsuitable, waste, and surplus materials; restoration of excavation and trench surfaces; and subsidiary work necessary to complete the grading of developed areas to conform with required lines, grades, and slopes.

B. Work includes, but is not necessarily limited to; excavation for structures, tanks, foundations, manholes, vaults, electrical manholes, conduits, cables, raceways and ducts, pipes, paving; grading; and related work such as sheeting, bracing and dewatering.

C. Provide services of a licensed Professional Engineer to prepare temporary excavation support system, dewatering system designs, and submittals.

D. Provide temporary excavation support systems, including sheeting, shoring, and bracing, to ensure the safety of personnel and protect adjacent structures, piping, and other materials in accordance with Federal, State and local laws, regulations, and requirements. Temporary excavation support systems are specified in Section 315000 “Excavation Support and Protection.”

E. Provide temporary dewatering, surface water control systems, and operate to dewater and maintain excavations in a dry condition. Control drainage into excavations and remove seepage water and rainwater. Dewatering and surface water control are specified in Section 312319 “Dewatering.”

F. Examine site and review available geotechnical test boring prior to submitting a proposal, taking into consideration project conditions that may affect the work. Owner and Design Engineer do not assume responsibility for variations of subsurface conditions at locations other than places shown and at the time investigations were made.

G. Do not initiate extra work without written notification to Owner and Engineer and receiving Owner’s written approval in response.

H. Protect existing structures and utilities that remain.

I. Related Requirements:

1. Section 013200 "Construction Progress Documentation."
2. Section 013233 "Photographic Documentation."
3. Section 310515 “Soils and Aggregates for Earthwork.”
4. Section 310900 “Geotechnical Instrumentation and Monitoring.”
5. Section 312333 “Trenching and Backfilling.”
6. Section 312319 "Dewatering."
7. Section 312500 “Erosion and Sedimentation Controls.”
8. Section 315000 "Excavation Support and Protection."

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Coverage: Pass of compaction equipment over the complete surface area of exposed lift or subgrade to receive compaction.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
2. Unauthorized Additional Excavation: Excavation as directed by Engineer to correct Contractor’s work not in compliance with Contract Documents, which will be performed without additional compensation.
3. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
4. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be provided without additional compensation.

E. Finished Grade: Required final grade elevation indicated on Drawings. Spot elevations take precedent over proposed contours.

F. In-the-Dry: An excavation subgrade where groundwater level: has been lowered to at least 2 feet below lowest level of excavation; is stable with no ponded water, mud, or muck; is able to support construction equipment without rutting or disturbance; and is suitable for placement and compaction of fill material, pipe, or concrete foundations.

G. Objectionable Material: Includes topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.

H. Optimum Moisture Content: Moisture content (percent by dry weight) corresponding to maximum dry density of the same material as determined by ASTM Test Method D1557 or D698.

I. Overexcavation: Removal of unsuitable soil or objectionable material at or below the normal grade of excavation or subgrade as indicated on Drawings.

J. Percent Compaction: Required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material, as determined in the laboratory by ASTM Test Method D1557 or D698.

K. Structures: Buildings, wet wells, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, manholes and vaults, or other man-made stationary features constructed above or below the ground surface.

L. Subgrade: Required surface of subsoil, borrow fill, or compacted fill that is immediately beneath site improvements, especially dimensioned fill, paving, or other surfacing material.

M. Unsuitable Soil: Includes existing fill materials, organic soils, weak native soils, or clays with a plasticity index of greater than 30, and any materials that cannot be properly placed and compacted as specified.

N. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

O. Zone of Influence: A line extending at least 2 feet beyond foundation or pipeline edge, then outward and downward at a slope of 1 horizontal to 1 vertical. Do no excavation below foundation of existing structures or pipeline.

P. Professional Engineer: Registered Professional Engineer meeting project qualifications and who is hired by Contractor.

Q. The Engineer: The Engineer or designated representative hired by Owner.

1. Approval given by The Engineer shall not relieve Contractor of its responsibilities for performing the work in accordance with Contract Document requirements.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at the Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:

a. Personnel and equipment needed to make progress and avoid delays.
b. Coordination of Work with utility locator service.
c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
d. Extent of trenching by hand or with air spade.
e. Field quality control.

1.5 ACTION SUBMITTALS

A. Coordinate various submittal types required by this Section with requirements of dewatering, support of excavation, and geotechnical instrumentation submittals specified in other Sections.

B. Slope Stability Evaluation: Submit a temporary excavation slope stability evaluation in accordance with OSHA for temporary slopes over 20 feet in height or where existing or proposed facilities or property limits are located at the top of the slope and within a distance from the top of the slope equal to the slope height.

1. Prepare evaluation by a licensed Professional Engineer registered in the Commonwealth of Massachusetts.

C. Site Characterization Data: Submit following information regarding off-site source and material:

1. Site location.
2. Present and past usage of the source site and material.
3. Previously existing reports associated with an assessment of source site relating to presence of oil or other hazardous materials.
4. Location within the site from which the material will be obtained.

D. Samples: Submit a representative sample weighing approximately 50 pounds of each fill material, filter sand, and crushed stone contained in sealed 5 gallon containers, at least 30 calendar days prior to date of anticipated use of each material.

E. Submit laboratory test results for fill materials that include maximum density, gradation, Atterberg limits, sand equivalent, and other applicable criteria, at least 72 hours prior to importing or placing fill.

F. Prepare excavation support system designs by a licensed Professional Engineer, registered in Commonwealth of Massachusetts and having a minimum of 5 years of professional experience in design and construction of excavation support systems.

1. Submit an original and three copies of licensed Professional Engineer's certification, stating excavation support systems designs have been prepared by Professional Engineer who is responsible for their execution.

1.6 INFORMATIONAL SUBMITTALS

A. Construction and Operations Plan: Submit proposed methods of construction, including earthwork operations, excavation limits, slopes, fill material moisture conditioning and handling, compaction equipment, excavation support systems designs, backfilling and filling and compaction, and material sources.

1. Include additional submittal requirements related to schedule, work sequence, and on-site and off-site storage when necessary based on project conditions.
2. Submit excavation support system plan as prepared by registered Professional Engineer complying with requirements stated in previous Article.

B. Submit copies of field daily reports by soil technician at the end of each workday that earthwork and grading operations occur.

C. Upon completion of earthwork and grading operations, submit an as-graded map showing density test numbers and locations, a table of density test results and depths, and a certification of compliance by geotechnical engineer in charge.

D. Qualification Data: For qualified testing agency to conduct geotechnical observation, testing and documentation. include qualifications of firm, resumes of soil technicians assigned to the project, and licensed geotechnical engineer in charge.

1. Firm Qualifications: Meet ASTM D3740.
2. Soil Technicians: Have minimum three years demonstrated experience in earthwork and grading operations and satisfy certification requirements of agency having local jurisdiction.

    a. The Engineer reserves right to request substitution of soil technicians assigned to field work. Do not substitute assigned soil technicians without prior approval of The Engineer.

E. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earthwork operations. Submit before earthwork begins.

1.7 QUALITY ASSURANCE

A. Excavation, trenching, sheeting, bracing, and similar work shall comply with requirements of OSHA excavation safety standards, 29 CFR Part 1926 Subpart P and State and local authorities having jurisdiction. Where conflict between OSHA, State and local regulations exists, apply most stringent requirements.

B. At least three working days (72 hours) prior to starting any excavation, notify the appropriate regional notification center for underground utilities and underground utility owners who are not members of notification center. To obtain area specific information for project site, refer to www.call 811.com.

C. Quality Control Testing for Off-site Borrow Materials:

1. Chemical testing will not be required where site characterization of off-site borrow sources indicates that soils are acceptable for use. If site characterization data or materials are suspected of being contaminated, perform chemical testing as directed by The Engineer with no additional compensation.
2. Chemical Test Data: Test each material source requiring testing by a person experienced in sample collection who is a registered Professional Engineer or geologist or certified groundwater or environmental professional registered in the Commonwealth of Massachusetts. Submit samples of each proposed material to a chemical analytical laboratory, certified by the governing agency, for following analyses:

    a. Volatile Organic Compounds: EPA 8240 plus Hazardous Substance List (HSL) Parameters.

b. Acid and Base Neutral Extractable Organic Compounds: EPA 8270.
c. Pesticides and PCBs: EPA 8080.
d. Total Petroleum Hydrocarbons: Infrared Method, EPA 9071/418.1.
e. Thirteen Priority Pollutant Metals: EPA 7000 Series.
f. Total Cyanide: EPA 9012.

3. Obtain and test off-site borrow samples in accordance with criteria established by The Engineer. Submit results for review and approval prior to use on site.

1.8 FIELD CONDITIONS

A. Be responsible for construction layout and reference staking necessary for proper control and satisfactory completion of structures, cutting, filling, grading, drainage, fencing, embankment improvements, curbing, and other appurtenances.

B. Perform construction layout and staking by a Professional Surveyor or Professional Engineer registered in Commonwealth of Massachusetts, experienced and skilled in construction layout and staking requirements.

C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earthwork operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Improvements on Adjoining Property: Authority for performing earthwork indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by The Engineer.

E. Utility Locator Service: Notify "Dig Safe System" for area where Project is located before beginning earthwork operations.

F. Do not commence earthwork operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" are in place.

G. Do not commence earthwork operations until plant-protection measures specified in Section 015000 "Temporary Facilities and Controls" are in place.

H. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

I. Do not direct vehicle or equipment exhaust towards protection zones.

J. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Fill materials designated for use in this Section are specified in Section 310515 “Soils and Aggregates for Earthwork.”

B. On-Site Fill Material: Earth and rock material obtained at project site during excavation, following clearing and stripping, from which any Unsuitable Soil or Objectionable Material has been removed.

C. General: Provide imported fill materials when sufficient satisfactory soil materials are not available from excavations.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, tanks, utilities, sidewalks, pavements, fencing, landscaping, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

1. If necessary, remove and restore or replace curbing, driveway aprons, and fencing after performing backfilling work.
2. Replace existing facilities damaged by construction with new material fully equal to existing without additional compensation.

B. Prior to and During Earthwork Operations:

1. Provide, monitor, and maintain geotechnical instrumentation regarding settlement; coordinate with Section 310900 “Geotechnical Instrumentation and Monitoring.”
2. Protect and maintain erosion and sedimentation controls; coordinate with Section 312500 “Erosion and Sedimentation Controls.”
3. Provide, monitor, and maintain excavation support; coordinate with Section 315000 “Excavation Support and Protection.”

    a. Use excavation support system for excavations within the zone of influence for existing structures or utilities.
    b. Do not permit excavations below base level of adjacent foundations or retaining walls, unless excavation design and bracing includes an analysis of structure’s

stability supported by the foundation. When necessary due to project conditions, incorporate required bracing and foundation underpinning.

4. Provide, monitor, and maintain dewatering and drainage systems; coordinate with Section 312319 “Dewatering.”

C. Test Pits:

1. Perform exploratory excavation work, test pits, for purpose of verifying the location of underground utilities and structures and to check for unknown utilities and structures, prior to commencing excavation work.
2. As earthwork progresses, perform test pits for the purpose of compaction testing. Pause operations and provide safe access for testing personnel.
3. Backfill and compact test pits as soon as desired information has been obtained. Stabilize backfilled surfaces in accordance with approved erosion and sedimentation control plans.

D. Clearing and Stripping. Initially clear and strip ground surfaces beneath planned structures and in areas requiring excavation or filling of organic material and debris. Do not use those materials as On-Site Fill Material; remove from the site and properly dispose or reuse as topsoil in landscape areas if approved the Engineer.

1. Stripping Depth Variance: From about 6 inches to 12 inches.

E. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

F. Saw cut existing pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

3.2 DEWATERING AND DRAINAGE

A. Provide dewatering and drainage in accordance with Section 312319 “Dewatering.” This Article supplements those requirements.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff and groundwater seepage away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

D. Prior to excavation, verify groundwater will be at required level indicated on approved dewatering and drainage submittal.

E. Accomplish dewatering by methods that preserve undisturbed state of subgrade soils. Dewater in a manner to prevent boiling, detrimental under-seepage, or disturbance at excavation base.

3.3 SUPPORT OF EXCAVATION

A. Provide excavation support in accordance with Section 315000 “Excavation Support and Protection.” This Article supplements those requirements.

B. Install excavation support in accordance with reviewed Shop Drawings prior to beginning excavation work. Maintain excavation supports that are required to remain in place, if applicable, as indicated on Drawings or as required by approved Shop Drawings.

C. Owner or The Engineer may direct that certain excavation supports remain in place or be cut off at any specific elevation. Supports directed by Owner or The Engineer to be left in place and not so designated on Contract Documents will be paid for according to Contract provisions for changes in the Work.

D. The right of Owner or The Engineer to direct that certain excavation supports remain in place shall not be construed as creating any obligation on Owner or The Engineer to give such direction, nor shall failure to give such direction relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise, growing out of a failure on the part of the Contractor to leave in place sufficient excavation supports to prevent any movement of the ground or damage to adjacent structures.

E. Construct temporary excavation slopes in accordance with the requirements of OSHA excavation safety standards and approved Shop Drawings.

F. Where allowed, carefully remove excavation supports in a manner without endangering the Work or other adjacent structures, utilities, or property. Immediately fill voids left or caused by withdrawal of supports with sand and compact.

3.4 EXCAVATION

A. Include material of every description and of whatever substance encountered as an unclassified excavation.

B. General: Excavate on-site soils using standard earthmoving equipment. Excavation in dense soil or rock may require special equipment. Do not plough, scrape, or dig earth with machinery so near to finished subgrade to result in excavation of or disturbance of below grade material.

C. Make excavations to grades indicated on Drawings and in widths sufficient for laying of pipe, construction of the structure, installing bracing, excavation supports, dewatering and drainage facilities, and working clearances.

D. Perform excavation in-the-dry and accomplished by methods which preserve the natural undisturbed condition of subgrade soils.

E. Moisture Sensitive Soils: Use a smooth-edge bucket to excavate last one foot of depth when excavation is to end in such soils.

F. If excavation bottom is removed below the limits shown on Drawings, specified, or directed by The Engineer, refill with structural fill or screened gravel without additional compensation.

G. When excavation has reached prescribed depths, notify The Engineer who will observe the conditions. If materials and conditions are not satisfactory, The Engineer will issue instructions for corrective procedures. The Engineer will be the sole judge as to whether the work has been accomplished satisfactorily.

H. Subgrade soils that have become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods in the opinion of The Engineer, remove existing soil and replaced with structural fill or screened gravel at Contractor's expense.

I. Exposed subgrades in large open areas for foundations shall be proof rolled with at least two overlapping coverages of a vibratory drum roller with a minimum static drum weight of 10 ton. Conduct proof-rolling in presence of The Engineer. The Engineer will waive this requirement, if in its opinion the subgrade will be rendered unsuitable by such proof-rolling.

1. Confined Areas: Proof-roll with hand operated vibratory equipment that is approved by The Engineer.

J. Perform over-excavation at The Engineer’s request to remove unsuitable soil, objectionable material, or other materials as determined by The Engineer and to such depth and width as directed. Replace with suitable material as directed by The Engineer.

1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

K. Perform excavation for pipelines beneath structures and excavation for footings with excavating equipment operating from the subgrade for the structure, while in-the-dry and in a manner preserving the undisturbed state of subgrade soils.

L. When excavations have reached the required subgrade, including any allowances for working mats or base materials and prior to their placement, notify soils testing laboratory to verify suitability of existing subgrade soils for anticipated foundation and structural loadings.

1. If existing subgrade soils are determined to be unsuitable, follow direction provided by The Engineer regarding removal and replacement with suitable materials.
2. Notify Engineer if the revised work scope would modify Contractor's cost and thereby entitle a change to the Contract Sum. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

M. Replace over-excavation beyond the limits and depths required by Contract Documents using structural fill or screened gravel without additional compensation.

N. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Section 015000 "Temporary Facilities and Controls."

3.5 SUBGRADE PREPARATION

A. Notify Engineer when excavations have reached required subgrade.

B. Maintain excavated subgrade in-the-dry condition.

C. Prior to fill placement, remove objectionable material which includes, but not be limited to, pavement, topsoil, organic matter, contaminated soil, construction debris, perishable materials, snow, ice, frozen earth, and rocks or lumps of cemented soils over 6 inches in maximum dimension.

D. For subgrades consisting of granular soils, proof roll the final subgrade using at least four coverages of a vibrator plate compactor.

E. Where existing subgrade contains a significant amount of clay or cohesive soils, over-excavate sufficiently below the bottom of structure for placement of a lean concrete working mat. Remove loose or soft material from the subgrade immediately prior to placing lean concrete working mat.

F. Remove and replace soft subgrades or unusable material with structural fill or screened gravel.

G. During wet or freezing weather, or in areas where exposed subgrade consists of moisture-sensitive soils, take measures to protect foundation excavations once they have been approved by The Engineer. Protective measures include, but are not limited to, placing insulation blankets, placing a layer of fill, pea gravel, crushed rock, or lean concrete on the exposed subgrade, or covering the exposed subgrade with a plastic tent.

   1. If additional over-excavation is required due to the subgrade not being protected against wet or freezing weather, perform additional work without additional compensation.

H. Notify Engineer to observe conditions following subgrade preparation and prior to fill placement. If existing subgrade soils are determined to be unsuitable, follow direction provided by The Engineer regarding removal and replacement with suitable materials.

   1. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

3.6 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust. Protect from precipitation.

   1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

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3.7 FILL PLACEMENT AND COMPACTION PROCEDURES

A. Fill and Backfill: Place materials in lifts to suit specified compaction requirements to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil or sod. Correct soft spots or uncompacted areas.

B. Do not place or compact fill and backfill when materials are too wet to properly compact.

1. In-place Soil Moisture Content: Maximum of three percentage points above optimum moisture content of soil, as determined by laboratory test of moisture-density relation appropriate to specified level of compaction.

C. Structural Fill and Embankment Fill: Construct to required lines and grades, making allowances for settlement and placement of cover materials, such as topsoil and sod. Correct soft spots or uncompacted areas.

D. Fill material shall be free of snow, ice, frost, and frozen earth. Do not place fill materials on frozen surfaces or surfaces covered by snow, ice, or frost.

E. Complete structure water-tightness tests and installation of dampproofing or waterproofing systems prior to placing various types of fill or backfill around structures.

F. If subgrade slopes more than 10 percent, step subgrade to produce a stable, horizontal surface for placement of fill materials. Scarify existing subgrade slope to a depth of at least 6 inches.

G. Compact filled slopes by slope rolling and trimming, or overfill and trim back to plan grade to expose a firm, smooth surface free of loose material.

H. Do not allow fill lifts to contain stones with a dimension larger than 2/3 the specified loose measure lift thickness.

I. Perform compaction in open areas using compaction equipment by any of the following methods:

1. Fully loaded ten-wheel trucks or front-end loaders.
2. Tractor dozers weighing minimum of 30,000 pounds.
3. Heavy vibratory rollers.

J. Confined Compaction: Perform compaction in confined areas, including areas within a 45-degree angle extending upward and outward from the base of a wall, and in areas where the use of large equipment is impractical, using hand-operated vibratory equipment or mechanical tampers.

1. Do not exceed lift thickness of 6 inches, measured before compaction, when using hand operated equipment.

K. Moisture condition on-site fill material prior to placement, unless Contractor demonstrates to The Engineer in-place moisture conditioning methods can achieve the required moisture content.

L. Conduct compaction of each specified lift of fill materials by a minimum of four complete coverages with acceptable compaction equipment to a specified density as a percentage of maximum dry density as determined by ASTM D1557, unless otherwise specified.

M. Use structural fill required beneath foundations or slabs on grade, except sidewalks. Place and compact structural fill in even lifts having a maximum thickness of 8 inches, measured before compaction.

N. Use select fill as backfill material placed within 10 feet of all structures. Uniformly place and compact select fill around the structure in even lifts having a maximum thickness of 8 inches, measured before compaction.

O. Use common fill in areas beyond those designated for structural fill or select fill, unless shown or otherwise specified. Place in even lifts having a maximum thickness of 12 inches, measured before compaction.

P. Place impervious fill in controlled, even lifts having a maximum thickness (measured before compaction) of 6 inches.

1. Permeability: Compact to attain a reading of less than 1×10^{-7} cm/sec.
2. Moisture Content: Compact to optimum moisture content of minus 2 percent to plus 3 percent.

3.8 COMPACTION REQUIREMENTS

A. Perform in-place testing of compacted fill lifts to measure in-place density and water content according to ASTM D6938 and ASTM D1557.

B. Beneath Foundations and Slabs-on-Grade, except sidewalks: Compact top 12 inches of existing subgrade and each layer of fill, if applicable to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D1557 or 98 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.

C. Area Around Structures: Within 10 feet compact each fill or backfill layer to:

1. Maximum Dry Density: Minimum of 92 percent for ASTM D1557 or 95 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.

D. Embankments, Lawn, or Unimproved Areas: Does not include embankments under roadways and earth dam structures. Compact each fill or backfill layer to:

1. Maximum Dry Density: Minimum of 90 percent for ASTM D1557 or 92 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content of minus 1 percent to plus 4 percent.

E. Sidewalks: Compact each fill layer to:

1. Maximum Dry Density: Minimum of 92 percent for ASTM D1557 or 95 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.

F. Roads, Paved Areas, and Roadway Embankments: Compact each layer of fill or backfill to:

1. Maximum Dry Density: Minimum of 95 percent for ASTM D1557 98 percent for ASTM D698.
2. Moisture Content: At or near its optimum moisture content of minus 2 percent to plus 3 percent.

3.9 DISPOSAL OF UNSUITABLE, WASTE, AND SURPLUS EXCAVATED MATERIALS

A. Unsuitable soil, objectionable material, waste, and surplus excavated material shall be removed and disposed of off-site. Materials may be temporarily stockpiled in an area within the limits of construction that does not disrupt construction activities, create any nuisances or safety hazards, or otherwise restricts access to work site.

B. Topsoil or loam excavated under this Section may be salvaged for use as specified under Section 329200 “Turf and Grasses,” as approved by The Engineer.

3.10 GRADING

A. Perform grading to lines and grades shown on Drawings. Remove objectionable materials encountered within the limits indicated and disposed of off-site. Completely and continuously drained and dewatered subgrades throughout the grading process. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the execution or condition of grading work.

B. If it is not possible at the time of grading to place material in its proper section of the Work, stockpile it in approved areas for later use. No additional compensation will be made for stockpiling or double handling of excavated materials.

C. In cut areas, remove loose or protruding rocks in slopes to line or finished grade of the slope. Uniformly dress, cut, and fill slopes to slope cross-section and alignment shown on Drawings, unless otherwise directed by The Engineer.

3.11 RIPRAP AND SLOPE STABILIZATION

A. Prior to installation of riprap, install erosion control blankets on slopes in accordance with manufacturer's instructions.

1. Properly prepare area to be covered before the blanket is applied.
2. When the blanket is unrolled, place netting on top with fibers in contact with the soil over the entire area.

3. Butt blankets snugly at ends and sides, placing blankets a minimum of three rows, each four-foot wide, for a total width of 12 feet.
4. Staple blankets together in accordance with manufacturer's instructions.
5. Secure blankets by driving staple vertically into the ground, spaced approximately 6 feet apart, on each side and one row in the center, alternately spaced between each side.
6. Do not overlap adjoining blankets. Utilize a common row of staples to attach to ground.

B. Place riprap in conjunction with embankment construction with only sufficient lag in construction of riprap protection necessary to allow for proper construction of the portion of embankment protected and to prevent mixture of embankment and riprap material.

1. Place and grade bank run gravel to a depth of 6 inches to obtain a continuous uninterrupted bed of required thickness within the required limits.
2. Compact by a minimum one coverage by a crawler-type tractor with a total weight, including blade and equipment, of not less than 30,000 pounds.

C. Hand-place riprap on compacted gravel bed; do not dump materials. Lay stones so maximum dimension is perpendicular to the bed. Place stones so weight of each stone is carried by underlying material and not by adjacent stones. Place large stones at the bottom of slope. Fill spaces between stones with spalls of suitable size to construct a solid, stable slope, free from large voids and defects, and to protect embankments against erosion.

3.12 FIELD QUALITY CONTROL

A. Test and observe materials as described in this Article. Cooperate by allowing free access to work for selection of test materials and observations.

B. General Testing Requirements:

1. At Structures: Prior to placement of bedding material, concrete work mats, structural fill or structural concrete, coordinate with Contractor’s Soils Testing Laboratory to verify suitability of existing subgrade soil.
2. Backfill and Fill: Prior to and during the placement of backfill and fill coordinate with Contractor’s Soils Testing Firm to perform in-place soil density tests to verify that backfill and fill material has been placed and compacted in accordance with specified compaction requirements.
3. Subgrade: Do not cover with fill without observation, testing, and approval by Project Geotechnical Engineer after review of the Contractor’s Soils Testing Laboratory results.

    a. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by The Engineer without additional compensation.

C. Test materials by a certified independent laboratory, engaged by Contractor and acceptable to The Engineer, demonstrating conformance with project requirements. Deliver test reports and material certifications to The Engineer before using any material in the work.

D. If field test results are not in conformance with project requirements, costs involved in correcting deficiencies in compacted materials to satisfaction of The Engineer without additional compensation.

E. Earthwork activities performed without properly scheduled inspection are subject to removal and replacement or additional testing as directed by The Engineer without additional compensation.

F. Testing methods shall comply with latest ASTM or equivalent AASHTO Standards applicable during bidding.

G. During placement of bedding, backfill, and fill, perform in-place soil density testing to confirm that fill material has been compacted in accordance with project requirements. The Engineer may designate areas to be tested. Notify Engineer at least 72 hours in advance of scheduled compaction testing. In place soil density tests on backfill and fill material shall be as required by authorities having jurisdiction and these technical specifications but in no instance, shall be less than those listed:

1. Structures and Embankments: At least one density and moisture content test for each 500 square feet of surface area for each lift of fill at embankment, structure, and manhole locations.
2. Trench Excavations: At least one nuclear density and one moisture content test at a maximum of 25 feet intervals for each lift of fill placed or as directed by The Engineer.
3. The Engineer may designate supplemental areas to be tested at additional compensation.

H. Materials which have been previously tested may be subjected to further testing from time to time and may be rejected, if it is determined that results do not conform to project requirements. Immediately remove rejected materials when directed by The Engineer, notwithstanding results of previous testing.

I. The Engineer or Owner may conduct additional soil testing. Cooperate fully in allowing additional test to be made, including free access to the work.

J. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

3.13 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by The Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 312000

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SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes delegated design of temporary construction dewatering and surface water control and incorporates the design, equipment, materials, installation, operation, protection, monitoring and removal of dewatering and drainage system. Provide dewatering system sufficient to lower groundwater and collect surface water, regardless of groundwater level or rainfall at any time during the work.

B. Obtain and pay for permits required for dewatering, including dewatering discharge, and drainage systems. Implement measurements to comply with dewatering and discharge permits requirements.

C. Related Requirements:

1. Section 013233 "Photographic Documentation."
2. Section 310515 “Soils and Aggregates for Earthwork.”
3. Section 310900 “Geotechnical Instrumentation and Monitoring.”
4. Section 312000 "Earthwork."
5. Section 312333 “Trenching and Backfilling.”
6. Section 312500 “Erosion and Sedimentation Controls.”
7. Section 315000 “Excavation Support and Protection.”

1.3 DEFINITIONS

A. In-the-Dry: An excavation subgrade where all of the following are met:

1. Groundwater level has been lowered to at least 2 feet below lowest excavation level.
2. Subgrade is stable with no ponded water, mud, or muck.
3. Subgrade is able to support construction equipment without rutting or disturbance.
4. Subgrade is suitable for placement and compaction of fill material, pipe, or concrete foundations.

B. Contractor’s Engineered Design: Design prepared on behalf of Contractor by a registered Professional Engineer.

C. Professional Engineer: Registered Professional Engineer meeting project qualifications and who is hired by Contractor.

D. The Engineer: Engineer hired by Owner.

1. Approvals given by Engineer shall not relieve Contractor of responsibilities for performing Work in accordance with Contract Document requirements.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Verify availability of Installer's personnel, equipment, and facilities needed to perform the work, make progress and avoid delays.
2. Review condition of site to be dewatered including coordination with temporary erosion-control measures, excavation support systems, and temporary controls and protections.
3. Review geotechnical report.
4. Review proposed site clearing and excavations.
5. Review existing utilities and subsurface conditions.
6. Review observation and monitoring of dewatering system.
7. Review sampling and testing requirements for discharge.
8. Review pretreatment requirements prior to discharge, discharge location(s), and flow rate requirements.
9. Review permitting conditions and requirements.

1.5 DELEGATED DESIGN SUBMITTALS

A. Design Plan: Submit written dewatering and drainage system design plan, prepared by a qualified Professional Engineer, that includes:

1. Description of proposed dewatering system and installation methods to be used for system elements and observation wells.
2. Description of equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, number and location of dewatering points and observations wells.
3. Dewatering system design calculations demonstrating that the proposed system meets all requirements herein and elsewhere.
4. Sequence of well and well-point placement coordinated with support of excavation system installation and control procedures to be adopted, if dewatering problems arise.
5. Identification of anticipated area influenced by dewatering system and address impacts to adjacent existing and proposed structures.

    a. Include detailed plans for pre-construction surveys of existing structures in vicinity of dewatering system, settlement monitoring of existing structures during construction, and provisions to address settlement of existing structures resulting from dewatering activities.

6. Coordinate dewatering and drainage submittals with excavation and support of excavation submittals.

7. Provide excavation support system design consisting of steel sheet piling prepared by a licensed Professional Engineer in the State where the work occurs where sheet piling is

necessary to cut off and reduce groundwater seepage in order to provide an excavation in the dry so that the structures and pipelines can be installed to project specifications. Any location along the shoreline (ocean), in proximity to rivers or streams, or near ponds or lake should be evaluated during bid preparation so that sheet piling can be used in conjunction with an active dewatering system to successfully dewater the excavations.

B. Shop Drawings: For dewatering system, prepared by a qualified Professional Engineer. If required by permit conditions, revise dewatering system(s) as necessary to satisfy associated regulatory agency.

1. Include plans, elevations, sections, and details.
2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, means of removing sediment from dewatering operations and location of discharge of filtered/settled groundwater.
3. Include pump capacity and anticipated discharge rate.
4. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
5. Show areas and depths of excavation to be dewatered and adjacent structures or facilities within the anticipated area influence.
6. Temporary excavation support system design in accordance with the requirements of Section 315000.
7. Commitment to provide one standby pump for immediate emergency use.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and Professional Engineer.

B. Field quality-control reports.

C. Existing Conditions: Using photographs and video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

E. Discharge sampling log, testing results of effluent samples and flow rate record.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in installation of dewatering systems and dewatering work and having a minimum of 5 years' experience.

B. Professional Engineer Qualifications: Licensed Professional Engineer registered in the State where project is located; having a minimum of 5 years' experience in design and construction of dewatering and drainage systems; and having completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that required for the work.

C. Land Surveyor Qualifications: Land Surveyor licensed in State of Project.

D. Comply with authorities having jurisdiction for the following:

1. Drilling and abandoning of wells used for dewatering systems.
2. Water discharge and disposal from dewatering operations.

E. Obtain permit from EPA under National Pollutant Discharge Elimination System (NPDES), for storm water discharge from construction sites.

1.8 FIELD CONDITIONS

A. Project-Site Information: A geotechnical test boring log has been prepared for this Project and is available for information only. Owner is not responsible for interpretations or conclusions drawn from this test boring log.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.
2. Groundwater levels may vary during the work and should not be assumed to be accurately represented by groundwater level readings reported in the boring logs or geotechnical report, if applicable.

B. Survey Work: Engage a qualified land surveyor or Professional Engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of surface and ground water and permit excavation and construction to proceed in-the-dry in accordance with the requirements herein and elsewhere.

1. Design dewatering system, including comprehensive engineering analysis by the Contractor’s Design Engineer.
2. Continuously monitor and maintain dewatering operations to ensure required groundwater lowering, erosion control, stability of excavations, excavation support, and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

B. Primary Purpose of Work: Preserve natural undisturbed condition of subgrade soils in areas of proposed excavations.

1. Prior to excavation, lower groundwater to at least 2 feet below lowest excavation subgrade elevation.
2. Additional groundwater lowering may be necessary beyond 2 feet requirement, depending on construction methods, equipment used, and prevailing groundwater and soil conditions. Lower groundwater as necessary to complete construction in accordance with Contract Documents without additional compensation.
3. Dewatering shall address tidal impact in areas where groundwater is like to be influenced.

C. Design deep wells, well points and sumps, and other groundwater control system components to prevent loss of fines from surrounding soils. Use sand filters with dewatering installations, unless screens are properly sized by Contractor's design engineer to prevent passage of fines from surrounding soils.

D. Maintain standby pumping systems and sources of standby power at various sites.

E. Design dewatering system to prevent damage to adjacent properties, buildings, structures, utilities, and facilities from dewatering operations. Be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements, and work that may result from dewatering or surface water control operations.

F. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.

G. Note that existing drainage systems may not have adequate capacity to accommodate discharge form dewatering systems. Make all investigations necessary to make this determination and develop appropriate strategies for proper handling and disposal of discharge from dewatering systems, including any permitting required.

2.2 MATERIALS

A. Pipe for Observation Wells: ASTM D1785, PVC Schedule 40 (minimum) in minimum interior diameter of 1 inch and machine slotted having a maximum slot size of 0.020 inch. Coordinate with Section 310900 “Geotechnical Instrumentation and Monitoring.”

B. Equipment: Piping, pumping, and other equipment and materials to provide control of surface water and groundwater in excavations.

C. Grout: Mixture of portland cement and bentonite clay or sand suitable for sealing abandoned wells and piping.

PART 3 - EXECUTION

3.1 GENERAL

A. Control surface water and groundwater such that:

1. Excavation to final grade is made in-the-dry.
2. Natural undisturbed conditions of subgrade soils are maintained.

3. Softening, instability, or disturbance due to presence or seepage of water does not occur.
4. Construction and backfilling proceeds in-the-dry.
5. Floatation of completed portions of work shall be prohibited.

B. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells, or any combination.

C. Where groundwater levels are above proposed bottom of excavation level, provide a pumped dewatering system for pre-drainage of soils prior to excavation and for maintaining lowered groundwater level until construction has been completed such that structure, pipeline, or fill will not be floated or otherwise damaged.

D. Vary type of system, spacing of dewatering units, and other details of the work depending on soil and water conditions at each location.

E. Do work in a manner to protect adjacent structures and utilities without causing loss of ground or disturbance to pipe bearing soils or soils supporting overlying or adjacent structures.

F. Install, monitor, and report data from observation wells. Evaluate collected data relative to groundwater control system performance and modify systems necessary to dewater site.

G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with installation and monitoring of geotechnical instrumentation including observation wells. Do not make excavations for sumps or drainage ditches within or below 1H:1V slopes extending downward and out from edges of existing or proposed foundation elements or from downward vertical footprint of pipe without approval by the Engineer.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways, if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls, which are specified in during dewatering operations.

3.3 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.4 SURFACE WATER CONTROL

A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent flow of surface water into excavations and to allow construction to proceed without delay.

B. Grade excavation to divert surface water and seepage water within excavation areas into sumps and dewatering wells.

3.5 EXCAVATION DEWATERING

A. Provide and maintain equipment and facilities to promptly remove and properly dispose of water entering excavations. Maintain excavations in-the-dry.

B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and be in operation until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

C. Do not place pipe, masonry, and concrete in water or submerge within 24 hours after being installed. Prevent water from flowing over new masonry or concrete within four days after placement.

D. Prevent water from rising to cause unbalanced pressure on structures until concrete or mortar has set at least 24 hours. Prevent pipe flotation by promptly placing backfill.

E. Conduct dewatering to preserve natural undisturbed condition of subgrade soils at bottom of excavation.

F. If trench subgrade or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Engineer and refill with structural fill, screened gravel, or other material as approved by the Engineer without additional compensation.

G. It is expected that initial dewatering plan may be modified to suit variable soil and water conditions encountered. Dewater and excavate in a manner without causing loss of ground or disturbance to pipe bearing soil or soil that supports overlying or adjacent structures.

H. If methods do not properly dewater excavation, install additional groundwater observation wells as directed by Engineer. Do not place pipe or structures until readings obtained from observation wells indicate that groundwater has been lowered to specified minimum of 2 feet below bottom of final excavation.

I. Surround dewatering units with suitable filter sand with no fines being removed by pumping. Pump continuously from dewatering system until pipe or structure is adequately backfilled. Provide stand-by pumps.

J. Collect water entering excavations from precipitation or surface runoff in shallow ditches around excavation perimeter, drained to a sump, and pump from excavation to maintain a bottom free from standing water.

K. Dispose of drainage to an approved area as specified in Section 013545 “Environmental Protection Procedures.”

3.6 WELL-POINT SYSTEMS

A. Where necessary, install a vacuum well-point system around excavation for dewatering purposes. Surround each well-point and riser pipe by a sand or gravel filter. Use sand of gradation that after initial development of well-points, quantity and size of soil particles discharged shall be negligible. Provide well-point systems capable of operating continuously under highest possible vacuum. Include sufficient valves and gauges to accurately monitor and control the system. Develop and redevelop well-points to provide reliable performance throughout the duration of the work.

B. Install well point systems in Engineer’s presence according with approved submittal.

3.7 DEEP WELLS

A. Where necessary, install a deep well system around an excavation to dewater or depressurize it. Surround each well with a sand or gravel filter having adequate gradation so quantity and size of soil particles discharged are negligible. Install sufficient number of wells to lower or depressurize groundwater level allowing excavation to proceed in-the-dry. Develop and redevelop wells as necessary to provide reliable performance throughout the duration of the work.

B. Install deep wells in the Engineer’s presence according with approved submittal.

3.8 OBSERVATION WELLS

A. Install observation wells as required under this Section and in accordance with the approved submittal to monitor groundwater levels beneath and around excavated areas until adjacent structures and pipelines are completed and backfilled.

B. Observation Well Locations and Depths:

1. Install a minimum of 2 wells around structure of trench excavations that require lowering the groundwater table more than 10 feet vertically to achieve the requirement of lowering and maintaining the groundwater table 2 feet below the lowest excavation level. Locate in critical areas with respect to groundwater control to monitor performance of dewatering systems as determined by Delegated Design.
2. Install observation wells to:

    a. Minimum depth of 10 feet below deepest level of excavation, unless otherwise approved by the Engineer.
    b. Depth necessary to indicate that groundwater control system designed under Delegated Design is performing as intended.

3. Provide additional observation wells required by Engineer if deemed necessary to monitor performance of groundwater control system without additional compensation.
4. Locations and depths are subject to approval by Engineer.

C. Protect observation wells at ground surface by providing a lockable box or outer protective casing with lockable top and padlock. Design surface protection to prevent damage by vandalism, construction operations, and surface water infiltration.

1. Provide two copies of padlock keys at each well for the Engineer’s access.
2. Develop observation wells to provide a reliable indication of groundwater levels. Re-developed wells: if well clogging is observed; in event of apparent erroneous readings; or as directed by the Engineer.
3. Submittal observation well installation logs, top of casing elevation, and well locations to the Engineer within 24 hours of completing well installation.

D. Observation Well Maintenance:

1. Maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.
2. Repair or replace wells without additional compensation, whether damage is caused by Contractor's operations or third parties.

E. Monitoring and Reporting of Observation Well Data:

1. Begin daily monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Continue daily monitoring in areas where groundwater control is in operation until time that adjacent structures and pipelines are completed and backfilled or until time that groundwater control systems are turned off.
2. Be responsible for processing and reporting observation well data to the Engineer on a daily basis. Provide data to the Engineer on a form that includes following information:

observation well number, depth to groundwater, total depth of well, top of casing elevation, groundwater level elevation, and date and time of reading.

F. Keep groundwater level at a minimum of 2 feet below lowest subgrade level for a given excavation.

3.9 REMOVAL OF SYSTEMS

A. At completion of excavation and backfilling work and when approved by the Engineer, remove from site various pipe, deep wells, well-points, pumps, generators, observation wells, other equipment, and accessories used for groundwater and surface water control systems.

1. Removed materials and equipment become property of Contractor.

B. Restore areas disturbed by installation and removal of groundwater control systems and observation wells to their original condition.

C. Leave in place deep wells casings, well-points, and observation wells located:

1. Within plan limits of structures or pipelines.
2. Within zone below 1H:1V planes extending downward and out from edges of foundation elements or from downward vertical footprint of pipe.
3. Where removal would result in ground movements causing adverse settlement to adjacent ground surface, utilities, or existing structures.

D. Fill pulled casings holes with sand. Where left in place, fill casings with cement grout and cut off a minimum of 3 feet below finished ground level or 1 foot below foundation level to prevent interference with finished structures or pipelines.

E. When directed by the Engineer, leave observation wells in place for continued monitoring. Cut casings flush with final ground level when directed and provide protective lockable boxes with locking devices. Provide protective boxes suitable for traffic and other conditions to which observation wells will be exposed.

END OF SECTION 312319

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SECTION 312323.33 - FLOWABLE FILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flowable fill for:

a. Structure backfill.
b. Utility bedding.
c. Utility backfill.
d. Filling abandoned utilities.

B. Related Requirements:

1. Section 310515 "Soils and Aggregate for Earthwork.”
2. Section 312000 "Earthwork."
3. Section 312333 "Trenching and Backfilling."

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.

B. Excavatable Flowable Fill: Lean cement concrete fill used where future excavation may be required, such as fill for utility trenches, bridge abutments, and culverts.

C. Non-excavatable Flowable Fill: Lean cement concrete fill used where future excavation is not anticipated, such as fill below structure foundations and filling abandoned utilities.

1.4 SUBMITTALS

A. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

B. Field Quality-Control Submittals:

1. Mix Design:

a. Furnish flowable fill mix design for each specified strength.
b. Furnish separate mix designs when admixtures are required for the following:

1) Flowable fill Work during hot and cold weather.
2) Air entrained flowable fill Work.

c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
d. Sieve analysis of aggregate.

2. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.

C. Delivery Tickets:

1. Furnish duplicate delivery tickets indicating actual materials delivered to Project Site.

D. Qualifications Statements:

1. Submit qualifications for supplier.

1.5 QUALITY ASSURANCE

A. Perform Work according to Project standards.

B. Maintain copies of each standard affecting the Work of this Section on Site.

C. All testing and inspection services required, unless otherwise specified, and paid for by the Contractor. Testing necessary to establish the mix shall be performed by and at the expense of the Contractor. Methods of testing shall comply with the latest applicable ASTM Methods except as specified herein.

1.6 QUALIFICATIONS

A. Supplier:

1. Company specializing in supplying products specified in this Section with minimum three years' documented experience.
2. Product source approved by authority having jurisdiction.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Store or stockpile fly ash, aggregate and cement in conformity with the recommendations of ACI 301.

B. Minimum Conditions: Do not install flowable fill during inclement weather or when ambient temperature is less than 40 degrees F.

1.8 FIELD MEASUREMENTS

A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

PART 2 - PRODUCTS

2.1 FLOWABLE FILL

A. Furnish materials according to Massachusetts Department of Transportation (MassDOT) standards.

B. Flowable Fill: Excavatable type.

2.2 MATERIALS

A. Flowable fill, also known as controlled density fill (CDF) or controlled low-strength material (CLSM) shall conform to Section M4.08.0 Type 2E Flowable (excavatable) of the MassDOT standards, current edition, and all addenda and supplements thereto.

1. Minimum Compressive Strength Flowable Fill Beneath Structures: 50 psi at 28 days.

2.3

2.3 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Testing, inspection, and analysis requirements.

B. Design mix shall result in flowable and excavatable material with a minimum 28 day compressive strength of 50 psi and a 90 day compressive strength less than 100 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions before starting the work.

B. Verify utility installation is complete and tested before placing flowable fill.

C. Verify excavation is dry and dewatering system is operating.

3.2 PREPARATION

A. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.

B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.

C. Protect utilities and foundation drains to prevent intrusion of flowable fill.

3.3 INSTALLATION - FILL, BEDDING, AND BACKFILL

A. Engineer approval required for the condition of subgrade and method of placement.

B. Remove all debris and foreign matter from the excavation before depositing flowable fill.

C. Do not place flowable fill in water or submerge within 24 hours after placing.

D. When required, place flowable fill under water using tremie procedure.

E. Do not place flowable fill through flowing water.

F. Place flowable fill by chute, pumping or other methods approved by Engineer.

G. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.

H. Place flowable fill evenly on both sides of utilities to maintain alignment.

I. Place flowable fill to elevations indicated on Drawings without vibration or other means of compaction.

3.4 INSTALLATION - FILLING ABANDONED UTILITIES

A. Verify pipes and conduits are not clogged and are sufficiently empty to permit gravity installation of flowable fill for entire length indicated to be filled.

B. Seal lower end of pipes and conduits by method to contain flowable fill and to vent trapped air caused by filling operations.

C. Place flowable fill using method to ensure there are no voids.

1. Fill pipes and conduits from high end.
2. Fill manholes, tanks, and other structures from grade level access points.

D. After filling pipes and conduits seal both ends.

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3.5 FIELD QUALITY CONTROL

A. Section 014000 “Quality Requirements” for inspection and testing.

3.6 CLEANING

A. Remove spilled and excess flowable fill from Project Site.

B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation.

END OF SECTION 312323.33

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SECTION 312333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes trench excavation, backfilling, and compaction.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork.”
2. Section 312000 “Earthwork.”
3. Section 312319 "Dewatering."
4. Section 312500 “Erosion and Sedimentation Controls.”
5. Section 330519 “Ductile-Iron Utility Pipe for Water Service.”
6. Section 333113 “Public Sanitary Utility Sewerage Piping.”

1.3 DEFINITIONS

A. Percent Compaction: Means at least the stated percentage of maximum density as determined by ASTM D1557, Method D or ASTM D698.

1.4 ACTION SUBMITTALS

A. Submit proposed method of backfilling and compaction prior to start of Work.

B. Submit method of excavation and trench support, where necessary, including design of sheeting and bracing with calculations signed and sealed by qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For material excavated from trench for re-use as backfill, by a qualified testing agency.

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1.6 QUALITY ASSURANCE

A. Comply with following regulations:

1. Massachusetts: 454 CMR 10.00 et. seq. - Construction Industry Rules and Regulations.
2. Occupational Safety and Health Administration (OSHA): 29 CFR Part 1926 Subpart P.

B. Provide excavation, trenching, related sheeting, bracing, and related materials to comply with requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations" (Chapter 454 CMR 10.00 et. seq.) and State requirements. Where conflict exists between OSHA and State regulations, more stringent requirements apply.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store excavated materials according to Section 312500 “Erosion and Sedimentation Control” to prevent erosion of soil type materials and contamination of adjacent water sources.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine that erosion and sedimentation controls are in place and comply with project requirements and authorities having jurisdiction.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Where excavation activities occur across active vehicular or pedestrian circulation paths, use temporary controls specified in Division 01 to maintain circulation during operations required by this Section. Maintain temporary controls for each day circulation paths are restricted.

B. Coordinate work of this Section with materials specified in other Sections of Division 31.

C. Identify required lines, levels, contours, and datum locations.

D. Protect features to remain-in-place including benchmarks, existing structures, fences, sidewalks, paving, curbs, etc. from excavating equipment and vehicular traffic.

E. Maintain and protect above and below grade utilities indicated to remain.

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3.3 TRENCH EXCAVATION

A. Trench excavation includes material of every description and substance encountered.

B. Cut rigid and flexible pavement with a saw, wheel, or pneumatic chisel along straight lines before excavating.

C. Strip and stockpile topsoil from grassed areas crossed by trenches.

1. At Contractor's option when required, topsoil may be disposed of and replaced with approved topsoil of equal quality.

D. While excavating and backfilling is in progress, maintain traffic and protect utilities and other property.

E. Excavate trenches to indicated depths and in widths sufficient and of practical minimum for pipe laying, bracing, and pumping and drainage facilities.

F. Accomplish excavation and dewatering by methods preserving undisturbed state of subgrade soils. Excavate trench by machinery to or just below designated subgrade, if material remaining in trench bottom is no more than slightly disturbed.

1. Remove subgrade soils that become soft, loose, quick, or otherwise unsatisfactory due to inadequate excavation, dewatering, or other construction methods and replace with screened gravel fill acceptable to the Engineer at Contractor's expense.

G. Use care when working in clay and organic silt soils, which are particularly susceptible to disturbance due to construction operations. When excavation is to end in such soils, use a smooth-edge bucket to excavate the last 12 inches of depth.

H. Where pipe is to be laid in screened gravel bedding, excavate trench by machinery to normal depth of pipe, provided material remaining in trench bottom is no more than slightly disturbed.

I. Where pipe is to be laid directly on trench bottom, manually perform final excavation, providing a flat-bottom, true to grade upon undisturbed material. Make bell holes required by project conditions.

3.4 DISPOSAL OF MATERIALS

A. Stack excavated material without excessive surcharge on trench bank or obstructing free access to hydrants and gate valves. Avoid inconvenience to traffic and abutters. Segregated excavated material for use in backfilling as specified below.

B. Do not remove excavated material from work site, except as directed by the Engineer. When removal of surplus materials is approved by the Engineer, dispose of such surplus material in approved designated areas.

C. Should conditions make it impracticable or unsafe to stack material adjacent to trench, haul and store material at a location provided. When required, re-handled and use it in backfilling trench.

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3.5 SHEETING AND BRACING

A. Provide and maintain sheeting and bracing required by Federal, State, or Local safety requirements to support sides of excavation and prevent loss of ground which could endanger personnel, damage, adjacent structures, or delay the work.

1. Engineer may order additional supports placed at Contractor’s expense if it is determined that at any point sufficient or proper supports have not been provided. Compliance with such order shall not relieve Contractor from their responsibility for sufficiency of such supports. Take care to prevent voids outside of sheeting; if voids are formed, immediately fill and ram them.

B. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support trench sides, take care in placing and moving the boxes or supporting bracing to prevent pipe movement, disturbance of pipe bedding, or screened gravel backfill.

1. Rigid Pipe Installation (such as R.C., V.C., A.C.): Raise that portion of box extending below mid-diameter above this point prior to moving box ahead to install next pipe. Perform to prevent separation of installed pipe joints due to box movement.
2. Flexible Pipe Installation (such as PVC): Do not allow trench boxes, moveable sheeting, shoring, or plates to extend below mid-diameter of pipe. As trench boxes, moveable sheeting, shoring, or plates are moved, place screened gravel to fill voids created. Re-compact screened gravel and backfill to provide uniform side support for pipe.

C. Engineer may give permission to use steel sheeting in lieu of wood sheeting for entire project wherever sheeting use is necessary. Include cost for use of sheeting in bid items for pipe, including full compensation for driving, bracing, and later removal of sheeting.

D. Carefully remove sheeting and bracing in manner to not endanger construction of other structures, utilities, or property, whether public or private. Immediately refill voids left after withdrawal of sheeting using sand by ramming with tools especially adapted to that purpose and watering or otherwise directed by the Engineer.

E. No payment will be given for sheeting, bracing, or other support during progress of the work. No payment will be given for sheeting left in trench for Contractor's convenience.

F. Leave sheeting driven below mid-diameter of pipe in place from driven elevation to at least 12 inches above top of pipe.

3.6 TEST PITS

A. Excavation of test pits may be required for purpose of locating underground utilities or structures as an aid in establishing the precise location of new work.

B. Backfill test pits as soon as desired information has been obtained. Maintain backfilled surface appropriate for travel until resurfaced.

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3.7 EXCAVATION BELOW GRADE AND REFILL

A. Drain trench completely and effectively be in-the-dry, whatever the nature of unstable material encountered or groundwater conditions.

B. If Contractor excavates below grade through error or for their own convenience, through failure to properly dewater the trench, or disturbs subgrade before dewatering is sufficiently complete, the Engineer may direct Contractor to excavate below grade as set forth in following Paragraph, where work shall be performed at its own expense.

C. If material at trench bottom consists of fine sand, sand and silt or soft earth which may work into the screened gravel, even with effective drainage, remove subgrade material to extent directed. Refill excavation with a 6 inch layer of coarse sand or a mixture graded from coarse sand to fine pea stone to form a filter layer preserving voids in pipe gravel bed. Composition and gradation of gravel shall be approved by the Engineer prior to placement. Place screened gravel in 6 inch layers thoroughly compacted up to normal grade of pipe. If directed by the Engineer, use bank-run gravel for refill of excavation below grade.

3.8 BACKFILLING

A. Begin backfilling as soon as practicable after laying and jointing pipe and continue expeditiously. Place bedding gravel of specified type for pipe installed up to 12 inches over the pipe.

B. Construct an impervious dam or bulkhead cutoff of clay or other impervious material in the trench, as directed by the Engineer, to interrupt unnatural flow of groundwater after construction is completed. Key dam into trench bottom and sidewalls. Provide at least one clay or other impervious material dam in pipe bedding between each manhole where directed or every 300 feet, whichever is less.

C. Where pipes are laid cross-country, fill remainder of trench with common fill material in layers not to exceed 12 inches and mounded 6 inches above existing grade or as directed by the Engineer. Where a loam or gravel surface exists prior to cross-country excavations, remove, conserve and replace it to full original depth as part of the work under pipe items. Where necessary, remove excess material during clean-up process, so that ground may be restored to its original level and condition.

D. Where pipes are laid in streets, backfill remainder of trench up to a depth of 12 inches [20 inches for State Highways] below bottom of specified permanent paving with select common fill material in layers not to exceed 12 inches and thoroughly compacted. Use bank-run gravel for subbase layer of paving and compact in 6 inches layers.

E. To prevent longitudinal pipe movement, do not dump backfill material into trench and then spread, until selected material or screened gravel has been placed and compacted to a level at least 12 inches over the pipe.

F. Bring backfill up evenly on all sides. Thoroughly compact each layer of backfill material by rolling, tamping, or vibrating with mechanical compacting equipment or hand tamping to 95 percent compaction according to ASTM D1557 or 98 percent according to ASTM D698. If

rolling, use a suitable roller or tractor being careful to compact fill throughout full width of trench.

G. Do not compact by puddling or water jetting.

H. Use hand or pneumatic ramming with tools weighing at least 20 pounds for compacting in confined areas. Spread and compact material in layers not exceeding 6 inches thick, an uncompacted loose measurement.

I. Use granular fill material as backfill around structures. Spread and compact specified backfill under and over pipes connected to structures.

J. Do not place bituminous paving in backfill. Do not use frozen material under any circumstances.

K. Broom and hose-clean road surfaces immediately after backfilling. Employ dust control measures throughout construction period.

3.9 RESTORING TRENCH SURFACE

A. Where trench occurs adjacent to paved streets, in shoulders, sidewalks, or in cross-country areas, thoroughly consolidate backfill and maintain surface as the work progresses. If settlement takes place, immediately deposit additional fill to restore ground level.

B. Within and adjacent to streets, 12 inches [20 inches for State Highways] of trench backfill below specified initial pavement shall consist of compacted bank-run gravel. If Contractor wants to use material excavated from trench as gravel subbase for pavement replacement, take samples at intervals not to exceed 500 feet of material and test by an independent testing laboratory at Contractor’s expense. Use only materials approved by the Engineer.

C. Restore surface of driveways or other areas which are disturbed by trench excavation to a condition at least equal to that existing before work began.

D. In areas where pipeline passes through grassed areas, remove and replace sod or loam and seed surface at Contractor's own expense.

END OF SECTION 312333

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SECTION 312500 - EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sediment Traps.
2. Sediment Fences.
3. Construction Entrances.
4. Turbidity Curtains.
5. Filter Bags.
6. Erosion Control Blanket.
7. Compost Sock.

B. Related Sections:

1. Section 033010 “Miscellaneous Cast-In-Place Concrete.”
2. Section 310515 “Soils and Aggregates for Earthwork.”
3. Section 312333 “Trenching and Backfilling.”
4. Section 321216 “Asphalt Paving.”
5. Section 329119 “Landscape Grading.”
6. Section 329200 “Turf and Grasses.

1.3 PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.4 ACTION SUBMITTALS

A. Submit, within 14 days after award of Contract, technical product literature for all commercial products.

B. Product Data: Product Data: Submit data on geotextile.

C. Submit proposed mix design of each class of concrete if applicable for review prior to commencement of Work.

1.5 INFORMATIONAL SUBMITTALS

A. Stormwater Pollution Prevention Plan (SWPPP) as specified in “Quality Assurance” article.

B. Copy of EPA NPDES Notice of Intent to Discharge submitted to the EPA as specified in “Quality Assurance” article.

1.6 SUSTAINABLE DESIGN SUBMITTALS

A. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.

1. Materials Resources Certificates:

a. Certify recycled material content for recycled content products.
b. Certify source for regional materials and distance from Project site.

B. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.

1. Provide cost data for the following products:

a. Products with recycled material content.
b. Regional products.

1.7 CLOSEOUT SUBMITTALS

A. Section 017700 “Closeout Procedures”: Requirements for submittals.

1.8 QUALITY ASSURANCE

A. Adhere to EPA document “Stormwater Management for Construction Activities – Developing Pollution Prevention Plans and Best Management Practices” document number EPA 832-R-92-005, dated 1992, or most recent edition. State or appropriate Conservation Commission standards can be substituted for the EPA standard if the State or Conservation Commission standard is equal to, or more detailed than, the EPA standard.

B. Prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) in accordance with the U.S. Environmental Protection Agency (EPA) National Pollution Discharge Elimination System (NPDES) General Permit applicable to this work) document number EPA 832-R-92-005, dated 1992, or most recent edition.

C. Prepare and submit the EPA NPDES Notice of Intent to Discharge to the applicable EPA office in accordance with EPA regulations.

D. Perform Work according to Massachusetts Department of Transportation (Mass DOT) standards.

E. Maintain one copy of each document on site.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not place grout when air temperature is below freezing.

B. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

A. Materials and Resources Characteristics:

1. Recycled Content Materials: Furnish materials with maximum available recycled content**.**
2. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site.

2.2 SILT FENCE

A. Silt fence filter fabric shall be a woven, polypropylene, ultraviolent resistant material meeting minimum requirements below:

Fabric Properties	Min. Acceptable Value	Test Method
Grab Tensile Strength (lbs)	110	ASTM D4632/ D4632M
Elongation at Failure (%)	20	ASTM D4632/ D4632M
Mullen Burst Strength	300 psi	ASTM D3786/ D3796M
Puncture Strength (lbs)	60	ASTM D4833/ D4833M
Minimum Trapezoidal Tear Strength (lbs)	50	ASTM D4533/ D4533M
Flow through Rate (gal/min/sf)	25	ASTM D4491/ D4491M
Equivalent Opening Size	40 – 80	US Std Sieve ASTM D4751
Minimum UV Residual (%)	70	ASTM D4355/ D4355M

B. Products: Provide one of the following:

1. “Mirafi FW402,” by TenCate Geosynthetics.
2. “Carthage 15%,” by Carthage Mills.
3. “HSP2.” by ACF Environmental, Inc.
4. Or equal.

C. Sediment fence shall be a prefabricated commercial product made of a woven, polypropylene, ultraviolet resistant material such as “Envirofence” by Mirafi Inc., Charlotte, NC or equal.

D. Include a drawstring in the top portion of the fence for added strength.

E. Posts: Constructed of hardwood with minimum diameter thickness of 1.5 inches. Standard T or U steel fence posts weighing not less than 1 pound / linear foot.

F. Tie wires for securing silt fence fabric to wire mesh shall be light gauge metal clips (hog rings), or 1/32 inch diameter soft aluminum wire.

G. Wire fence shall be minimum 14 gage with maximum 6 inch mesh opening.

2.3 TURBIDITY CURTAIN

A. Barrier Material: 10 mil polyethylene sheets filter fabric.

B. Barrier height shall be 20 percent greater than the depth of water as indicated on the drawings.

2.4 FILTER BAGS

A. Filter Bags: Sized with manufacturer recommendations based on pumped discharge rate.

B. Geotextile Material for Bags: Meet the following minimum requirements:

Minimum Grab Tensile Strength	200 lbs
Minimum Grab Tensile Elongation	50%
Minimum Trapezoidal Tear Strength	80 lbs
Mullen Burst Strength	380 psi
Minimum Puncture Strength	130 lbs
Apparent Opening Size	40-80 US Sieve
Minimum Flow Through	70 gpm/square foot

C. Bag shall have opening large enough to accommodate 4 inch diameter discharge hose.

2.5 EROSION CONTROL BLANKET

A. Erosion control blankets: 100 percent agricultural straw fiber matrix, 0.5 lbs / sq yd, stitch bonded with degradable thread between two photodegradable polypropylene nettings.

1. Product: Provide Model S150 Double Net Short-Term Blanket (12 months) by North American Green, Evansville, IN), or equal.

B. Prior to start of work, provide a certified statement as to the number of pounds of materials to be used per 100 gallons of water. Specify the number of square feet of seeding that can be covered with the quantity of solution in the Contractor's hydroseeder.

2.6 COMPOST SOCK

A. Compost sock shall be a mesh tube, oval to round in cross section, 12 inches in diameter. Sock shall have a minimum durability of one year after installation. Sock shall be composed of biodegradable jute, sisal, burlap, or coir fabric. Fabric shall be clean, evenly woven, and free of encrusted concrete or other contaminating materials and free from cuts, tears, broken or missing yarns and thin, open, or weak places.

B. Compost sock shall be securely anchored by wood stakes driven 8 feet on center. Wood stakes shall be untreated fir, redwood, cedar, or pine and cut from sound timber, and shall be straight and free of loose or unsound knots and other defects which would render the stakes unfit for use. Stake shall be pointed on the end to be driven into the ground, and at least 1" x 1" x 24" in size.

C. Compost sock shall be filled with compost derived from any single, or mixture of the following feedstock material: green material consisting of chipped, shredded, or ground vegetation, or clean recycled wood products, biosolids, manure, or mixed food waste. Compost feedstock material to reduce weed seeds, pathogens and deleterious materials to comply with state and local regulations. Compost shall not be derived from mixed municipal solid waste and be reasonably free of visible contaminants. Compost shall not contain paint, petroleum products, pesticides or any other chemical residues harmful to animal like or plant growth. Compost shall not possess objectionable odors.

PART 3 - EXECUTION

3.1 SEDIMENT TRAPS

A. Construct trap by excavating and forming embankments as specified in Section 312000 "Earthwork" and Section 312333 "Trenching and Backfilling."

B. Place coarse aggregate or rock at outlet as indicated on Drawings.

C. Place geotextile fabric, as specified for rock energy dissipator.

D. On entire sediment trap area, apply soil supplements and sow seed as specified in Section 329200 "Turf and Grasses."

E. Mulch seeded areas with hay as specified in Section 329200 "Turf and Grasses."

3.2 SILT FENCE

A. Position sediment fences as indicated on the Drawings and to prevent off site movement of sediment produced by construction activities as directed by the Engineer. Areas beyond limits of silt fence shall be undisturbed or stabilized.

B. Dig trench approximately 6 inch wide and 6 inch deep along proposed fence lines.

C. Drive stakes, 10 feet on center (maximum) at back edge of trenches. Drive stakes 2 feet (minimum) into ground.

D. Hang filter fabric on posts carrying to bottom of trench with about 4 inches of fabric laid across bottom of trench. Stretch fabric fairly taut along fence length and maintain secure both ways.

E. Backfill trench with excavated material and tamp.

F. Install pre-fabricated silt fence according to manufacturer's instructions.

3.3 CONSTRUCTION ENTRANCE

A. Construct entrance with minimum of 6 inch of course aggregate at all points of ingress/egress.

B. Width: Minimum 20 feet, increased as needed for typical construction vehicles.

C. Minimum Length: 50 feet.

D. Install filter fabric below aggregate.

E. Maintain entrance throughout construction, adding more aggregate or increasing length as needed.

3.4 TURBIDITY CURTAIN

A. Install turbidity curtain parallel to bank, extending beyond lateral limits of construction.

B. Install weights at 10 foot intervals, floats at 5 foot intervals.

C. Inspect turbidity curtain daily and repair/replace worn/torn areas as needed.

D. At end of construction, remove accumulated sediment by hand before removing the turbidity curtain.

3.5 FILTER BAG

A. Locate filter bag at least 50 feet from all wetlands, streams or other surface waters.

B. Install bag on a 2 inch gravel bed, a 4 inch thick straw mat, or a vegetated filter strip to allow water to flow in all directions.

C. Bag is full when remaining flow area is reduced by 75%. Replace full bags with new bags.

3.6 EROSION CONTROL BLANKETS

A. Install erosion control blankets onto all exposed slopes to be loamed and seeded that are steeper than 4 (Horizontal) to 1(Vertical) as shown on the Drawings. Erosion control blankets shall also be installed in all seeded drainage swales and ditches, and as directed by the Engineer in accordance with manufacturer's instructions.

B. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow and stapled.

C. Place blankets and stapled together in accordance with manufacturer's instructions. Side overlaps shall be 4 inch minimum. The staples shall be made of wire, 0.091 inch in diameter or greater, "U" shaped with legs 10-inch in length and a 1-1/2-inch crown. Commercial biodegradable stakes may also be used with prior approval by the Engineer. The staples shall

be driven vertically into the ground, spaced approximately two linear feet apart, on each side, and one row in the center alternately spaced between each size. Upper and lower ends of the matting shall be buried to a depth of 4-inch in a trench. In swales and ditches, erosion stops shall be created every 25-feet by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be 4-inch below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4-inch. Overlap lower end of upstream roll 4-inch past edge of downstream roll and staple.

D. To ensure full contact with soil surface, roll matting with a roller weighing 100 lbs/ft of width perpendicular to flow direction after seeding, placing matting and stapling. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below. Erosion control blankets for bottom of swales and along edge of pathways.

3.7 COMPOST SOCK

A. To ensure optimum performance, cut down or remove heavy vegetation, and level and uneven surfaces to ensure that the compost sock uniformly contacts the ground surface.

B. Prior to installation, clear the bedding area of obstructions including rocks, clods, and debris greater than one inch.

C. Fill socks uniformly with compost to the desired length such that the logs do not deform and secure ends. When more than one compost sock is required to achieve desired length, join socks longitudinally with a 1.5-ft overlap.

D. Installation:

1. Place directly on the ground with good contact with the final grade.
2. Secure with wood stakes every 8 feet along the length of the compost sock.
3. Secure the ends of the compost sock by placing a stake 6 inches from the end of the compost sock.
4. Drive the stakes into the soil so that the top of the stake is less than 2 inches above the top of the compost sock.
5. Any stockpiled material shall have a compost sock installed around it.

3.8 SITE STABILIZATION

A. Incorporate erosion control devices indicated on the Drawings into the Project at the earliest practicable time.

B. Construct, stabilize and activate erosion controls before site disturbance within tributary areas of those controls.

C. Stockpile and waste pile heights shall not exceed 35 feet. Slope stockpile sides at 2: 1 or flatter.

D. Stabilize any disturbed area of affected erosion control devices on which activity has ceased and which will remain exposed for more than 20 days.

1. During non-germinating periods, apply mulch at recommended rates.
2. Stabilize disturbed areas which are not at finished grade and which will be disturbed within one year in accordance with Section 329200 “Turf and Grasses” at 50 percent of permanent application rate with no topsoil.
3. Stabilize disturbed areas which are either at finished grade or will not be disturbed within one year in accordance with Section 329200 “Turf and Grasses” permanent seeding specifications.

E. Stabilize diversion channels, sediment traps, and stockpiles immediately.

3.9 FIELD QUALITY CONTROL

A. Section 017300 “Execution”: Field inspecting, testing, adjusting, and balancing.

B. Inspect erosion control devices on a weekly basis and after each runoff event. Make necessary repairs to ensure erosion and sediment controls are in good working order.

C. Compaction Testing: As specified in Section 312000 “Earthwork.”

D. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.10 CLEANING

A. When sediment accumulation in sedimentation structures has reached a point one-third depth of sediment structure or device, remove and dispose of sediment.

B. Do not damage structure or device during cleaning operations.

C. Do not permit sediment to erode into construction or site areas or natural waterways.

D. Clean channels when depth of sediment reaches approximately one-half channel depth.

END OF SECTION 312500

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SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temporary excavation and trench support and protection systems.

B. Related Requirements:

1. Section 013233 "Photographic Documentation."
2. Section 014000 “Quality Requirements.”
3. Section 310900 “Geotechnical Instrumentation and Monitoring.”
4. Section 312000 "Earthwork."
5. Section 312319 "Dewatering."

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review test boring.
2. Review existing utilities and subsurface conditions.
3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
4. Review proposed excavations.
5. Review proposed equipment.
6. Review monitoring of excavation support and protection system.
7. Review coordination with waterproofing.
8. Review abandonment or removal of excavation support and protection system.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer, meeting the minimum performance requirements in Part 2 of this Section.

1. Include overall system plan, indicating clearances, dimensions, material properties, member sizes, locations, spacing and member penetrations depths, and locations of various types of lateral supports.
2. Show details, layout, arrangement, equipment requirements, and method of construction of proposed excavation support system.

3. Indicate existing and proposed utilities, structures or other obstructions.
4. Show wall elevations and locations of bracing.
5. Show overall installation sequence and removal of bracing. Indicate work levels to be performed before bracing is installed or removed.
6. Method of preloading bracing, if required, including preload for each member, and method of locking-off the preload. Submit detailed drawings of connections, jacking supports, and method of shimming.
   Include procedures for resolving difficulties arising from misalignment of members exposed during excavation and criteria for implementing those procedures.

B. Design Calculations: For excavation support and protection system. Include analysis data prepared, signed, and sealed by professional engineer responsible for their preparation.

1. Include loads on excavation support system for all stages of excavation, bracing removal, and concrete placement, including material and equipment loads on adjacent ground during construction.
2. Include design of wall and bracing members including details for all construction stages.

   a. Design: Account for water pressures associated with flood conditions if the site falls within a flood plain.

3. Include theoretical deflections of excavation support system and deformation of structures, pipelines, and other improvements located within areas influencing excavations.

C. Submit to the Engineer for review and acceptance, a plan of action to be implemented in the event any deformation threshold value is reached as specified in Section 310900 “Geotechnical Instrumentation and Monitoring.” Identify positive measures in action plan to further limit wall movement, including but not limited to trenching for struts and wales, placement of granular earth berms against the wall, installation of additional struts, or combinations thereof.

1. Include description and details of mitigating measures, work schedule, location and availability of materials, and structural details for connections to wall and support elements.
2. Be prepared to work 24 hours per day to implement such measures.
3. Perform remedial work and mitigating measures at no additional cost to Owner.

1.5 INFORMATIONAL SUBMITTALS

A. Submit quality control measures to ensure that performance of excavation support system complies with project requirements.

B. Submit welder qualifications and weld procedures in accordance with AWS D1.1.

C. Qualification Data: For the Contractor’s independent excavation support system designer.

D. Maintain at least one copy of design at job site during excavation that includes a plan indicating sizes, types, and configurations of the materials to be used in protective system. Identity registered Contractor’s design engineer who stamped the design.

E. Do not proceed with excavation support or protection activities until submittals have been reviewed and approved by the Engineer.

F. Submit inspection documentation:

1. On-site inspections of excavation support system as the systems are constructed.
2. Review of quality control measures and performance data.
3. Certification that excavation support system is constructed per applicable design following completion of each support system and following Contractor modifications during construction.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications: Minimum 5 years' experience compatible to indicated Work, and who employs labor and supervisory personnel similarly experienced in Work of this Section.

B. Contractor's Design Engineer: Registered Professional Structural or Civil Engineer in the State where the work is located with at least 5 years' professional experience in design and construction of support of excavation systems and having completed a minimum of 5 successful excavation support projects of equal type, size, and complexity to specified work.

C. Existing Conditions: Using photographs and video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.

D. Regulatory Requirements: Comply with authorities having jurisdiction, including OSHA requirements.

E. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.7 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Contact utility companies and other responsible authorities to locate and mark underground utilities.
2. Notify the Engineer and Owner no fewer than five days in advance of proposed interruption of utility.
3. Do not proceed with interruption of utility without the Engineer and Owner's written permission.

B. Project-Site Information: A test boring has been performed for this Project and is available for information only. Owner is not responsible for interpretations or conclusions drawn from the test boring data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, design**,** monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads within specified movement criteria (Section 310900 "Geotechnical Instrumentation and Monitoring").

1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems to minimize horizontal and vertical movements without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

B. Do not permit excavations below the level of the base of adjacent existing foundations or retaining walls, unless excavation design and bracing includes an analysis of stability of structure supported by foundation and if necessary, incorporates required bracing or underpinning of foundation.

C. For support systems in which bracing is installed between opposite sides of the excavation, design excavation support of both sides to be nearly the same as feasible.

D. Where necessary to resist point loads, fill pipe piles used as soldier piles with concrete. Do not consider concrete strength in design of pipe pile for bending stress.

E. Design, install, operate, and maintain ground water control system to control ground water inflows, prevent piping or loss of ground, and maintain stability of the excavation. Refer to the requirements of Section 312319 "Dewatering."

F. Design review and field monitoring activities by Owner or the Engineer does not relieve Contractor of its work responsibilities.

2.2 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A36/A36M, ASTM A690/A690M, or ASTM A992/A992M.

C. Steel Pipe Used as Soldier Piling: ASTM A252, Grade 2 or better.

D. Steel Sheet Piling: ASTM A572/A572M, or ASTM A690/A690M; with continuous interlocks.

1. Steel sheet piling conforming to ASTM A572, Grade 50 or better.
2. Corners: Site-fabricated mechanical interlock or Mill Roll-formed corner shape with continuous interlock.

E. Steel Liner Plates: ASTM A1101, structural quality hot-rolled carbon steel sheets or plates of either the two- or four-flange type, punched for bolting on all sides. Space bolts according to manufacturer's standards and be multiples of plate length, so members having same curvature are interchangeable with bolt numbers and patterns determined by liner supplier.

1. Tensile Strength: 42,000 psi
2. Yield strength: 28,000 psi

F. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of 3 inches with minimum allowable flexural strength of 1,100 psi .

G. Cast-in-Place Concrete: ACI 301, with minimum compressive strength of 3,000 psi, unless a higher strength is required for application.

H. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that instrumentation required under Section 310900 "Geotechnical Instrumentation and Monitoring" is installed and initialized prior to start of work required by this Section.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Obtain permits from local authority having jurisdiction prior to initiating excavation work.

B. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

C. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate

routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

2. Install fencing, gates, lights, and signs around excavations and staging areas to provide for public safety.

D. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.3 GENERAL

A. Install excavation support systems in accordance with the shop drawings and applicable permits.

B. Fill voids between excavation support system and earth with materials acceptable to the Engineer.

C. If unstable material is encountered during excavation, take immediately measures to contain it in place and prevent ground displacement.

D. If settlement or deflections of supports indicate that support system requires modification to prevent excessive movements, redesign and resubmit revised shop drawings and calculations to the Engineer without additional compensation.

E. Maintain sufficient quantity of material on site for protection of work and for use in case of accident or emergency.

3.4 PORTABLE TRENCH BOXES

A. Use portable trench boxes or sliding trench shields only for worker protection.

B. Additional excavation, backfilling, and surface restoration required as result of trench box use shall be provided without additional compensation.

C. Design, construct, and maintain trench boxes or shields to meet acceptable engineering and industry standards.

D. Install shields in a manner to restrict lateral or other hazardous movement of the shield in the event of sudden lateral loads.

E. Maintain a written copy of trench box manufacturer's specifications, recommendations, and limitations at job site during excavation work.

3.5 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation.

1. Install using impact hammer or vibratory hammer in predrilled holes.
2. Soldier Piles in Predrilled Holes:

a. Provide casing or other methods of support to prevent caving of holes and loss of ground.
b. Backfill with concrete from elevation of bottom excavation to pile tip elevation. Backfill remainder of predrilled hole with lean concrete or sand.
c. Predrilled hole of sufficient diameter allowing for proper alignment and concrete backfilling of pile.

3. Install driven piles with driving shoes where hard driving is anticipated.
4. Advance driven soldier piles without aid of a water jet**,** unless otherwise authorized.

a. Perform authorized jetting on both sides of pile simultaneously and discontinue when pile tip is approximately 5 feet above calculated pile tip elevation. Make final 5 feet of penetration by driving. Firmly seat pile in place by application of a number of reduced energy hammer blows before commencing driving of final penetration.

B. Extend soldier piles below excavation grade level to depths shown on reviewed Shop Drawings. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging.

1. Install lagging so ground loss does not occur between adjacent or below lowest board. As excavation proceeds, do not maximum height of 4 feet for unlagged face of excavation.
2. Do not exceed unlagged face of 2 feet, if water seeps or flows from excavation face or excavation face becomes unstable.

D. As installation progresses, pack voids between excavation face and lagging with materials such as hay, burlap, or geotextile filter fabric to allow drainage of ground water without loss of ground. Fill voids behind lagging with soil, and compact.

E. Install wales at locations indicated on Drawings and secure to soldier piles.

3.6 STEEL SHEET PILING

A. Thoroughly cleaned and inspect sheet piles for defects and proper interlock dimensions prior to installation. Provide a tool for checking interlock dimensions.

B. Before starting excavation, drive one-piece sheet piling lengths in plumb position and tightly interlock vertical edges for its entire length to form a continuous barrier. Form a continuous diaphragm throughout length of each run of wall, bearing tightly against original ground.

1. Exercise care in driving so interlocking members can be extracted without damaging adjacent structures or utilities.
2. Use driving, cutting, and splicing methods conforming to approved Shop Drawings.
3. Use templates or other temporary alignment facilities to maintain piling line.

C. Accurately place piling, using templates and guide frames unless otherwise recommended in writing by sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 5 feet. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

D. Install each sheet pile having sufficient clearance in interlocks to slide under its own weight into interlock of previously placed sheet pile.

E. Do not excavate in advance of steel sheet piling installation.

F. Where obstructions are anticipated, pre-excavate or pre-drill along sheet pile wall alignment without additional compensation. Do not extend pre-excavation and pre-drilling below lowest excavation level or into bearing soils for existing or future structures.

G. Remove obstructions encountered before the specified embedment for piles. Where obstructions cannot be removed, re-evaluate sheet pile system by Contractor's design Engineer show reduced embedment and additional toe stability measures to be implemented for sheet pile wall realignment. Submittal proposed design measures to the Engineer for review.

H. Withdraw damaged or faulty aligned pilings with provide new piling, driven properly in its place without additional compensation.

I. Cut tops of sheet piling to uniform elevation at top of excavation.

3.7 LINER PANELS

A. Install liner plates as soon as excavation has progressed sufficiently to install next complete circumferential ring of liner plates. Complete ring of liner plates prior to continuing excavation.

1. Do not install more than one ring of liner plates at any time.

B. Stagger plates in vertical direction to facilitate shaft strength and leakage resistance.

C. Grout liner plates in accordance with approved Shop Drawings.

3.8 INTERNAL BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work, unless otherwise approved by the Engineer.
2. Install internal bracing if required to prevent spreading or distortion of braced frames.
3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

B. Provide internal bracing to carry maximum design load without distortion or buckling.

C. Include web stiffeners, plates, or angles required to prevent rotation, crippling, or buckling of connections and points of bearing between structural steel members. Allow for eccentricities caused by field fabrication and assembly.

D. Install and maintain bracing support members in tight contact with each other and with the surface being supported. Do not use wood shims.

E. Coordinate excavation work with installation of bracing. Extend excavation no more than 2 feet below any brace level prior to installation of the bracing.

F. Use procedures that produce uniform loading of bracing member without eccentricities, overstressing, or distortion of system members.

3.9 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly and not less than weekly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.10 REMOVAL

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 60 inches below overlying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earthwork."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Do not remove vertical support members that were installed within zone of influence of new or existing structures. Cut off support members installed within this zone at 5 feetbelow finished grade and abandon in place.

C. Do not remove internal bracing or transfer loads to permanent structure without prior acceptance of the Engineer.

D. Begin removal at excavation bottom and progress upward. Slowly release members noting indication of possible failure of remaining members or possible cave-in of excavation sides.

E. Progress backfilling together with removal of support systems from excavations.

F. Remove all portions of excavation support, unless otherwise indicated by approved Shop Drawings.

1. Zone of Influence Definition: Zone extending down and away from outer edge of the structure at 1 horizontal to 1 vertical.

G. When removing excavation support system, do not disturb or damage adjacent buildings, structures, waterproofing material, or utilities. Fill voids immediately with lean concrete or well-graded cohesionless sand or as directed by the Engineer.

H. Immediately remove excavation support system material from site.

END OF SECTION 315000

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SECTION 321123 - AGGREGATE BASE COURSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Aggregate subbase.
2. Aggregate base course.

B. Related Sections:

1. Section 312000 "Earthwork."
2. Section 321216 "Asphalt Paving."
3. Section 329119 "Landscape Grading."
4. Section 330513 "Manholes and Structures."

1.3 ACTION SUBMITTALS

A. Section 013300 "Submittal Procedures" for requirements for submittals.

B. Product Data:

1. Geotextile fabric.
2. Initial aggregate test reports.

C. Samples: Submit, in air-tight containers, 10 lb sample of each type of aggregate fill to testing laboratory.

D. Materials Source: Name of aggregate materials suppliers.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work according to Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges, latest revision.

C. Maintain one copy of each document on site.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Materials and Resources Characteristics:

1. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles of Project site.

2.2 MATERIALS

A. Gravel Borrow: MassDOT M1.03.0.

1. Percent Passing per Sieve Size:

Sieve Size	Percent Passing by Weight		
1/2 inch	50	to	85
No. 4	40	to	75
No.50	8	to	28
No. 200	0	to	10

B. Dense Graded Crushed Stone: MassDOT: M2.01.7.

1. Percent Passing per Sieve Size:

Sieve Size	Percent Passing by Weight		
2 inches	100		
1 1/2 inches	70	to	100
3/4 inches	50	to	85
No. 4	30	to	55
No.50	8	to	24
No. 200	3	to	10

C. Crushed Stone: MassDOT: M2.01.4 (3/4” crushed stone).

1. Percent Passing per Sieve Size:

Sieve Size	Percent Passing by Weight		
1 inch	100		
3/4 inches	90	to	100
½ inches	10	to	50
3/8 inches	0	to	20
No. 4	0	to	5

2.3 AGGREGATE QUALITY REQUIREMENTS

A. All aggregate must meet the requirements of the MassDOT Standard Specifications for Highways and Bridges Sections M1 and M2.

2.4 INITIAL TESTS

A. Perform all of the following tests on the proposed material to demonstrate that it meets all specified requirements when furnished. Submit the initial test results to the Engineer for approval prior to commencement of construction.

1. Sieve Analysis.
2. Liquid limit and plasticity index.
3. Moisture-density relationship.
4. Wear Resistance to Degradation (ASTM C131/C131M).

B. Geotextile Fabric: AASHTO M288; non-woven, polypropylene.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Clean the underlying course or subgrade of all foreign substances prior to constructing the subbase base course(s).

B. Do not construct base/subbase course(s) on underlying course or subgrade that is frozen.

C. Prepare the surface of the underlying course or subgrade to meet specified compaction and surface tolerances.

D. Correct ruts or soft yielding spots in the underlying courses.

E. Correct areas having inadequate compaction, and deviations of the surface from the specified requirements:

1. Loosen and remove soft or unsatisfactory material and add approved material
2. Reshape to line and grade,
3. Recompact to specified density requirements.

F. For cohesion-less underlying courses or subgrades containing sands or gravels:

1. Stabilize the surface prior to placement of the base course(s):

a. Mix aggregate into the underlying course
b. Compact by approved methods.
c. Do not allow traffic or other operations to disturb the finished underlying course
d. Maintain underlying course until the base course is placed.

G. Verify that the underlying surface has been inspected, gradients and elevations are correct.

3.2 AGGREGATE PLACEMENT

A. Install geotextile fabric over subgrade according to manufacturer's instructions.

1. Lap ends and edges minimum 6 inches.
2. Anchor fabric to subgrade when required to prevent displacement until aggregate is installed.

B. Place aggregate equal thickness layers to total compacted thickness within 1/2 inch of the thickness indicated on the drawings.

1. Maximum lift Compacted Thickness: 6 inches.
2. Minimum lift Compacted Thickness: 3 inches.

C. Level and compact the base and subbase course to within 1/2 inch of the thickness indicated.

D. Degree of Compaction:

1. Compact aggregate lifts to 95 percent of laboratory maximum dry density.
2. Except as noted below, degree of compaction is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557.
3. Degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

E. Maintain optimum moisture content of material as necessary to achieve the specified degree of compaction.

3.3 ERECTION TOLERANCES

A. Maximum Variation from Flat Surface: 1/4 inch measured with 10-foot straight edge.

B. Maximum Variation from Thickness: 1/4 inch.

C. Maximum Variation from Elevation: 1/2 inch.

3.4 FIELD QUALITY CONTROL

A. Section 017300 "Execution" for field inspecting, testing, adjusting, and balancing.

B. Field Density Measurements: Measure field density in accordance with ASTM D1556/D1556M, ASTM D2167 or ASTM D6938.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

D. Frequency of Tests: One test for every 1000 square yards of each layer compacted aggregate.

END OF SECTION 321123

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SECTION 321216 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Asphalt materials.
2. Aggregate materials.
3. Asphalt paving base course, binder course, and wearing course.
4. Asphalt paving overlay for existing paving.
5. Surface slurry.

B. Related Requirement:

1. Section 321123 “Aggregate Base Courses”: Compacted subbase for paving.
2. Section 321723 “Pavement Markings”: Painted pavement markings, lines, and legends.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Submit product information for asphalt and aggregate materials.
2. Submit mix design with laboratory test results supporting design.
3. Submit Massachusetts Department of Transportation (MassDOT) Hot Mix Asphalt (HMA) Laboratory Trial Mix Formulas (LTMFs), if applicable.

B. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

A. Mixing Plant: Conform to MassDOT Standard Specifications for Highways and Bridges (MSSHB).

B. Obtain materials from same source throughout.

C. Perform Work in accordance with MSSHB and MassDOT Supplemental Specifications for Highways and Bridges.

D. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing work of this section and on the MassDOT prequalified list.

1.6 AMBIENT CONDITIONS

A. Section 015000 “Temporary Facilities and Controls”: Ambient conditions control facilities for product storage and installation.

B. Do not place asphalt mixture when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen.

C. Do not place asphalt mixture between November 15 and April 1 in MassDOT roadways, unless otherwise approved by MassDOT.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

A. Materials and Resources Characteristics:

1. Recycled Content Materials shall conform to the MSSHB.

2.2 ASPHALT PAVING

A. Performance / Design Criteria:

1. Paving: Design for parking and light duty commercial vehicles.

B. Asphalt Materials:

1. Asphalt Binder: AASHTO M320; performance grade PG 64-28 or PG 64E-28.
2. Tack Coat: In accordance with Section M3.11.6 of MSSHB and be applied to all layers of Pavement Materials (including HMA driveway). The contact surfaces of adjacent cut pavement edges shall be painted with a tack coat.
3. Reclaimed Asphalt Pavement (RAP): Processed material obtained by milling or full depth removal of existing asphalt paving.

C. Aggregate Materials: Coarse and Fine Aggregate and Mineral Filler shall be in accordance with the MSSHB.

D. Aggregate Subbase: Specified in Section 321123 “Aggregate Base Courses.”

E. Pavement reclaimed as base course shall be in accordance with the MSSHB.

2.3 MIXES

A. Use dry material to avoid foaming. Mix uniformly.

B. Asphalt Paving Mixtures: Designed in accordance with MSSHB.

1. Binder Course MassDOT HMA Binder: Superpave Intermediate Course.
2. Wearing Course MassDOT HMA STD. Top Course.

2.4 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Testing, inspection and analysis requirements.

B. Submit proposed mix design of each class of mix for review prior to beginning of Work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.

B. Verify compacted subgrade and subbase is dry and ready to support paving and imposed loads.

1. Proof roll subbase with 50-ton roller with 150 psi tire pressure in minimum two perpendicular passes to identify soft spots.
2. Remove soft subbase and replace with compacted fill as specified in Section 321123 “Aggregate Base Courses.”

C. Verify gradients and elevations of base are correct.

D. Verify manhole frames and covers and gate valve boxes are installed in correct position and elevation.

3.2 PREPARATION

A. Prepare subbase in accordance with the requirements of the MSSHB.

B. All raised structures (frames and covers, gate valve boxes, etc.) within the project area shall be spray painted safety orange and have a light barrel on it to notify traffic and pedestrians of the raised structure.

3.3 DEMOLITION

A. Saw cut and notch existing paving.

B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.

C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.4 INITIAL TRENCH REPAIR

A. Initial trench pavement shall be placed wherever existing pavement has been removed or disturbed as soon as practical, but in all cases, trenches will be paved at the end of every work week in Town streets. This requirement will be modified only with permission of the Owner and Engineer. For MassDOT streets (Route 28), initial trench width paving shall be placed at the end of each work day, in accordance with the MassDOT permit. Before placing the temporary trench pavement, the edges of the existing paving shall be saw or blade cut to a smooth, straight edge.

1. At the end of every workday, backfill the trench as specified in Section 312333 "Trenching and Backfilling" to existing pavement grade. When pavement is to be placed, the full width of the trench, provide a second cut of the pavement and excavate the gravel borrow subbase to a depth of 4-in for Town streets and 3-in for MassDOT streets below the surface of the existing pavement, shaped and compacted. Final pavement subgrade shall consist of 8 inches of gravel borrow and 4 inches of dense graded crushed stone over it beneath the pavement.
2. Hose clean all road surfaces adjacent to the trench area to be paved. No paving is to be placed until subsurface is dry.
3. Thoroughly clean the vertical edges of the existing pavement to remove loose material, taking extra care to clean the corners.
4. Tack coat the vertical edges of the existing pavement and the gravel subbase with emulsified asphalt.
5. The Town streets initial trench width pavement (binder course) shall be placed and compacted by steel-wheeled rollers of sufficient weight to thoroughly compact the bituminous concrete without damaging the existing pavement. The new pavement shall be rolled smooth and even with the existing pavement.
6. For Route 28 (MassDOT) the 3-in initial trench width plus 1 foot pavement (1.5-in base coarse and 1.5-in intermediate course) shall be placed and compacted by steel-wheeled rollers of sufficient weight to thoroughly compact the bituminous concrete without damaging the existing pavement. The new pavement shall be rolled smooth and even with the existing pavement.
7. Seal surface of butted joint with emulsified asphalt.
8. Initial pavement shall be maintained in a condition suitable for traffic until replaced or overlaid by intermediate patch or final pavement. Defects shall be repaired within 1 day of notification of such defects.

3.5 FINAL TRENCH WIDTH PAVING (ROUTE 28)

A. Remove and dispose of initial pavement and subbase to a depth below existing pavement sufficient to place 12 inches of subbase materials plus 7.5 inches of pavement (3.5-in base or intermediate course, 2.25-in intermediate course, 1.75-in surface course) or thickness to match existing pavement, whichever is greater. Place 8-inches of bank run gravel and 4-inches of dense graded crushed stone for roadway subbase beneath the pavement and compact to 95

percent of maximum dry density as determined by ASTM D1557, Method D. Final trench paving shall be performed every 30 days or as directed by the Engineer, Owner, or MassDOT.

B. Trim loose edge of existing pavement. Broom and tack coat all edges with emulsified or cutback asphalt.

C. Place Intermediate or Base Course and compact to minimum 3.5-in thickness or thickness required to match existing pavement thickness less 4 inches by steel-wheeled roller to a width of trench plus 1 foot on both sides of the trench.

D. Broom and tack coat edges of existing pavement and Intermediate/Base Course with emulsified or cutback asphalt.

E. Place Intermediate Course and compact to 2.25-in thickness by steel-wheeled roller to a width of trench plus 2 feet on both sides of the trench.

F. Broom and tack coat edges of existing pavement and Intermediate Course with emulsified or cutback asphalt.

G. Place Top Course and compact to 1.75-in thickness, finish smooth, dense and flush with surface of existing pavement to a width of trench plus 2 feet on both sides of the trench.

H. Infra-red method must be used in conjunction with the permanent patch (for small openings) to create a smooth driving surface consistent with the existing roadway surface.

I. Final trench patch will also be required along the trenches associated with service laterals.

J. Do not place final pavement over trenches in less than 90 days after completion of backfilling, before temporary pavement has set through winter season or the opening of the asphalt plants, whichever occurs first, or as otherwise directed in writing by Owner and Engineer.

3.6 INSTALLATION

A. Subbase:

1. Aggregate Subbase: Install as specified in Section 321123 “Aggregate Base Courses.”

B. Tack Coat:

1. Apply tack coat in accordance with the MSSHB.
2. Apply tack coat to contact surfaces of curbs, gutters and pavement surfaces that have been exposed to traffic and milled surfaces in accordance with the MSSHB.
3. Coat surfaces of manhole and catch basin frames with oil to prevent bond with asphalt paving. Do not tack coat these surfaces.

C. Single Course Asphalt Paving:

1. Install Work in accordance with the MSSHB
2. Place asphalt within 24 hours of applying primer or tack coat.
3. Place asphalt wearing course to thickness indicated on Drawings.

4. Compact paving by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
5. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks and even with the existing pavement.

D. Double Course Asphalt Paving:

1. Place asphalt binder course within 24 hours of applying primer or tack coat.
2. Place binder course to thickness indicated on Drawings.
3. Place wearing course within 24 hours of placing and compacting binder course. When binder course is placed more than 24 hours before placing wearing course, clean surface and apply tack coat before placing wearing course.
4. Place wearing course to thickness indicated on Drawings.
5. Compact each course by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
6. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks and even with the existing pavement.

E. Asphalt Paving Overlay:

1. Apply tack coat to existing paving surface at rate recommended by geotextile fabric manufacturer.
2. Place wearing course to 1 inch compacted thickness.
3. Compact overlay by rolling to specified density. Do not displace or extrude paving from position. Hand compact in areas inaccessible to rolling equipment.
4. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

F. Pavement Milling:

1. Work in accordance with the MSSHB.
2. Depth of pavement milling shall be as specified.

G. Curbs:

1. Replace in kind and meet material and construction requirements of the MSSHB.

3.7 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

B. Scheduled Compacted Thickness: Within 1/4 inch.

C. Variation from Indicated Elevation: Within 1/4 inch.

3.8 FIELD QUALITY CONTROL

A. Take samples and perform tests in accordance with the MSSHB.

B. Asphalt Paving Mix Temperature: Measure temperature at time of placement.

C. Asphalt Paving Thickness: ASTM D3549; test one core sample from every 1000 square yards compacted paving.

D. Asphalt Paving Density: ASTM D2950 nuclear method; test one location for every 1000 square yards compacted paving.

3.9 PROTECTION

A. Immediately after placement, protect paving from mechanical injury until surface temperature is less than 140 degrees F.

3.10 PAVEMENT MARKINGS

A. As specified in Section 321723 “Pavement Markings.”

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SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes painted markings applied to asphalt pavement.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.

B. Shop Drawings: For pavement markings.

1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges (MSSHB) for pavement-marking work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 45 deg F, and not exceeding 95 deg F.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Must be on the MassDOT Qualified Construction Material list.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint and Glass Beads will conform to the MSSHB and all supplemental documents.

B. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II.

1. Color: White and Yellow.

C. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.

1. Color: White and Yellow.

D. Glass Beads: AASHTO M247, Type 1.

1. Roundness: Minimum 80 percent true spheres by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 ROADWAY MARKINGS

A. Markings: Located as follows:

1. Locate and catalog all pavement markings prior to beginning work to facilitate placing temporary and permanent markings.
2. Install temporary water bourn pavement markings at the end of each workday.

3. Repaint temporary pavement markings when they are worn, as determined by the Engineer.
4. Permanent thermoplastic pavement markings on roads shall be installed in the same location as the original markings.
5. Pavement markings shall meet the requirements of the Federal Highway Administration Manual on Uniform Traffic Control Devices (MUTCD) and the associated Massachusetts Amendments.

B. Remove all surface dirt within the areas to be painted. Large areas of tar, grease or foreign materials may require sand blasting, steam cleaning or power brooming to accomplish complete removal. Do not proceed with the application of stripes until final authorization is received from the Engineer.

C. Markings: Fast drying white water-borne traffic paint as follows:

Material Application Material	Line Temperature	Reflectorized Bead Thickness	Application
M7 .01.23	40 to 120 deg F	15 mils	6 lbs / gal

D. Use no thinners for the above listed pavement marking applications except in accordance with the manufacturer's specifications and at the direction of the Engineer.

E. Do not heat paint or pavement marking material above the temperature marked on the container.

F. Bituminous concrete pavements must be in place for 48 hours prior to the application of pavement markings.

G. If for any reason material is spilled or tracked on the pavement, or any markings applied, in the Engineer's judgement, fail to conform because of a deviation from the desired pattern, remove such material by a method that is not injurious to the roadway surface and is acceptable to the Engineer, clean the roadway surface and prepare the surface for a reapplication of markings and reapply the markings as directed without additional compensation for any of the foregoing corrective operations.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

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SECTION 323300 - SITE FURNISHINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fixed Bollards

B. Related Requirements:

1. Section 033010 "Miscellaneous Cast-in-Place Concrete" for in concrete footings.
2. Section 312000 "Earthwork" for excavation for installing concrete footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Product Schedule: For site furnishings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 FIXED BOLLARDS

A. Steel bollard units shall be from one manufacturer. Pipe shall be welded and seamless hot dipped galvanized steel pipe with plain ends, conforming to ASA Pipe Schedule 40 ASTM A120. Dimensions shall be nominal as shown on the Drawings. All metal surfaces shall be prime painted with one coat exterior oil base rust inhibitor paint and finished with two coats exterior oil base gloss black.

B. Apply white, pressure sensitive sheeting to the top of the bollards as shown on the Drawings, all around the unit. The sheeting shall have a precoated adhesive backing protected by a removable liner and may be applied without necessity of additional adhesive coats on either the reflective sheeting or application surface. White reflective sheeting (pressure sensitive) for each bollard shall conform to AASHTO M 268 Type II – Super Engineering Grade, or equal.

C. Furnish each bollard complete with concrete footing and appurtenances as shown on the Drawings.

2.2 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.

E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.3 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.5 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored and positioned at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

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F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

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SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Related Requirements:

1. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
3. Section 329300 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. AOAC: Association of Official Analytical Chemists.

C. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

D. CEC: Cation exchange capacity. The measure of a soil’s ability to retain and supply nutrients.

E. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

F. CPSS: Certified Professional Soil Scientist.

G. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

H. Imported Soil: Soil that is transported to Project site for use.

I. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

J. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

K. Methods of Soil Analysis: Standards of soil testing by the AOAC.

L. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

M. NRCS: Natural Resources Conservation Service

N. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

O. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

P. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

Q. SSSA: Soil Science Society of America.

R. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

S. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

T. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

U. USCC: U.S. Composting Council.

V. USDA: U.S. Department of Agriculture.

W. USDA Textural Classification System: The USDA system of classifying soils by their proportions of sand, silt and clay within the USDA soil triangle.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.

4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed:

1. Laboratories: Subject to compliance with requirements, provide testing by the following:

    a. UMASS Soil and Plant Tissue Testing Lab, 161 Holdsworth Way, Amherst, MA 01003, ph. (413) 545-2311.

2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil:

1. Notify Engineer seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles:

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by soil scientist (CPSS) certified by SSSA or state-certified, -licensed, or -registered soil scientist under the direction of the testing agency:

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for lawn establishment or landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85 percent compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium,

and vanadium. If RCRA metals are present, include recommendations for corrective action.

4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NCR-13, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients:

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inchdepth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inchdepth of soil.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type Existing: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers as recommended by qualified testing agency.

C. Planting-Soil Type Imported: Imported, naturally formed soil from off-site sources and consisting of sandy loam soil according to USDA textures; and modified to produce viable planting soil:

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Unacceptable Properties: Clean soil of the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding in any dimension.

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves.
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 30 to 40 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 4-inch sieve.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials:

1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. of loose sawdust or ground bark.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 2-inch sieve to remove large materials.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property:

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 2 inches of subgrade. Spread remainder of planting soil.

C. Mixing: Spread unamended soil to total depth of 6 inches, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet:

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil:

a. Mix lime and sulfur with dry soil before mixing fertilizer.
b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments, except compost, and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil:

1. Mix lime and sulfur with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.5 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

A. Application: Apply compost component of planting-soil mix 6 inches of compost to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.7 PROTECTION

A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.8 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

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SECTION 329119 - LANDSCAPE GRADING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Final grade topsoil for finish landscaping.

B. Related Sections:

1. Section 310515 “Soils and Aggregates for Earthwork” for various soil materials.
2. Section 312000 “Earthwork” for excavating, filling and backfilling, compacting, and grading.
3. Section 312333 “Trenching and Backfilling” for trenching and backfilling for utilities outside of buildings, usually extending to utility service connections.
4. Section 321216 “Asphalt Paving.”
5. Section 329200 “Turf and Grasses” for seeded, sodded, plugged, and sprigged turf and meadows; pesticides; erosion-control materials; turf renovation; and grass paving.

1.3 ACTION SUBMITTALS

A. Samples: Submit, in air-tight containers, 10 lb sample of each type of fill to testing laboratory.

B. Materials Source: Submit name of imported materials source.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 SUSTAINABLE DESIGN SUBMITTALS

A. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements:

1. Materials Resources Certificates:

a. Certify source for regional materials and distance from Project site.

B. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products:

1. Provide cost data for the following products:

a. Regional products.

1.6 QUALITY ASSURANCE

A. Furnish each topsoil material from single source throughout the Work.

B. Maintain one copy on site.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Topsoil: As specified in Section 310515 “Soils and Aggregates for Earthwork.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify building and trench backfilling have been inspected.

B. Verify substrate base has been contoured and compacted.

3.2 PREPARATION

A. Protect landscaping and other features remaining as final Work.

B. Protect existing structures, fences, sidewalks, utilities, paving, and curbs.

3.3 SUBSTRATE PREPARATION

A. Eliminate uneven areas and low spots.

B. Remove debris, roots, branches, stones, in excess of 1inch in size. Remove contaminated subsoil.

C. Scarify surface to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment used for hauling and spreading topsoil has compacted subsoil.

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3.4 PLACING TOPSOIL

A. Place topsoil in areas where seeding, planting, is required. to thickness as scheduled. Place topsoil during dry weather.

B. Fine grade topsoil to eliminate rough or low areas. Maintain profiles and contour of subgrade.

C. Remove roots, weeds, rocks, and foreign material while spreading.

D. Manually spread topsoil close to plant material, building, to prevent damage.

E. Lightly compact placed topsoil.

F. Remove surplus subsoil and topsoil from site.

G. Leave stockpile area and site clean and raked, ready to receive landscaping.

3.5 TOLERANCES

A. Top of Topsoil: Plus or minus 1/2 inch.

3.6 PROTECTION OF INSTALLED WORK

A. Prohibit construction traffic over topsoil.

3.7 SCHEDULES

A. Compacted topsoil thicknesses:

1. Seeded Grass: 6 inches.
2. Sod: 4 inches.
3. Shrub and Tree Beds: 18 inches.

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SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and

percentage of purity, germination, and weed seed. Include the year of production and date of packaging:

1. Certification of each seed mixture for turfgrass, sod or plugs. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment:

1. Professional Membership: Installer shall be a member in good standing of the National Association of Landscape Professionals.
2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:)

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawncare Manager.
    c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in the Turfgrass Producers International’s (TPI) "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion:

1. Spring Planting: May 1st – June 15th.
2. Fall Planting: September 15th – November 1st.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with Association of Official Seed Analysts (AOSA's) "Rules for Testing Seeds" for purity and germination tolerances.

B. Grass-Seed Mix: Proprietary seed mix as follows:

1. Products: Subject to compliance with requirements, provide the following :

a. Bioretention Seed Mix: “Native Detention Area Mix” (ERNMX-183)
As manufactured by Ernst Seeds 8884 Mercer Pike
Meadville, PA 16335. (800) 873-3321 or approved equal.
b. Wildflower Seed Mix: “New England Showy Wildflower Seed Mix” as provided by New England Wetland Plants, Inc. 14 Pearl Lane South Hadley, MA 01075 (413) 548-8000, or approved equal.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 LIME

A. Description: Agricultural limestone containing a minimum of 80 percent calcium carbonate equivalent.

B. Comply with ASTM C602.

2.4 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

F. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

G. Asphalt Emulsion: ASTM D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.5 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 EROSION-CONTROL MATERIALS

A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.

B. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of 3-inch nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work:

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations:

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LIMING AND FERTILIZING

A. Apply lime at application rate recommended by soil analysis.

B. Work lime into top 6 inches of soil.

C. Apply fertilizer at application rate recommended by soil analysis.

D. Apply fertilizer after smooth raking of topsoil and prior to installation of sod.

E. Apply fertilizer no more than 48 hours before laying sod.

F. Mix fertilizer thoroughly into upper 4 inches of topsoil.

G. Lightly water soil to aid dissipation of fertilizer.

3.4 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil.

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Engineer's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph:

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.
3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 3 to 4 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment:

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

G. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.6 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches:

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry:

1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.8 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: 60 days from date of planting completion:

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

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SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparation of subsoil and topsoil.
2. Topsoil bedding.
3. Trees, plants, and ground cover.
4. Mulch.
5. Fertilizer.
6. Pruning.
7. Maintenance.

B. Related Sections:

1. Section 312000 “Earthwork” for excavating, filling and backfilling, compacting, and grading.
2. Section 312333 “Trenching and Backfilling” for trenching and backfilling for utilities outside of buildings, usually extending to utility service connections.
3. Section 329119 “Landscape Grading” for preparation of subsoil and placement of topsoil in preparation for the Work of this section.

1.3 DEFINITIONS

A. Weeds: Vegetative species other than specified species to be established in given area.

B. Plants: Living trees, plants, and ground cover specified in this Section, and described in ANSI Z60.1.

1.4 SUBMITTALS

A. Section 013300 “Submittal Procedures” for requirements for submittals.

B. Product Data: Submit list of plant material sources, data for fertilizer and other accessories.

C. Submit minimum1-lb sample of topsoil proposed. Forward sample to testing laboratory in sealed containers to prevent contamination.

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1.5 CLOSEOUT SUBMITTALS

A. Section 017700 “Closeout Procedures” for requirements for submittals.

1.6 QUALITY ASSURANCE

A. Tree Pruning: ANSI A300 Pruning Standards for Woody Plants.

B. Perform Work according to MSSHB standards.

C. Nursery: Company specializing in growing and cultivating plants with three years documented experience.

D. Installer: Company specializing in installing and planting plants with 5 years documented experience.

E. Maintenance Services: Performed by installer.

1.7 PRE-INSTALLATION MEETINGS

A. Section 013100 “Project Management and Coordination” for pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

B. Protect and maintain plant life until planted.

C. Deliver plant life materials immediately prior to placement. Keep plants moist.

D. Plant material damaged as a result of delivery, storage or handling will be rejected.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F or rise above 90 degrees F.

1.10 COORDINATION

A. Section 013100 “Project Management and Coordination” for requirements for coordination.

1.11 WARRANTY

A. Section 017700 “Closeout Procedures” for requirements for warranties.

B. Furnish one year manufacturer warranty for trees, plants, and ground cover.

1.12 MAINTENANCE SERVICE

A. Section 017700 “Closeout Procedures” for requirements for maintenance service.

B. Maintain plant life for three months after Date of Substantial Completion.

C. Maintain plant life immediately after placement until plants are well established and exhibit vigorous growing condition. Continue maintenance until termination of warranty period.

D. Maintenance includes:

1. Cultivation and weeding plant beds and tree pits.
2. Applying herbicides for weed control. Remedy damage resulting from use of herbicides.
3. Remedy damage from use of insecticides.
4. Irrigating sufficient to saturate root system.
5. Pruning, including removal of dead or broken branches.
6. Disease control.
7. Maintaining wrapping, guys, turnbuckles, and stakes. Adjust turnbuckles to keep guy wires tight. Repair or replace accessories when required.
8. Replacement of mulch.

PART 2 - PRODUCTS

2.1 TREES, PLANTS, AND GROUND COVER

A. Planting Stock:

1. Species: According to Standardized Plant Names, official code of American Joint Committee on Horticulture Nomenclature.
2. Identification: Label individual plants or each bundle of plants when tied in bundles.
3. Plants: No. 1 Grade conforming to "American Standard for Nursery Stock" of American Association of Nurserymen (AAN); well-branched, vigorous and balanced root and top growth; free from disease, injurious insects, mechanical wounds, broken branches, decay and other defects.
4. Trees: Furnish with reasonably straight trunks, well balanced tops, and single leader.
5. Deciduous plants: Furnish in dormant state, except those specified as container grown.

B. Trees Plants and Ground Cover: Species and size identifiable in plant schedule, grown in climatic conditions similar to those in locality of the Work.

2.2 SOIL MATERIALS

A. Topsoil: As specified in Section 310515 “Soils and Aggregates for Earthwork”.

2.3 SOIL AMENDMENT MATERIALS

A. When soil tests indicate soil amendment, apply soil conditioners or fertilizers to amend soil to specified conditions:

1. Tree Fertilizer: Containing fifty percent of elements derived from organic sources; of proportion necessary to eliminate deficiencies of topsoil

B. Lime: Ground limestone, dolomite type, minimum 95 percent carbonates.

C. Water: Clean, fresh, and free of substances or matter capable of inhibiting vigorous growth of plants.

2.4 MULCH MATERIALS

A. Mulching Material: Composted, shredded hardwood bark, dark brown in color.

2.5 ACCESSORIES

A. Wrapping Materials: Burlap.

B. Stakes: Softwood lumber, pointed end.

C. Cable, Wire, Eye Bolts: Non-corrosive, of sufficient strength to withstand wind pressure and resulting movement of plant life.

D. Plant Protectors: Rubber sleeves over cable to protect plant stems, trunks, and branches.

2.6 SOURCE QUALITY CONTROL

A. Test and analyze imported or existing topsoil.

B. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt and organic matter; pH value and.

C. Provide recommendation for fertilizer and soil amendment application rates for specified planting as result of testing.

D. Testing is not required when recent tests are available for imported topsoil. Submit these test results to testing laboratory. Indicate, by test results, information necessary to determine suitability.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 013100 “Project Management and Coordination” for verification of existing conditions before starting work.

B. Verify prepared subsoil are ready to receive work.

C. Saturate soil with water to test drainage.

D. Verify required underground utilities are available, in proper location, and ready for use.

3.2 PREPARATION OF SUBSOIL

A. Prepare subsoil to eliminate uneven areas. Maintain profiles and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds and undesirable plants and their roots. Remove contaminated subsoil.

C. Scarify subsoil to depth of 6 inches where plants are to be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

D. Dig pits and beds three times wider than plant root system.

3.3 PLACING TOPSOIL

A. Spread topsoil to minimum depth of 6 inches over area to be planted. Rake smooth.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low or soft areas, and to ensure positive drainage.

E. Install topsoil into pits and beds intended for plant root balls, to minimum thickness of 6 inches.

3.4 FERTILIZING

A. Apply starter fertilizer at a rate as specified by the soil test

B. Apply after initial raking of topsoil.

C. Mix thoroughly into upper 3 inches of topsoil.

D. Lightly water soil to aid dissipation of fertilizer.

3.5 PLANTING

A. Place plants for best appearance.

B. Set plants vertical.

C. Remove non-biodegradable root containers.

D. Set plants in pits or beds, partly filled with prepared plant mix, at minimum depth of 6 inches under each plant. Remove burlap, ropes, and wires, from top half of root ball.

E. Saturate soil with water when pit or bed is half full of topsoil and again when full.

3.6 PLANT SUPPORT

A. Brace plants vertically with plant protector wrapped guy wires and stakes.

B. Tree Support Method per Tree Caliper:

1. 1 inch: One stake with one tie.
2. 1 to 2 inches: Two stakes with two ties.
3. 2 to 4 inches: Three guy wires.
4. Over 4 inches: Four guy wires.

3.7 TREE PRUNING

A. When pruning trees is required, lightly prune trees according to ANSI A300 Maintenance Pruning Type: Crown Cleaning.

3.8 FIELD QUALITY CONTROL

A. Section 017300 “Execution” for field inspecting, testing, adjusting, and balancing.

B. Plants will be rejected when ball of earth surrounding roots has been disturbed or damaged prior to or during planting.

3.9 SCHEDULE

A. Plant Schedule: As shown on the Drawings.

END OF SECTION 329300

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SECTION 330130.81 - EPOXY MONOLITHIC LINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The term “structure” herein refers to all sanitary sewer manholes and structures to be lined with the Epoxy Monolithic Lining System (EMLS).

B. Furnish all labor, materials, equipment, and incidentals required to install and test EMLS as noted on the Drawings and as specified herein for the purpose of providing corrosion protection of structures.

C. Where indicated in the Drawings or as directed by the Engineer work may require, patching structure exterior or stopping infiltration with chemical grout.

D. Eliminate active infiltration observed in the frame seal, chimney (corbel for brick manholes), cone, wall, bench, invert, holes, or pipe connections prior to applying the lining system.

E. Reinstall existing manhole rings and covers removed to allow the completion of the lining work. Restore the site to its pre-construction condition.

F. Extend lining from invert of lowest pipe connection to 1-inch below bottom of frame, as specified.

G. Accurately field measure and size each individual structure. Note that each existing sewer structure designated to receive epoxy monolithic lining may have a different configuration and varying field dimensions. Field measurements to conform to requirements of monolithic lining manufacturer.

H. Note that presence or absence of leakage through structure wall is dependent upon ground water levels and conditions at time of inspections. High ground water levels in project area typically occur in winter months (December through March) but will vary with rainfall in any given year. Stop leakage prior to lining structures. No additional payment will be made for repairing leaks.

1.3 ACTION SUBMITTALS

A. Staging Area Plan: Provide a plan identifying the staging area for deployment of lining materials and equipment for each work area.

B. Submit to Engineer shop drawings and product data for all lining materials specified in this Section.

1. Name of supplier (manufacturer), name of installer, and a list of materials to be furnished.
2. Information on the chemical grout and additives, cementitious compound, waterproofing, and corrosion control materials that will be used, the installation method, and equipment. For the materials that will be used, identify, and furnish references for successful use of the materials in similar applications.
3. Method for sealing pipe connections.
4. Manufacturers' instructions for the proper installation of the lining product.

C. Test and Evaluation Reports:

1. Prior to each shipment of materials, submit certified test reports that materials for this Contract were manufactured and tested in accordance with ASTM Standards specified herein.

D. Source Quality-Control Submittals: Indicate results of factory tests and inspections.

E. Field Quality-Control Submittals: Indicate results of Contractor furnished tests and inspections.

F. Qualifications Statement:

1. The Contractor to perform the structure lining shall be fully qualified, experienced, and equipped to complete the work in a timely and satisfactory manner. Submit the following information to Engineer for review and approval before any work is performed.

   a. Proof of certification by manufacturer to install EMLS.
   b. List of projects showing minimum of five years' experience in performing this type of specialized work.
   c. List of projects showing successfully installed the proposed lining system in a minimum of 500 structures along with a contact name, telephone number, and brief description of work performed.
   d. Name of the manufacturer and suppliers of all material proposed to be used for installation of liner.

2. Owner reserves the right to disapprove the use of the Contractor based on the submitted qualifications.

1.4 QUALITY ASSURANCE

A. Supplier shall be responsible for provisions of test requirements specified in referenced ASTM Standards as applicable. In addition, monolithic lining products to be installed under this Contract may be inspected at plant for compliance with these specifications by an independent testing laboratory provided by Owner. Contractor shall require manufacturer's cooperation in these inspections. Cost of plant inspection of lining products and materials approved for this Contract shall be borne by Owner.

B. Inspections of lining products and materials may also be made by Engineer or other representatives of Owner after delivery. Lining products and materials shall be subject to rejection at any time on account of failure to meet any of Specification requirements, even though samples may have been accepted as satisfactory at place of manufacture. Lining materials

rejected after delivery shall be marked for identification and shall be immediately removed from job site.

C. Contractor shall furnish services of epoxy liner manufacturer's field service technician to advise and assist epoxy lining installation and provide instruction to Contractor for lining of first structure. Field service technician shall be fully qualified and experienced in EMLS.

D. Provide monolithic lining from a single manufacturer. Supplier shall be responsible for provisions for test requirements specified in ASTM Standards D 870, and D 2247 as applicable for monolithic lining.

E. Inspections of EMLS materials may be made by Engineer or other representatives of Owner after delivery. Materials shall be subject to rejection at any time on account of failure to meet any of Specification requirements, even though sample lining materials may have been accepted as satisfactory at place of manufacture. EMLS materials rejected after delivery shall be marked for identification and shall be removed from the job at once.

1.5 QUALIFICATIONS

F. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

G. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience and approved by manufacturer.

H. Licensed Professional: Professional Engineer experienced in design of specified Work and licensed in the Commonwealth of Massachusetts.

1.6 DELIVERY, STORAGE, AND HANDLING

I. Care shall be taken in shipping, handling, and placing to avoid damaging the chemical grouts, cementitious materials, and other products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the Engineer.

J. Any materials showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

K. While stored, the materials shall be adequately packaged and protected. The materials shall be stored in a manner as recommended by the manufacturer.

L. Materials shall be stored, shipped, and handled according to their material safety data sheet and manufacturer's recommendations. Materials damaged in shipment shall be replaced as directed by Engineer at no additional cost to Owner.

1.7 EXISTING CONDITIONS

A. Field Measurements: Verify field measurements prior to mobilization of installation crews. Indicate field measurements on Shop Drawings.

1.8 WARRANTY

A. All monolithic lining work shall be warranted by the Contractor for a period of two years from the date of Substantial Completion. During this period, all defects in the lining shall be repaired in a manner satisfactory to the Engineer or the lining shall be re-applied at no cost to the Owner. At 21 months following substantial completion of the lining work, the Owner/Engineer shall inspect all of this work to ensure proper performance. If deficiencies are found during these inspections, the Contractor shall repair them at no additional cost to the Owner.

B. Contractor shall be responsible for stopping any infiltration leaks as recommended by the manufacturer prior to installation of EMLS.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Design and install EMLS to protect concrete, brick mortar, and other surfaces from corrosion. Design products to stop infiltration and root intrusion. Interior surfaces to be protected shall include walls, benches, inverts, pipe junctions and chimney (corbel).

2.2 MATERIALS TO STOP ACTIVE LEAKS

A. To stop active leaks in the structure, use any of the following of the following materials and procedures to stop the active leaks prior to lining.

1. Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug: Hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents, containing chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents, or promote the corrosion of steel it may come in contact with. The cement plug shall comply with the following minimum requirements:

Minimum Requirements		
Compressive Strength	ASTM C 109	>1000 psi, 1hr. >2500 psi, 24 hrs.
Sulfate Resistance	ASTM C 267	No weight loss after 15 cycles @ 2000 ppm
Freeze/Thaw	ASTM C 666 "Method A"	100 cycles
Pull Out Strength	ASTM C 234	14,000 lbs.
Set Time		<5.0 minutes

2. Chemical Grout: Repair work shall be in accordance with ASTM F 2414-04, and manufacturers recommended installation methods. Use in accordance with the

manufacturer's recommendations for the specific application. Be of a formula that is suitable for application in a structure that is susceptible to frost, if applicable for the regional climate.

a. Drilling and injection method shall use a hydrophilic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the Engineer.
b. Exterior chemical curtain grouting method shall use a hydrophobic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the Engineer.
c. Expanded Gasket Procedure shall use Oil Free Oakum with hydrophilic polyurethane chemical grout manufactured by Avanti or equal used for sealing larger cracks and joints, unless otherwise approved by the ENGINEER.

2.3 PATCHING, REPOINTING, FILLING AND REPAIRING NON-LEAKING HOLES, CRACKS AND SPALLS IN THE CONCRETE AND MASONRY STRUCTURES

A. Quick-Setting Cementitious Patching material shall comply with the following minimum requirements:

Physical Properties		
Compressive Strength	ASTM C109	>1800 psi, 1 hr. >2600 psi, 24hr. >3000 psi, 28 days
Bond	ASTM C882	>1600 psi, 28 days
Applied Density		105 lbs pcf ± 5 lbs
Shrinkage	ASTM C596	0% at 90% R.H.
Placement Time		5 to 10 minutes
Set Time		15 to 30 minutes

M. The water used to mix product shall be clean and potable. No material (other than water) shall be used with or added to the patching product without prior approval or recommendation from manufacturer.

2.4 EPOXY MONOLITHIC LINING SYSTEM (EMML)

A. The EMLS shall be a resin filled system suitable for use as a trowel, spray, or spin applied monolithic lining in sewer structures. The resin shall be 100% epoxy resin. The EMLS shall conform to ASTM C722. The EMLS materials shall be suitable for all the specified design conditions.

1. The EMLS shall provide a minimum service life of 25 years.
2. The cured EMLS shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer structure. Provide bond strength data on cured EMLS based on ASTM C882 test method.

3. The cured EMLS shall provide a minimum total thickness of 0.10 inches (100 mils). The cured lining thickness shall be continuous with proper sealing connections to all unsurfaced areas.
4. Chemical sealants or grouts used to seal active leaks, to patch cracks, to fill voids and to otherwise prepare the structure surfaces shall be compatible with the EMLS.

B. When cured, the EMLS shall form a continuous, tight fitting, hard, impermeable lining, which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

C. The EMLS shall bond to the sewer structure being lined after being placed and cured. The EMLS shall cover the complete interior of the existing sewer structure including the benches (shelves), inverts (channels or troughs) and pipe connections. The EMLS shall provide a continuous watertight seal or barrier.

1. The EMLS shall effectively seal the interior surfaces of the sewer structure and prevent any penetration or leakage of groundwater infiltration.
2. Provide water resistance data on EMLS based on ASTM Standards D870 and D2247 test methods.
3. The EMLS shall be compatible with the thermal condition of the existing sewer structure surfaces. Surface temperatures will range from 30 degrees F to 80 degrees F. Provide test data on EMLS thermal compatibility based on ASTM C884.
4. The EMLS shall be separated from the manhole frame by a suitable joint. The joint shall be sealed with joint sealing tape.

D. The EMLS shall be as manufactured by Raven Lining Systems, Warren Environmental, Sauereisen, AP/M PermaForm, WBE Dorcas Inc. or an approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Thoroughly clean and then inspect structure for loose or missing bricks, loose mortar, or holes, and remove any protrusions or obstructions. Observed leaks shall be eliminated prior to applying the lining system.

B. Damage incurred to the structures or pipe segments due to methods and equipment employed by the Contractor is the responsibility of the Contractor. The cost to repair the structure or pipe segments and expenses incurred by the Owner as a result of the damage shall be the responsibility of the Contractor.

3.2 SURFACE PREPARATION

A. When existing surfaces adjacent to areas where work of this Section is scheduled may be damaged or harmed, provide temporary materials to protect those existing surfaces. Contractor shall determine type and quantity of protective materials.

B. Pre-lining Surface Preparation: Areas to be lined which require bonding of new cementitious, chemical or waterproofing material to existing cement or masonry shall be prepared as follows.

1. Clean the area with high-velocity water cleaning equipment to remove all foreign matter, oil, grease, wax, and dirt, including removal of bitumastic coatings. Pressure shall not exceed that which may cause any permanent damage to the existing concrete walls or other parts of the structure.
2. Remove all foreign material remaining after high-velocity water blasting using an acid wash. The acid wash shall be muriatic acid (hydrochloric acid) at a ratio of 1-part acid (HCl) to 10 parts of water. The mixing, application and removal of the acid solution shall be in accordance with the manufacturers' recommendations. The acid solution shall remain on the structure surface until all foreign material have been removed and completely washed off with water.
3. Chip or chisel away all loose or defective material from the areas to be repaired. Furnish a firm mechanical key by undercutting whenever possible.
4. Allow interior surfaces to dry before applying lining systems.
5. Fill all large voids with quick setting patching mix.
6. Remove protruding rubber gaskets between wall joints.

C. Sewer Line Protection: Place covers over the invert to prevent material from entering the sewer lines.

D. Drop Connections: Remove any interior drop connections anchored to structure walls prior to installing the lining system. After installation and proper curing of the liner, reinstall interior drop connections to their original condition prior to removal. If the existing drop connection is already damaged and cannot be reused, Contractor shall request from the Engineer the best course of action.

E. Conduct a visual inspection of each structure after it is cleaned. All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate grout compatible with the lining system. Remove all loose mortar and rubble of existing chimney (corbelling), cone, walls, benches and inverts. Prepare surfaces to receive epoxy lining as necessary by reshaping and repairing benches, inverts, cone, walls, and corbelling where required. All interior surfaces shall be prepared as recommended by the lining manufacturer. Minimum requirements are as listed below:

1. Repair cracks and other voids and fill with suitable non-shrinking cements, sealants or grouts, including all voids between the existing sewer pipes and structure walls. Patches shall be smooth and even with the structure wall.
2. Suitably prepare surfaces for required bonding of lining as recommended by the manufacturer.

3.3 SEALING OF LEAKS IN INVERTS, BENCHES, WALLS, CONE, CORBELLING AND PIPE CONNECTIONS

A. Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug: Seal unsealed lifting holes, unsealed step holes, and voids larger than 1/2 inch in thickness with a waterproof, quick setting mortar. Place waterproof mortar according to manufacturer’s instructions.

B. Sealing by Chemical Grout Application: Chemical grouting shall include the following:

1. Transporting, delivering, and storing the chemical grout shall be according to the manufacturers published directions and requirements.
2. Preparation: Remove loose material from the areas to be grouted.
3. Chemical Grout Formulation: Mix each batch of chemical grout according to the manufacturer's published directions and requirements.
4. Sealing Active Leaks: Use the Expanded Gasket Procedure, drilling and injection procedure and/or chemical curtain grouting to stop active leaks.

    a. Expanded Gasket Procedure (EGP): Perform per ASTM F 2414-04, and the chemical grout manufacturers recommended installation methods. This is performed by soaking dry oil free oakum with hydrophilic polyurethane chemical grout. The resulting oakum/resin plug shall be forced into the opening until it sets. Perform the EGP to:

        1) Control flowing water in larger cracks, joints, or pipe connection boots.
        2) Seal drop or lateral connections, slip line terminal seals and open joints in RCP structures.
        3) Seal between the corbel and manhole rings.
        4) Seal between the manhole rings and manhole frame.

5. Drilling and Injection Procedure: Perform per ASTM F 2414-04 (2023) and the chemical grout manufacturers recommended installation methods to seal the structure with chemical grout. Drill injection holes through the structure at locations recommended by the manufacturer. Inject the chemical grout through the holes under pressure. Injection pressure shall not cause damage to the structure or surrounding surface features. Inject chemical grout through the lowest holes first. Repeat the procedure until the structure is externally sealed. Grout travel shall be verified by observation of grout to defects or adjacent injection holes. Drill additional injection holes as necessary to ensure grout travel. Do not inject grout from the ground surface. After chemical grout injection is complete, clean injection holes with a drill and patch with a waterproof, quick setting mortar for brick and concrete structures. Perform the drilling and injection procedure to control flowing water in cracks.
6. Curtain Grouting: Perform per ASTM F 2414-04 (2023) and the chemical grout manufacturers recommended installation methods. Perform the curtain grouting procedure when there are multiple active leaks, and the drilling and injection procedure does not eliminate the active leaks.

3.4 INSTALLATION - EPOXY MONOLITHIC LINING SYSTEM (EMLS)

A. Install EMLS in complete accordance with the applicable provisions of ASTM C722 and the manufacturers' specifications. A representative of the manufacturer shall be present during the actual installation.

1. Prior to placing the EMLS the manufacturer's representatives must approve the surface preparation work and installation conditions including temperatures.
2. All surfaces shall be sufficiently dry and even.
3. All bottom and horizontal surfaces including the benches and channels shall have the EMLS applied to the required thickness by hand trowelling or spray-on methods.
4. All side vertical surfaces shall have the EMLS applied to the required thickness by manufacturer's recommended methodology.

5. Temperature limitations must be handled as appropriate and as approved by the manufacturer.

B. All cutting and/or sealing of EMLS at pipe connections, rungs and top connections shall provide watertight seals.

3.5 FIELD QUALITY CONTROL PRIOR TO LINER INSTALLATION

B. Engineer or Owner may enter the structures to inspect the benching, invert channels, wall/pipe connections, surface preparation, and other parts of the work. Provide forced air ventilation, gas monitors and detectors, harnesses, lights, etc. for the Engineer or Owner to enter the structure and perform the inspection in complete accordance with OSHA requirements.

C. The wall surfaces shall be sufficiently prepared for the lining system as recommended by the lining manufacturer and free from significant defects. Defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the structure shall be repaired at the Contractor's expense, in a manner mutually agreed upon by the Engineer and the Contractor.

D. No Active infiltration shall be observed in the structure as confirmed by visual inspection of the Owner or Engineer. Infiltration found shall be repaired by the Contractor immediately.

E. Contractor is responsible for coordinating inspection times with Engineer.

3.6 FIELD QUALITY CONTROL – EPOXY MONOLITHIC LINING SYSTEMS (EMLS)

A. Field acceptance of EMLS shall be based on the Engineer's evaluation of the installed liner and evaluation of the appropriate installation and curing test data.

B. The EMLS shall provide a continuous monolithic lining with uniform thickness throughout the entire interior of the structure. If the thickness of the EMLS is not uniform or is less than specified, it shall be repaired or replaced at no additional cost to the Owner.

1. The Engineer or Owner will measure the EMLS cured thickness by physically cutting through the lining (by drilling or coring) and making a direct measurement. There will be up to two thickness measurement locations in each lined structure. A suitable non-destructive type of thickness measurement may also be used.
2. All the EMLS thickness measurement locations shall be repaired by the Contractor in accordance with the manufacturer’s recommendations. These repairs shall be included in the two-year EMLS guarantee.
3. The Contractor shall also perform in-place testing in each structure to verify the adhesion of the EMLS to the existing structure substrate. Adhesion strength tests shall be in accordance with ASTM D7234 and the test area shall be isolated from the remaining portion of the structure by coring through the liner into the substrate. Two tests shall be performed in each structure at locations directed by the Engineer. Testing shall consist of a calibrated pull test. All equipment shall be provided by the contractor. Samples must meet a minimum pressure resistance of 400 psi.

C. There shall be no cracks, voids, pinholes, uncured spots, dry spots, lifts, delaminations, or other type defects in the EMLS.

D. Contractor shall submit proposed method for testing for these defects. One of the following tests shall be performed by the Contractor as directed by the Owner or the Owner's Agent.

1. Vacuum Test: A vacuum test conforming to the requirements of ASTM C1244 shall be performed where practical.
2. Holiday Detection Test: A high voltage holiday detection system may be used to determine if any holidays (pinholes, voids, etc.) exist in the lining. Normally the sensitivity control of the holiday tester is set to accommodate the thickness of the applied lining (100-125 volts for each 1 mil thickness). Follow the guidelines of the holiday manufacturer for correct control settings. One such service is the Tinker & Rasor Holiday Tester Model APW. Should a holiday be detected, it shall be marked and the lining installation contractor will repair the void according to the correct procedure determined by the system manufacturer.
3. Ultrasonic Testing: Per ASTM D 6132

3.7 CLEANING

A. Remove temporary protective materials at existing surfaces, excess materials, installation equipment, and clean work areas around structures. Properly remove trash and debris leaving work area in condition that existed prior to work performed under this Section.

END OF SECTION 330130.81

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SECTION 330513 - MANHOLES AND STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Modular precast concrete manhole, catch basins, and structures with tongue-and-groove joints with masonry transition to cover frame, covers, anchorage, and accessories.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete” for concrete type for manhole, catch basin, and structures base pad construction.
2. Section 310515 “Soils and Aggregates for Earthwork” for soil and aggregates for backfill in trenches.
3. Section 312000 “Earthwork” for excavating for manholes, catch basins and structures.
4. Section 312323.33 “Flowable Fill.”

1.3 ACTION SUBMITTALS

A. Section 013300 “Submittal Procedures” for submittals requirements.

B. Product Data: Submit cover and frame construction, features, configuration, dimensions.

1.4 DELEGATED DESIGN SUBMITTALS

A. Product Data: Provide structure frame and cover, access hatch, rungs and or ladders product data with notarized certificate indicating compliance with the specified ASTM standard and Class designation.

B. Shop Drawings: Indicate manhole, catch basin and structure locations, elevations, piping, conduit, and sizes and elevations of penetrations.

C. Submit for review, structural calculations (including assumptions and design references) and drawings for all precast structures and their precast (or cast-in-place) footing foundations as indicated on the Drawings. Structural design calculations and drawings shall be prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

D. Submit for review, buoyancy calculations, and if required by buoyancy calculations submit design calculations and details for hold-down slab and anchorage to the precast manholes, catch basins, and precast structures including assumptions and design references. Calculations shall be prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

E. Submit for review, structural calculations (including references and design references) and drawings for precast manhole and catch basin top slab and base slab. Calculations shall be prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

F. Submit shop drawings showing details of construction, reinforcing, joints, pipe connection to manhole and catch basin, manhole rungs, manhole frames and covers for precast manholes and precast structures, and catch basin frames and grates for precast catch basins.

G. Concrete design mix data and concrete test cylinder reports from an approved concrete testing laboratory certifying that the concrete used in the precast structures conforms with the strength requirements specified herein for precast manholes, catch basins and precast structures.

H. Delegated design engineer qualifications in accordance with “Quality Assurance” article.

I. All design data in accordance with ASTM C478 for precast manholes and catch basins.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Manufacturer Instructions: Detailed instructions on installation requirements, including storage and handling procedures.

C. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

D. Qualifications Statements: Qualifications for manufacturer.

E. Submit results of leakage tests and/or visual inspection.

1.6 QUALITY ASSURANCE

A. Perform Work according to Town of Yarmouth Department of Public Works standards.

B. Maintain a copy of each standard affecting Work of this Section on Site.

C. The quality of all materials, the process of manufacture, and the finished sections are subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, at work site, or at both places. Rejected materials shall be replaced at no cost to the Owner.

D. Delegated Design Engineer Qualifications: Engage a professional engineer registered in the Commonwealth of Massachusetts to be the Registered Design Professional responsible for the

design and construction of the precast structure, precast manholes and catch basis, hold down tabs, anchorage, and foundation supports.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Unload, store, and handle precast manholes, catch basins and structures according to manufacturer instructions.

B. Storage: Store precast concrete manholes, catch basins and structures as to prevent damage to Owner's property or other public or private property.

1. Repair property damaged from materials storage.

1.9 AMBIENT CONDITIONS

A. Subsequent Conditions: Maintain materials and surrounding air temperature at minimum 50 degrees F prior to, during, and 48 hours after completion of masonry Work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Precast concrete: confirm to ACI 318 and ACI 350.

B. Cement: ASTM C150/C150M, Type II.

C. Deformed concrete reinforcing bars shall confirm to ASTM A615, Grade 60.

D. Load Rating: HS-20 live load plus the weight of the soil above at 120 pcf.

E. Design of Lifting Devices for Precast Components: According to ASTM C913.

F. Design of Joints for Precast Components:

1. According to ASTM C913.
2. Maximum Leakage: 0.025 gal. per hour per foot of joint at 3 feet of head.

G. Shaft Construction: Concentric with eccentric cone top section; lipped male/female joints; sleeved to receive pipe sections.

H. Shape: Cylindrical or Rectangular as indicated on Drawings.

I. Clear Inside Dimensions: As indicated on Drawings.

J. Design Depth: As indicated on Drawings.

K. Clear Cover Opening: As indicated on drawings.

L. Pipe Entry: Furnish openings as indicated on Drawings.

M. Dampproofing: Outer surfaces of precast and cast in place manholes and catch basins shall be given two coats of bituminous dampproofing at the rate of 30 to 60 square feet per gallon as directed by the Engineer and in accordance with manufacturer's instructions.

N. Intermediate precast concrete landing for manholes exceeding 20 feet in depth shall be minimum 6-in thick and contain a manhole opening and light duty cast iron frame and cover (East Jordan 1480C Cover and 1322Z Frame or equal) with vent holes and lifting handles.

O. Top sections shall be eccentric except that barrel sections with flat slab shall be used where shallow pipe cover requires a top section less than 4-ft as shown on the Drawings. Top sections shall accommodate male/female precast concrete grade rings.

2.2 PRECAST MANHOLES AND CATCH BASINS

A. Manhole and Catch Basin Sections: Reinforced precast concrete according to the minimum requirements of ASTM C478Intermediate Landing for Precast Manhole: Reinforced precast concrete according to ASTM C478.

C. Precast Concrete Grade Rings: Reinforced precast concrete according to ASTM C478.

1. Lipped male/female joints.
2. Gaskets: According to ASTM C923.
3. Grade Rings shall withstand a live load of AASHTO HS20.

D. Gaskets: According to ASTM C923.

E. Clay Brick Units:

1. Bricks for the channels and shelves shall comply with ASTM C32 for Sewer Brick, Grade SS (from clay or shale) except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent.
2. Bricks for building up and leveling manhole and catch basin frames shall conform to ASTM C62, Grade SW solid units.
3. Bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture and satisfactory to the Engineer. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted therefor.

F. Mortar and Grout:

1. Type S.
2. Mortar used in the brickwork shall be composed of one part Type II portland cement conforming to ASTM C150 to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs to each bag of cement shall be added.
3. The sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. It shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

G. Reinforcement: Formed non-galvanized steel wire.

H. Design the precast top slab and base slab to support their own weight, the weight of the soil above at 120 pcf, and a live load equal to an AASHTO HS-20 highway loading applied to the top slab.

I. Floatation: Prevent floatation, with groundwater level at finished ground surface, by dead weight of manhole or catch basin and soil load above manhole or catch basin. Do not consider skin friction (soil cone), soil friction, or weight of equipment or contents in manhole or catch basin.

1. Floatation Safety Factor: Not less than 1.15. If required, provide reinforced concrete "hold-down" slab firmly anchored to the base of the manhole or catch basin with Type 316 stainless steel bolts.

J. Reinforcement: The calculated stress in reinforcement closest to a surface in tension at service loads not to exceed the value in Article 10.6.4.2 of ACI 350-06 and not be greater than 50 percent of the specified yield strength fy.

K. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections, 6-in for 60-in diameter reinforced barrel sections and 7-in for 72-in diameter reinforced barrel sections.

2.3 PRECAST STRUCTURES:

A. Provide structural design calculations for structures prepared and sealed by a licensed Professional Engineer in the Commonwealth of Massachusetts. Submit the sealed drawings and calculations for approval prior to fabrication.

B. Calculate stress in reinforcement closest to a surface in tension at service loads so that it does not exceed the value given in Article 10.6.4.2 of ACI 350-06 and shall not be greater than 50 percent of the specified yield strength fy.

C. Provide minimum concrete thickness of walls and slabs of 8-in, or as indicated on Drawings. Provide minimum reinforcing of #5 at 12-in, each face, each way. Provide additional reinforcing around all openings.

D. Cast base slab and walls together to form a monolithic base section.

E. Design the precast structure's elements to support their own weight, the weight of the soil above at 120 pcf, and a live load equal to an AASHTO HS-20 highway loading applied to the top slab.

F. Design structure walls that withstand an equivalent lateral fluid pressure of 60 pcf above groundwater and 90 pcf below groundwater. Design groundwater elevation is at finished grade. Originate pressure diagram at finished ground surface. Design structure walls for an additional surcharge load from adjacent structures and approaching vehicles in accordance with AASHTO. Use a minimum uniform lateral surcharge pressure equal to 120 psf.. Maximum gross allowable bearing pressure of 2000 psf.

G. Design structure for leakage test loading condition, structure full of no soil backfill in place.

H. Consider discontinuities in structure produced by openings and joints. Provide additional reinforcing around openings. Frame openings to carry full design loads to support walls.

I. Prevent flotation, with groundwater level at finished ground surface, by dead weight of structure and soil load above structure. Do not consider skin friction, soil friction, or weight of equipment or contents in structure. Provide concrete slab if required to prevent flotation. Submit slab design and details and provide anchorage of the structure to the slab. Safety factor for floatation is 1.15 when groundwater is at finished grade. If required provide reinforced concrete "hold-down" slab firmly anchored to the base of the structure to resist buoyant forces with Type 316 stainless steel anchor bolts. Buoyancy calculations and anchorage design calculations and details shall be prepared and stamped by a professional engineer registered in the Commonwealth of Massachusetts.

J. Locate horizontal wall joints 18 in. minimum from horizontal centerline of wall openings.

K. Design structures with minimum number of joints. Maximum number of structure sections, including top slab, shall be four sections.

L. Locate access openings and pipe penetrations as indicated.

2.4 MANHOLE FRAMES AND COVERS AND CATCH BASINS FRAME AND GRATES

A. Manhole Frame and Cover:

1. Manhole frame and covers shall have 30-in clear openings and be by East Jordan Iron Works; Mechanics Iron Foundry; Neenah Foundry or equal. The following model numbers refer to East Jordan Iron Works products:

    a. Manhole Frame and Cover in Streets – 396-RH SWR BWT Frame and Cover

2. Substitutions: In accordance with Paragraph 7.05 of the General Conditions.
3. Construction: ASTM A48 , Class 35B cast iron.
4. Surface: Machined flat bearing.
5. Lid: Removable/Bolted and Gasketed. Manholes located below elevation 11 shall have bolted and gasketed covers.

6. Cover Design: Sewer manhole covers shall have a diamond pattern, pickholes and the word "SEWER" cast in 3-in letters. Cost for obtaining manhole tag for sewer manhole cover shall be included in the precast manhole bid price.
7. Live Load Rating: HS-20 loading plus the weight of the soil above at 120 pcf.
   Sealing gasket: Where shown on the Drawings.
8. Supple five (5) additional frames and covers to be delivered to the Owner. Cost to be included in the Bid Price for manholes.

B. Catch Frame and Cover
1. Catch basin frame and grate shall be East Jordan Iron Works; Mechanics Iron Foundry; Neenah Foundry or equal. The following model numbers refer to East Jordan Iron Works products:

   a. Model: 0MA554000002, or approved equal for frame.
   b. Model: 0MA552000025, or approved equal for grate.

2. Substitutions: In accordance with Paragraph 7.05 of the General Conditions.

C. Catch Basin Hood:

1. Manufacturer: East Jordan Iron Works, or approved equal.
2. Model: 00595470, or approved equal.

D. Access Hatches:

1. Construction Aluminum, welded.
2. Size: As indicated on the drawings.
3. Door: Single or Double.
4. Cover: Diamond plate, reinforced with welded structural stiffeners to support H-20 live load. Water-tight as indicated on the drawings.
5. Frame:

   a. 1/4-inch minimum aluminum channel frame, with integral seat to support cover stiffeners.
   b. Anchor flange around frame perimeter.
   c. EPDM gasket.

6. Hinges: Stainless steel.
7. Lift Handle: Flush drop handle, non-removable type mounted in cover.
8. Lifting Mechanism:

   a. Stainless steel compression springs with automatic hold-open and dead stop to retain cover in open position.
   b. Cover springs to prevent contact by personnel entering utility structure.

9. Latch Mechanism: Stainless steel lock with removable external handle and permanent internal release mechanism.
10. Hardware: Type 316 stainless steel.
11. Finishes: Factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete.
12. Watertight and have a 1 1/2 -inch drainage coupling to the channel frame.

13. Provide hinged fall protection grating for all hatches.
14. Recessed padlock hasp feature with lock with shroud over lock.

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type as specified in Section 310515 “Soils and Aggregates for Earthwork.”
2. Cover: Fill Type, as specified in Section 310515 “Soils and Aggregates for Earthwork.”
3. Soil Backfill from Above Pipe to Finish Grade:

    a. Soil Type, as specified in Section 310515 “Soils and Aggregates for Earthwork.”
    b. Subsoil: No rocks over 6 inches in diameter, frozen earth, or foreign matter.

2.6 FINISHES

A. Steel Galvanizing: ASTM A123. Hot dip galvanize after fabrication.

2.7 ACCESSORIES

A. Manhole and Structure Steps:

1. Formed steel-reinforced plastic rungs.
2. Formed integral with manhole and structure sections.
3. Diameter: 3/4 inch.
4. Width: 14 inch.
5. Spacing: 16 inch o.c. vertically, set into manhole and structure wall.

B. Base Pad: Leveled top surface. Cast-in-place concrete of type as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

C. Internal Drop Bowl Connection:

1. Reliner Inside Drop System or equal.
2. As Shown on the Drawings.

D. Pipe Supports for drop connections:

1. Pipe support brackets: Type 316 stainless steel, 11 gauge.
2. Anchor bolts: Type 316 stainless steel.

E. Air/Vacuum Valves for Wastewater Service

1. Description:

    a. Type: Fully automatic, float operated.
    b. Comply with AWWA C512.
    c. Valves shall be designed to release large amounts of air during pipeline filling, release small amounts of air accumulated during pipeline operation, and allow

large volume of air during pipeline drainage or pipe break. Valves shall have an intake orifice area equal to nominal size of valve.

d. Suitable for sewage service.
e. Size: 2-in.
f. Valve Body Connections: Furnish 2-inch NPT cleanout and 1-inch NPT drain.
g. Pressure Rating: 150 psig

2. Materials:

a. Body and Cover: Type 316 stainless steel, ASTM A351/A351M.
b. Float: Type 316 stainless steel.
c. Seats: Buna-N.
d. Seals: Buna-N.
e. Trim: Type 316 stainless steel
f. Hardware: Type 316 stainless steel

3. End Connections:

a. Size 3 Inches and Smaller:
b. Threaded, NPT.

4. Valve Body Connections:

a. Threaded, NPT.
b. Cleanout: 2 Inches.
c. Drain: 1 inch.

5. Manufacturers:

a. DeZURIK.
b. Flomatic Corporation.
c. Val-Matic Valve & Manufacturing Corp.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that items provided by other Sections of Work are properly sized and located.

B. Verify that built-in items are in proper location and ready for roughing into Work.

C. Verify correct size of manhole, catch basin and structure excavation.

3.2 PREPARATION

A. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.

B. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.

C. Do not install structures where Site conditions induce loads exceeding structural capacity of structures.

D. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage; remove and replace damaged units.

3.3 INSTALLATION

A. Excavation and Backfill:

1. Excavate manholes, catch basins and structures as specified in Section 312000 “Earthwork” in location and to indicated depth.
2. Provide clearance around sidewalls of structure for construction operations.
3. When groundwater is encountered, prevent accumulation of water in excavations; place manholes, catch basins and structures in dry trench.
4. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Engineer.

B. Base Pad:

1. Place base pad.
2. Trowel top surface level.

C. Place manhole, catch basin and structure sections plumb and level, trim to correct elevations, and anchor to base pad.

D. Backfill excavations for manholes, catch basins and structures as specified in Section 312000 “Earthwork.”

E. Form and place manhole, catch basin and structures cylinder plumb and level and to correct dimensions and elevations.

F. Cut and fit for pipe.

G. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel as indicated on Drawings.

H. Set cover frames and covers and frames and grates level without tipping and to correct elevations.

I. Coordinate with other Sections of Work to provide correct size, shape, and location.

J. Precast Concrete Manholes, Catch Basins and Structures:

1. Lift precast components at lifting points designated by manufacturer.
2. When lowering manholes, catch basins and structures into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.

3. Set precast structures bearing firmly and fully on crushed stone bedding, compacted as specified in Section 312000 “Earthwork” or on other support system as indicated on Drawings.
4. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.
5. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
6. Maintain alignment between sections by using guide devices affixed to lower section.
7. Joint sealing materials may be installed on Site or at manufacturer's plant.
8. Verify that installed manholes, catch basins and structures meet required alignment and grade.
9. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
10. Cut pipe flush with interior of structure.
11. For manholes with drop bowl connections, cut incoming pipe so that only 2" maximum protrudes into manhole.

    a. For improved flow control, cut a "V" shaped notch at bottom edge of incoming pipe.
    b. Center Drop Bowl directly under incoming pipe, allow approximately 1" clearance between pipe and bowl.
    c. Attach Drop Bowl to manhole wall with 3/8" diameter stainless steel bolts in lead expansion anchors.

12. Shape inverts through manhole and structures as indicated on Drawings.

3.4 FIELD QUALITY CONTROL

A. Test concrete manhole, catch basin and structure sections according to ASTM C497

B. Test cast-in-place concrete as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

C. Vertical Adjustment of Existing Manholes and Structures:

1. If required, adjust top elevation of existing manholes and structures to finished grades as indicated on Drawings.
2. Reset existing frames, grates, and covers that were carefully removed and cleaned of mortar fragments to required elevation according to requirements specified for installation of castings.
3. When removal of existing concrete wall is required, remove concrete without damaging existing vertical reinforcing bars, clean concrete from vertical bars, and bend into new concrete top slab or splice to required vertical reinforcement as indicated on Drawings.
4. Clean and apply sand-cement bonding compound on existing concrete surfaces to receive cast-in-place concrete as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

D. Leakage Tests for Drain Manholes and Catch Basins

1. Engineer will visually inspect structure(s) for possible leaks before backfilling of drain manholes and catch basins is allowed. All joints shall be sealed to the satisfaction of the Engineer.
2. Engineer may require a leakage test as described for sewer manholes on any structure for which he/she deems the test appropriate.

E. Leakage Tests for Sewer Manholes and Structures:

1. Performed on every manhole and structure with Engineer observing.
2. Preparation:

    a. Prior to placing the shelf and invert, and pointing the horizontal joints, fill all lifting holes within 6 feet of ground surface with approved non-shrinking mortar.
    b. Lower groundwater table as required.
    c. Plug all pipes and other openings into manhole.

3. Test:

    a. Fill water to top of cone section.
    b. Observe for visible water in the excavated area.
    c. If area around manhole is backfilled or the test is unsatisfactory, repeat the test allowing for suitable time for absorption of water in the excavated area.
    d. At the end of the absorption period, refill manhole and wait 8 hours.
    e. Refill the cone at the end of 8 hours, measuring the amount required to refill.
    f. Extrapolate to determine 24-rate of leakage. Do not allow leakage to exceed 1 gallon per vertical foot in a 24-hour period.
    g. Engineer will perform visual inspection along with the Contractor.

4. Repair:

    a. If leakage is less than 3 gallons per vertical foot per 24 hours, make approved repairs to the manhole and retest, if it is determined the leakage is due to defects in the joints or sections.
    b. If leakage is 3 gallons or more, then replace the entire manhole, including all joints and sections at the Contractor’s expense. Retest the new manhole as described above.

F. A vacuum test may be substituted for a leakage test as follows:

1. The filling and pointing of exterior joints are not required where the excavation has not been backfilled.
2. Inflate to affect a seal between the vacuum base and the top of the manhole.
3. Connect the vacuum pump to the outlet port with the valve open and a vacuum of 10" Hg (20" of Hg absolute) drawn.
4. Close the valve.
5. The following test criteria shall apply to 4-ft and 5-ft diameter manholes:

    a. Allowable drops in pressure:

        1) Manholes 0 – 10 ft. deep:

a) Drop of 1" Hg over 2 minutes.

2) Manholes 10 -15 ft. deep:

a) Drop of 1” Hg over 2-1/2 minutes.

3) Manholes 15 - 30 feet:

a) Drop of 1” Hg over 3 minutes.

6. If the pressure drop exceeds the acceptable limits, make necessary repairs as approved by the Engineer, and:

a. Re-test the manhole.
b. If the manhole fails to meet the minimum requirements of the vacuum test retest using the leakage test.

7. Upon completion of a successful vacuum test, the interior and exterior joints shall be filled and pointed.

3.5 CLEANING

A. Clean all new manholes to be free of silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION 330513

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SECTION 330519 - DUCTILE-IRON UTILITY PIPE FOR WATER SERVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Materials, equipment, and incidentals required to install and test ductile iron pipe and fittings for piping as shown on Drawings and as specified.

    a. The word "pipe" is used to refer to pipe, fittings, or appurtenances unless otherwise noted.

2. Locate piping as shown on the Drawings. The Engineer reserves the right to make modifications in locations as may be found desirable to avoid interference between pipes or for other reasons.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork” for granular fill.
2. Section 312319 “Dewatering.”
3. Section 312323.33 “Flowable Fill.”
4. Section 312333 “Trenching and Backfilling.”
5. Section 312500 “Erosion and Sedimentation Controls.”
6. Section 321216 “Asphalt Paving.”
7. Section 331213 “Water Service Connections.”
8. Section 331216 “Water Utility Distribution Valves.”
9. Section 331219 “Water Utility Distribution Fire Hydrants.”
10. Section 331300 “Disinfecting of Water Utility Distribution.”

1.3 COORDINATION

A. Section 013100 “Project Management and Coordination” specifies requirements for coordination.

1.4 PREINSTALLATION MEETINGS

A. Section 013100 “Project Management and Coordination” specifies requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

A. Section 013300 “Submittal Procedures” for submittals requirements.

B. Shop Drawings and Product Data:

1. Including piping layouts, design calculations, warranty information, test reports, in accordance with Section 013300 “Submittal Procedures” and referenced standards.
2. Name of pipe and fitting suppliers and a list of materials to be furnished.
3. Warranties information.
4. Anticipated production and delivery schedule.

1.6 DELEGATED DESIGN SUBMITTALS

A. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for required thrust anchorage.

B. Tabulated Laying Schedule:

1. Reference stations and invert elevations as shown on Drawings.

    a. Include fittings, bends, outlets, restrained joints, tees, special deflection bells, adapters, solid sleeves and specials.

2. Manufacturer's drawings and specifications providing complete details of all items. Show on laying schedule:

    a. Pipe class.
    b. Class coding.
    c. Station limits.
    d. Transition stations.
    e. Various pipe classes.
    f. Submit to engineer for approval before manufacture and shipment.

3. Full length pipe may be supplied from inventory provided that all specification requirements are met. Shop drawings shall include but not be limited to:

    a. Complete and dimensional working drawings of pipe layouts, including pipe stationing, invert elevation at changes in grade or horizontal alignment, all elements of curves and bends both in horizontal alignment and vertical position.

4. Grade of material; size, wall thickness, of pipe and fittings and appurtenances, type and location of fittings, specials, and valves; and type and limits of lining, lining reinforcing and coating systems of pipe and fittings. Methods and procedures recommended by coating manufacturer to also be documented.
5. Joint details: methods and locations of supports and complete information concerning type, size, and location of all welds.

a. Shop welds (no field welding will be allowed) will be clearly differentiated.
b. welds will be clearly detailed with preparation procedures for all pipe and parent material comprising each weld.
c. Critical welding procedures will be identified along with methods for controlling welding stresses and distortions.
d. Locations and proposed joint details will also be clearly identified.

6. Method of manufacture of pipe; joint details, fittings, and any specials.
7. All other pertinent information for all items to be furnished; product data to show compliance of all couplings, supports, fittings, coatings, and related items.

1.7 INFORMATIONAL SUBMITTALS

A. Prior to Pipe Shipment:

1. Certified copies of mill tests confirming type of materials used in pipe, and shop testing of pipe to show compliance with requirements of applicable standards, along with a sworn affidavit of compliance that pipe complies with referenced standards.
2. Certified affidavit of compliance from manufacturer stating that pipe, fittings, gaskets, linings and exterior coatings for project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

B. Copies of shop tests, including hydrostatic tests.

C. Handling Procedures: For all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at project site and required protection following installation prior to startup.

D. Test and Evaluation Reports: Prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM and ANSI/AWWA Standards specified herein.

E. Manufacturers' Instructions.

F. Source Quality Control Submittals: Document results of shop tests and inspections.

G. Field Quality Control Submittals: Document results of required tests and inspections.

H. Qualifications Statements:

1. Qualifications for manufacturer, fabricator, applicator, installer, erector, and licensed professional.
2. Manufacturer's approval of applicator, fabricator, and installer.

1.8 CLOSEOUT SUBMITTALS

A. Section 017700 “Closeout Procedures” for closeout procedures requirements.

B. Project Record Documents: Actual locations of pipe.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Submit two sets of manufacturer's recommended spare parts.

1.10 QUALITY ASSURANCE

A. Perform Work according to Town of Yarmouth Water Department and Commonwealth of Massachusetts Department of Transportation standards.

B. Pipe and fittings to be supplied by a single manufacturer.

C. Hydrostatically tested at point of manufacture to 500 psi for a duration of 10 seconds per AWWA C151. Testing may be performed prior to machining bell and spigot.

1. Test Failure: Defined as any leak or rupture of pipe wall.
2. Certified test results furnished in duplicate to Engineer 5 days prior to shipment.

D. Pipe and Fittings: Cost of foundry inspection of all pipe approved for this contract, plus cost of inspection of a reasonable amount of disapproved pipe will be borne by Owner.

1. Inspected and tested at foundry as required by specified referenced standards.
2. Certified test results furnished in duplicate to Engineer 5 days prior to shipment.

E. Inspection of Pipe and Fittings After Delivery: By Engineer or representative of Owner.

1. Pipe and fittings subject to rejection if failing to meet specified requirements even though pipe may have been accepted as satisfactory at the place of manufacture.
2. Pipe rejected after delivery (including defects from manufacturing or delivery/transport) to be marked for identification and immediately removed from the job.

F. Pipe and fittings installed under this Contract may be inspected at the factory for compliance with this Section by an independent testing laboratory selected by Owner at Owner's expense.

G. Manufacturer's Representative:

1. Made available to Owner and Owner's representative during the manufacturing, furnishing, transporting, and unloading of pipe, as well as during installation and testing of pipe to assist in ensuring that pipe is properly fabricated, transported, unloaded, stored in the field, joined, and tested.
2. Manufacturer's responsibilities relate only to the proper care and treatment of pipe during these procedures and not techniques or procedures used during installation and testing.
3. Available at any time the Owner may request. A minimum of 10 working days (time on site) during the project when requested by Owner.
4. Cost for services of the factory representative, including expenses, to be considered incidental to the project and will not be paid separately.

H. Pipe and fittings marked in accordance with all applicable AWWA standards. Legibly and permanently mark pipe, fittings, specials, and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:

1. Manufacturer.
2. Date of manufacture.
3. Size, type, class, or wall thickness.
4. AWWA Standard(s) produced to.
5. Pipe identified with sequential numbering consistent with the laying schedule and marking drawings and each marked pipe will appear on the marking drawings in the identified location for installation.
6. Special fittings, bends, and appurtenances requiring specific orientation will be appropriately marked with words "TOP" in correct position and in a consistent location.

1.11 QUALIFICATIONS

A. Manufacturer shall meet the following criteria and furnish necessary project information, which demonstrates required experience:

1. Experience that includes successful fabrication (followed by installation, acceptance and service) to AWWA C151 standards of at least 50,000 lineal feet of largest specified diameter or larger ductile iron pipe with similar linings/coatings within the past 5 years.
2. Experience to include successful fabrication of at least 50 fittings in compliance with AWWA C110 or C153 of largest specified diameter or larger with similar lining/coatings within the past 5 years.
3. Experience that includes successful fabrication (followed by installation, acceptance and service) of at least 10,000 lineal feet of largest specified diameter or larger push-on style, boltless restrained joint for ductile iron pipe within the last 5 years.

B. Pipe Origin: Manufactured in the United States. Ductile iron pipe to be supplied by a single manufacturer.

C. Fittings Origin: Manufactured in the United States but supplied by one of the named pipe fitting manufacturers in Part 2 or Engineer approved equal. Ductile iron fittings to be supplied by a single manufacturer. Written certification fittings are compatible with the supplied brand of pipe.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Per AWWA C600 and referenced AWWA Standards for shipping, handling, and storage procedures.

1. Deliver materials in manufacturer's packaging including application instructions.
2. Handle to prevent injury to pipe, pipe linings and pipe coatings.

    a. Examine pipe and fittings as noted in Division 01. Damage to linings or coatings discovered during examination to be repaired to the satisfaction of Engineer before proceeding with work.

3. Transport pipe to job site on padded bunks or oak timbers and secured with steel banding or nylon tie down straps adequately protecting pipe and coating.

a. Handle pipe using slings, hooks, pipe tongs or other devices acceptable to Engineer.
b. Do not use non-cushioned ropes, chairs, wedges, cables, or levers when handling finished pipe, fittings or couplings.
c. Do not drop pipe or fittings.
d. Do not skid pipe or fittings against each other.
e. Do not mar pipe or fitting coatings.
f. Utilize padded wooden pipe cradles or chocks suitable for protecting coatings between and beneath finished pipes when pipes are placed upon rough surfaces.

B. Storage:

1. Do not store pipe on bare ground unless soft sand berms are used to support pipe and is approved by Engineer.
2. Keep materials safe from damage if stored. Interior of pipe, fittings and other appurtenances to be kept free from dirt, excessive corrosion or foreign matter.
3. Do not stack pipe higher than limits recommended by manufacturer. Keep bottom tier off ground using timbers, rails, or concrete. Stacking to conform to manufacturer's recommendations and/or AWWA C600.
4. Store gaskets for mechanical and push-on joints in a cool location out of direct sunlight; not in contact with petroleum products. Use gaskets on a first-in, first-out basis.

C. Protection:

1. Lined and coated pipe: Suitably protected from exposure and heating from sun. Follow procedures recommended by coating and lining system manufacturer.

a. Exposure will not be allowed except for short periods such as installation, assembly and repairs.

2. Metal tools or heavy objects are not permitted to come in contact unnecessarily with finished coating.

a. Workers may walk on coated pipe only when necessary, and only when wearing footwear with rubber or composition soles and heels sufficiently free of dirt and mud so coating remains undamaged.

3. Prevent damage to linings and coatings caused by handling, onsite storage, and exposure to low temperatures (due to embrittlement), high temperatures, or direct sunlight.

1.13 EXISTING CONDITIONS

A. Field Measurements: Verify field locations and sizes of connections to existing piping and equipment prior to submitting pipe lay drawings.

1. Indicate field measurements on Shop Drawings.

B. Piping shall be located substantially as shown on the Drawings. The Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and

does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.

1.14 WARRANTY

A. Furnish two year manufacturer's warranty for ductile iron pipe and fittings.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Assure compatibility between joints of all items supplied.

2.2 DUCTILE IRON PIPE

A. Manufacturers: Provide pipe and fittings supplied by:

1. American Cast Iron Pipe Co.
2. U.S. Pipe and Foundry.
3. Griffin Pipe Products.
4. McWane Company; all pipe divisions.
5. An approved equal member of the Ductile Iron Pipe Research Association (DIPRA).

B. Fitting Certification: From fitting manufacturer; written certification that fittings are compatible with supplied brand of pipe.

C. Ductile Iron Pipe: Per AWWA C151, Class 52. Provide in standard lengths as much as possible.

D. Thickness Design: Per AWWA C150**:**

1. Piping 12 inches and Smaller: Minimum Class 52.
2. Piping 14 inches to 20 inches: Minimum Class 52.

2.3 END TREATMENTS/JOINTS

A. Unrestrained Pipe and Fitting Joints: Push-on rubber gasket type per AWWA C111. Minimum thrust restraint requirements for restrained areas are shown on the Drawings. All ductile iron pipe and fittings within the restrained lengths shown on the Drawings shall be restrained as specified.

B. Restrained Pipe and Fitting Joints: Push-on rubber gasket, locking ring type joints per manufacturer's standard described below.

C. Gasket materials: Per Table 5-1 of AWWA M-41.

1. Rubber-Gasket Joints: Per AWWA C111. Styrene butadiene rubber (SBR).

D. Restraints for push-on joint pipe and fittings to be positive locking, utilizing restraints independent of joint gasket.

1. Joint Test Pressure 350 psig.
2. Joint Fabrication: Heavy section ductile iron casting.
3. Bolts and Nuts: Low carbon steel conforming to ASTM A193, Grade B7.
4. Restraint for mechanical joint pipe shall use retainer glands for restraining joint.

E. Provide restrained push on joints from one of the following manufacturers or an Engineer approved equal.

1. US Pipe and Foundry Company: "TR Flex" or “HDSS” (high deflection high pressure restrained pipe, sizes 12”, 16”, 20”, 24”, 30”, 36”, 42”, and 48”).
2. American Cast Iron Pipe Company: "Lok-Ring” or "Flex Ring (positive locking style)."
3. Clow Water Systems Company: "Superlok.”

F. Required lengths of restrained joints shall be as shown on Drawings.

G. Pipe manufacturer proprietary mechanical joint restraint systems that utilize a wedge-style gripping system or a gland/ring positive restraint system will be considered acceptable on a case-by-case basis as determined by Engineer.

1. Optional mechanical joint restraint shall be incorporated in the design of a follower gland. Gland shall be manufactured of ductile iron per ASTM A536. Dimensions of gland must be such that it can be used with standard mechanical joint bell and tee-headed bolts, as specified with pipe.
2. Restraint Mechanism:

    a. Individually activated gripping surfaces maximizing restraint capability.
    b. Wedges designed to spread bearing surfaces on pipe.
    c. Torque limiting twist-off nuts sized same as T bolts for mechanical joints. When nut is sheared off, standard hex nut shall remain.

3. Restraint Device for Ductile Iron Pipe: EBAA Iron Megalug Series 1100, Ford/Uniflange Series 1400, US Pipe MJ Field Lok, or approved equal.

    a. Working Pressure: 350 psi and a safety factor of 2:1.

H. Couplings: and Adapters Sleeve Type Couplings:

1. Transition couplings shall be manufactured by Smith Blair (Model Omni 441), HyMax, Romac Industries, or an approved equal and shall have the following attributes:

    a. Conforming to AWWA C219.
    b. Ductile iron sleeve.
    c. Buna N gaskets.
    d. High strength alloy steel bolts with heavy, semi-finished hexagon nuts per AWWA C219.

2. Excavate test pits to measure the dimensions and pipe outside diameters for the required couplings at the connection points between new and existing piping prior to ordering new couplings.

I. Buried Sleeve-Type Couplings: Protective wrapping of "Denso" material by DENSO Inc. of Texas or equivalent.

1. Where "Denso" material is used, pack joint with "Densyl mastic" to give an even contour for wrapping with "Densopol" tape.
2. Apply a 1/16 inch thick coating of "Denso" paste followed by 4-inch or wider "Densopol" tape wound spirally around joint with at least 50 percent overlap.

2.4 FITTINGS

A. Pipe Fittings: Ductile iron per AWWA C110 or AWWA C153 as applicable. Fittings to have the same pressure rating, as a minimum, of the connecting pipe.

1. Piping 24 inch and smaller: minimum pressure rating of 350 psi.

B. Closures: Made with mechanical joint ductile iron solid sleeves. Locate in straight runs of pipe at minimum cover outside the limits of restrained joint sections; subject to approval of Engineer.

C. Plugs required for ductile iron pipe shall be Style F-1137 solid plug as manufactured by Clow Corporation, or equal.

2.5 LININGS, COATINGS & CORROSION PROTECTION

A. Interior Lining:

1. Ductile iron pipe and fittings shall have same type of lining.
2. Cement Mortar Lining: Per AWWA C104. Cement type per ASTM C150.

a. Thickness of cement mortar lining:

1) 1/8-inch for pipes 12 inches and smaller.
2) 3/16-inch for pipes 14 inches and larger.

b. At Supplier’s Option: Fittings may be lined per AWWA C550; NSF/ANSI 61 certified.

B. Exterior Coating

1. Buried pipe installed with exterior bituminous coating per AWWA C151 and C110 respectively.
2. Where indicated on the Drawings, buried ductile iron pipe shall be installed with a V-Bio® Enhanced Polyethylene Encasement per AWWA C105.

a. Tubing shall be Linear Low Density Polyethylene (LLDPE) Tubing, with a minimum 9 mil thicknesses and anti-microbial design.

b. The anti-microbial is part of a 3 layer co-extruded linear low density polyethylene (LLDPE) film that features an inside surface that is infused with a blend of an anti-microbial to mitigate microbiologically influenced corrosion (“MIC”) and a volatile corrosion inhibitor (“VCI”) to control galvanic corrosion.
c. Tubing shall have markings of “Warning – Corrosion Protection – Repair All Damage.”
d. Remove lumps of clay, mud and cinders from outside surface of pipe prior to installation.
e. Tubing manufactured by: McWane Ductile, US Pipe, American Pipe, or equal.

2.6 INSULATION

1. Water main and fittings installed with less than 4-feet of cover and where called off on the project drawings shall be insulated. Insulation shall be structurally strong, water-tight, and entirely resistant to corrosive elements.
2. Interior insulation shall have the following physical characteristics.

    a. Minimum density: 2.0 lb/cu ft (ASTM D1621).
    b. K factor: 0.147 BTU-in/hr-sq ft-°F (ASTM C177).
    c. 90-95% closed cell (ASTM D6226).

3. Exterior casing shall be seamless, non-tape cast, HDPE complying with ASTM D1248. The exterior casing shall have the following physical characteristics.

    a. Ultimate elongation: 850% (ASTM D638).
    b. Tensile yield strength: 3300 psi (ASTM D638).
    c. Resin: Type III, Grade P34 (ASTM D3350).
    d. Tangent flexural module: 175,000 psi (ASTM D790).

2.7 UNDERGROUND PIPE MARKERS

A. Ribbon Tape:

1. Material: Polyethylene silver metal detectable tape.
2. Brightly colored blue for water, continuously printed with the warning message for the utility such as "CAUTION – WATER LINE BURIED BELOW".
3. Size: Minimum 6 inches wide by 5 mil thick.
4. Manufactured for direct burial service.

2.8 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

B. Owner Inspection: Make completed products specified in this section available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.

C. Owner Witnessing: Allow witnessing of factory inspections and test at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

B. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.

D. Specified shop tests are not required for Work performed by approved fabricator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 “Execution” for installation examination requirements.

3.2 PREPARATION

A. Section 017300 “Execution” for installation preparation requirements.

B. Handle piping and fittings per “Delivery, Storage, and Handling” Article in Part 1 of this specification.

C. Examine pipe and fittings before laying. Repair any damage to pipe, lining or coatings per manufacturer's recommendations prior to installation.

D. Interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

E. As pipe laying progresses and at the conclusion of the work, thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

F. Contractor shall excavate test pits to measure the dimensions and pipe outside diameters for the required coupling at the connection points between new and existing pipelines prior to ordering and installing new couplings.

G. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer, drain, sewer or drain manhole, septic tank, or subsoil treatment system where possible. Water mains crossing sewers shall be laid to provide a minimum vertical distance of at least 18-inches between the outside of the water main and outside of the sewer or drain and this shall be the case where the water main is either above or below the sewer with preference to the water main located above the sewer. At crossings, one full length of water pipe shall be located so that both joints are as far away from the sewer or drain as possible. Water mains that cross under existing sewers or drains shall be concrete encased for a minimum of 10 feet on each side of the drain or sewer pipe centerline at the crossing. Deviations from this requirement must be approved by the Engineer and Owner.

H. Ductile iron pipe installed within 5 feet of a gas line shall be fully encased in polyethylene material. Polyethylene shall be 8 millimeters thick and comply with ANSI/AWWA C105/A21.5-10.

3.3 INSTALLATION

A. Installed per requirements of laying schedule and AWWA C600, unless otherwise specified.

1. Provide firm, even bearing length of pipe. Dig bell holes at each joint. Tamp backfill materials on pipe sides to springline per details on Drawings.
2. Blocking is not permitted.
3. Replace with sound pipe or fitting, defective pipe or fitting discovered after having been laid.
4. When laid, pipe and fittings shall perform to lines and grades required. When laying is not in progress, close open ends of pipe with watertight plug or other approved means.
5. Place sufficient backfill to prevent flotation. Joint deflection not to exceed manufacturer’s recommendation.
6. Pipe Laid Underground: 5 feet cover unless Drawings show otherwise or otherwise specified.
7. Lay pipe such that invert elevations shown on Drawings are not exceeded.
8. Provide fittings, in addition to those shown on Drawings, where required, in crossing utilities which may be encountered upon opening trench. Install solid sleeve closures at locations approved by Engineer.
9. Pipe Interior: Maintain dry and broom clean throughout construction period.
10. Field Cutting Pipe: When required, smooth cut by machine perpendicular to pipe axis. Bevel cut pipe ends per manufacturer's recommendations for spigot end.

    a. Repair coating removed from cut per manufacturer's recommendation and/or coating and lining paragraphs of Part 2 above (whichever method is more stringent in opinion of Engineer).
    b. Cement lining shall be undamaged.
    c. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with use of restrainer glands by EBAA Iron or field adaptable restrained joints.
    d. Where Field Cuts are Permitted: Pipe supplied by factory as "gauged full length".

        1) Gauged Full Length Pipe is Unavailable: Pipe to be field gauged at location of new spigot using a measuring tape, or other means approved by manufacturer, to verify that diameter is within tolerances permitted in Table 1 of AWWA C151.

B. Jointing Ductile-Iron Pipe:

1. Push-On Joints: Install per manufacturer's instructions, AWWA C600 and Appendix B of AWWA C111. If there is conflict, manufacturer's instructions take precedence.

    a. Lay pipe with bell ends looking ahead.
    b. Insert rubber gasket in groove of bell end of pipe.
    c. Clean and lubricate joint surfaces.

d. Align plain end of pipe with bell of pipe to which it is to be joined and pushed home.
e. Metal feeler shall be used to make certain that rubber gasket is properly seated.

2. Mechanical Joints: Assembled per manufacturer's instructions, AWWA C600 and Appendix A of AWWA C111. If there is conflict, manufacturer's instructions take precedence.

a. Lay pipe with bell ends looking ahead.
b. Clean and lubricate joint surfaces and rubber gasket.
c. Tighten bolts to specified torques.
d. Extension wrenches or pipe over handle of ordinary ratchet wrench are not allowed to secure greater leverage.
e. Encapsulate bolts and nuts using wax sealing tape per AWWA Standard C217.
f. Install polyethylene encasement as specified.

3. Bolts in Mechanical or Restrained Joints: Tightened alternately and evenly.
4. Restraint for Mechanical Joint Pipe:

a. Retainer glands for restraining joint.
b. Restrained mechanical joints to be suitable for specified test pressure.
c. Installed according to pipe manufacturer's instructions.

5. Sleeve Couplings: Only installed for closure or as shown on Drawings. Do not assemble couplings until adjoining joints have been assembled.

a. Encapsulate bolts and nuts using wax sealing tape per AWWA Standard C217.
b. Install protective wrap recommended by manufacturer or as required herein. Maintain insulating properties of insulating and dielectric couplings.

6. Blowoffs, outlets, valves, fittings, and other appurtenances to be set and jointed as indicated on Drawings and per manufacturer's instructions.

C. Polyethylene Encasement:

1. Install polyethylene encasement around ductile iron pipe to limits shown on Drawings and in accordance with pipe manufacturer's recommendations.

a. Installed per ANSI/ AWWA C105/A21.5, Method 'A' in accordance with section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.

2. Use a fabric type or padded sling when handling pipe to prevent damage to encasement.
3. Seal seams with approved 2 inch wide plastic adhesive tape.
4. Repair encasement rips or tears with tape and film per ANSI/AWWA C105/A21.5.
5. When backfilling do not damage polyethylene encasement.

3.4 FIELD QUALITY CONTROL

A. Section 014000 “Quality Requirements” for inspecting and testing requirements.

B. Replace with sound pipe or fitting, defective pipe or fitting discovered after having been laid.

C. Thoroughly clean pipe and fittings before laying. Keep clean until used in Work.

D. Pipe and fittings, when installed or laid, shall conform to lines and grades required.

E. Filling and Testing – see Specification Section 331300 “Disinfecting of Water Utility Distribution.”

3.5 CLEANING AND DISINFECTION

A. Sections 017300 “Execution” and 017700 “Closeout Procedures” for cleaning requirements.

B. See Specification Section 331300 “Disinfecting of Water Utility Distribution” for cleaning, testing, and disinfection requirements.

3.6 PROTECTION

A. Section 017300 “Execution” and Section 017700 “Closeout Procedures” for protecting finished Work requirements.

END OF SECTION 330519

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SECTION 331213 - WATER SERVICE CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings for water service connections to buildings.
2. Corporation stop assemblies.
3. Curb stop assemblies.
4. Underground pipe markers.
5. Bedding and cover materials.

B. Related Requirements:

1. Section 033010 "Miscellaneous Cast-in-Place Concrete" for concrete for thrust restraints.
2. Section 310515 "Soils and Aggregates for Earthwork" for backfill soil type.
3. Section 312317 "Trenching and Backfilling" for excavation of pipe trench.
4. Section 330110 “Disinfection of Water Utility Piping Systems” for flushing and disinfecting of water system.

1.3 SUBMITTALS

A. Product Data: Submit data on pipe materials, pipe fittings, corporation stop assemblies, curb stop assemblies, meters, meter setting equipment, service saddles, backflow preventer, and accessories.

B. Shop Drawings: Indicate details showing vault and accessories.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

F. Qualifications Statement:

1. Submit qualifications for manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of piping mains, curb stops, connections, thrust restraints, and invert elevations.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.5 QUALITY ASSURANCE

A. Perform Work according to AWWA standards.

B. Maintain one copy of each standard affecting Work of this Section on Site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Store products and materials off ground and under protective coverings and away from walls.

C. Exercise care in handling precast concrete products to avoid chipping, cracking, and breakage.

PART 2 - PRODUCTS

2.1 WATER PIPING AND FITTINGS

A. Furnish materials according to Town of Yarmouth standards.

B. Any brass part of fittings or valves in contact with potable water shall be made of a “Lead Free” brass, defined as CDA Copper Alloy No. C89520 or C89833 in accordance with the chemical and mechanical requirements of ASTM B584 and AWWA C-800. “Lead Free” brass alloy shall contain no more than twenty-five one hundredths of one percent (0.25%) total lead content by weight.

C. Plastic Tubing:

1. Comply with AWWA C901, ASTM D3350, and D2737.
2. "Copper sized" outer diameter.
3. Tracing wire shall be attached to the outside of the piping not incorporated into the plastic piping.
4. Blue color, HDPE, SDR9, and have a minimum working strength of 200 psi, 600 psi bursting strength.
5. Single piece without breaks for couplers up to 500 linear feet.

D. Adapter couplings and Fittings:

1. Fittings for plastic pipe shall be waterworks brass-compression style meeting or exceeding AWWA C800. Compression joints shall provide watertight seal up to 300 ps. Setscrew compression joints shall not be allowed.
2. All valves on plastic tubing must be accompanied by stainless steel insert stiffeners.
3. Contractor shall have fittings of various sizes on hand to prevent delays during construction.

2.2 CORPORATION STOP ASSEMBLIES

A. Furnish materials according to Town of Yarmouth standards.

B. Corporation Stops:

1. Comply with ANSI/AWWA C800-89 and latest revisions.
2. Any brass part of the corporation in contact with potable water shall be made of "Lead Free" brass, defined as CDA Copper Alloy No. C89520 or C89833 in accordance with the chemical and mechanical requirements of ASTM B584 and AWWA C800. "Lead Free" brass alloy shall contain no more than 0.25% total lead content by weight.
3. Cast alloy "Lead Free" body.
4. One piece cap and stem.
5. Ball type with ball full opening to provide maximum flow capacity and ease of turning.
6. Integral checks for 90-degree rotation only
7. Double O-ring seals
8. 300 psi working pressure
9. AWWA taper thread or inlet and CTS compression end(s) (Mueller type, or approved equal) at outlet
10. Open COUNTER-CLOCKWISE (LEFT).
11. Corporation stops shall be quick style connections, positive shutoff, with no inverted key.
12. Corporation stops shall be fully manufactured in the United States.

C. Service Saddles:

1. Service saddles shall be double band or double strap type with a ductile iron body conforming to ASTM A-536, Grade 65-45-12, as manufactured by Smith-Blair S317 or equal.
    a. Threaded opening shall be CC (AWWA C800).
    b. Finished epoxy coat of 10 mils minimum.
    c. Bolts, nuts, and washers shall be Type 304 (18-8) stainless steel.
    d. Gaskets shall be virgin NBR compounded for water service.

e. Straps shall be Type 204 (18-8) stainless steel with coated threads to prevent galling.
f. 250 psi working pressure.
g. Service saddles shall be completely manufactured in the United States.

2. Shall be compatible with approved corporation stops.

2.3 CURB STOP ASSEMBLIES

A. Furnish materials according to Town of Yarmouth standards.

B. Curb Stops:

1. Curb stops for use with CTS tubing shall be manufactured by Mueller Co., plug type (Model No. B-25209 (no drain) and H-15219 (with drain), or an approved equal.
2. Comply with ANSI/AWWA C800 and latest revisions.
3. Any brass part of the corporation in contact with potable water shall be made of "Lead Free" brass, defined as CDA Copper Alloy No. C89520 or C89833 in accordance with the chemical and mechanical requirements of ASTM B584 and AWWA C800. "Lead Free" brass alloy shall contain no more than 0.25% total lead content by weight.
4. Cast alloy "Lead Free" body.
5. One piece closed-bottom body.
6. Free turning plug type with low friction thrust washer for ease of turning.
7. Integral checks for 90-degree rotation only.
8. Top and port O-ring seals.
9. 300 psi working pressure.
10. Compression end(s) (Mueller type, or approved equal) for CTS OD tubing.
11. Integral tee head and plug.
12. Open COUNTER-CLOCKWISE (LEFT).
13. Curb stops shall be fully manufactured in the United States.

C. Curb Boxes and Covers:

1. Shall be manufactured by Bibby Ste-Croix or an approved equal.
2. Body: Cast iron.
3. Type: Two (2) piece slide type.
4. Base: Arch pattern, Buffalo style.
5. Lid: One (1) piece.

a. Inscription: WATER.

2.4 UNDERGROUND PIPE MARKERS

A. Plastic Ribbon Tape:

1. Brightly colored, continuously printed with the warning message for the utility such as "CAUTION – WATER LINE BURIED BELOW".
2. Size: Minimum 2 inches wide by 4 mil thick.

3. Manufactured for direct burial service.
4. Conductive tape.

2.5 MATERIALS

A. Bedding and Cover: as specified in Section 310515 “Soils and Aggregates for Earthwork”.

B. Soil Backfill from Above Pipe to Finish Grade: as specified in Section 310515 “Soils and Aggregates for Earthwork.”

2.6 ACCESSORIES

A. Concrete for Thrust Restraints: As specified in Section 033010 “Miscellaneous Cast-in-Place Concrete”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 "Execution" for requirements for installation examination.

B. Verify that building service connections and municipal utility water main sizes, locations, and inverts are as indicated on Drawings.

3.2 PREPARATION

A. Section 017300 "Execution" for requirements for installation preparation.

B. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.

C. Remove scale and dirt from inside and outside of piping before assembly.

D. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Corporation Stop Assemblies:

1. Make connection for each different kind of water main using suitable materials, equipment, and methods as approved by Engineer.
2. The tapping machine shall be rigidly fastened to the pipe as near the horizontal diameter as possible. The length of travel of the tap should be so established that when the stop is inserted and tightened with a 14-in wrench, not more than one to three threads will be exposed on the outside. When a wet tapping machine is used, the corporation cock shall be

inserted with the machine while it is still in place. Stops shall be tightened only sufficiently to give watertightness and care must be constantly exercised not to overtighten them.

3. Location:

    a. Screw corporation stops directly into tapped and threaded iron main at 10 and 2 o'clock positions along main's circumference.
    b. Locate and stagger corporation stops at least 12 inches apart longitudinally.

4. Use proper seals or other devices such that no leaks are present in mains at points of tapping.
5. Do not backfill and cover service connections until installation is approved by Architect/Engineer.

B. Bedding:

1. Excavate pipe trench as specified in Section 312333 “Trenching and Backfilling.”
2. Placement:

    a. Place bedding material at trench bottom.
    b. Level fill materials in one continuous layer not exceeding 6 inches compacted depth.
    c. Compact to 95 percent maximum density.

3. Place fill material as specified in Section 312333 “Trenching and Backfilling.”

C. Pipe and Fittings:

1. Maintain separation of water main from sewer piping as indicated on the Drawings.
2. Group piping with other Site piping Work whenever practical.
3. Install pipe to indicated elevation to within tolerance of 5/8 inch.
4. Install trace wire continuously over and around pipe.
5. Care shall be exercised in the placing and laying of service tubing to be sure that the pipe does not have kinks or sharp bends and to assure against it being in contact with sharp stones or ledge which would cause damage to the pipe.
6. At least 12-in of selected fill shall be placed adjacent to and above the pipe and no stone shall be placed over the pipe until the depth of backfill above the latter is in excess of 1-ft.
7. Straight couplings. Install straight couplings to existing water mains of the sizes required in the locations designated by the Engineer in the field. Utilize the manufacturer's recommended installation procedures while performing the work. Care shall be taken to ensure a watertight connection.
8. Backfill trench as specified in Section 312333 “Trenching and Backfilling.”
9. All service connections shall be installed perpendicular (90 degrees) from water main to property line and shall have a minimum of 5 feet of cover and must not be laid in the same trench as other utilities (i.e., gas, electric, sewer).
10. The actual size of water service connections to all residential and commercial buildings is unknown. The following is clarification of water service connection requirements between the new water main and the property line:

    a. If existing service connection is smaller than 1-1/2-in, replace with 1-in plastic tubing, corporation cock, curb stop and box, and provide reducer and/or adapter as required to connect new service connection to existing service connection.

b. If existing service connection is 1-1/2-in to 2-in, replace with 2-in plastic tubing, corporation cock, curb stop and box, and provide reducer and/or adapter as required to connect new service connection to existing service connection.
c. When encountered, payment for replacement of water service connections 3-in and greater will be made under the 6-in pipe item and 6-in gate valve item. Exact size to be determined in the field by the Engineer and Owner.
d. Services larger than 6-in will be replaced with pipe of the same size, as directed by the Engineer and Owner.

D. Curb Stop Assemblies:

1. Set curb stops on compacted soil.
2. Curb stops will, in most cases, be installed 1.5-ft from the curb line or pavement limit. Install the curb cocks and boxes in a workmanlike manner as described herein and as directed by the Engineer and shall place compacted screened gravel around and below the cock to permit ready draining of the pipe through the waste opening.
3. Boxes:

a. Center and plumb curb boxes over curb stops.
b. The boxes shall be set in a true vertical position and if they are within the limits of the roadway or within limits where the plowing of snow will take place in the winter, the ops of the boxes shall be set about 1/2-in below the top of the finished grade. In locations where these boxes are not likely to be disturbed, the tops shall be set flush with the adjoining ground. Select fill shall be brought up evenly on all sides and compacted in lifts.

E. Service Connections:

1. Install water service according to utility company and Town of Yarmouth Water Department requirements.

F. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 331300 “Disinfecting of Water Utility Distribution.”

3.4 FIELD QUALITY CONTROL

A. Section 017300 "Execution" for requirements for testing, adjusting, and balancing.

B. Pressure test water distribution system according to AWWA C600.

END OF SECTION 331213

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SECTION 331216 - WATER UTILITY DISTRIBUTION VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Valves.
2. Valve boxes.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete”: Concrete for thrust restraints.
2. Section 330519 “Ductile Iron Utility Pipe for Water Service”: Piping trenching, backfilling, and compaction requirements.
3. Section 331213 “Water Service Connections”: Pipe materials, fittings, and service connection appurtenances and installation requirements.
4. Section 331219 “Water Utility Distribution Fire Hydrants”: Execution requirements for fire hydrants.
5. Section 331300 “Disinfecting of Water Utility Distribution”: Flushing and disinfection requirements.

1.3 COORDINATION

A. Coordinate Work of this Section with Massachusetts Department of Transportation (MassDOT) standards and utilities within construction area.

1.4 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.5 SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data: Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.

C. Shop Drawings: Submit description of proposed installation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Coordinate following Subparagraphs with requirements specified in QUALIFICATIONS Article.
2. Submit qualifications for manufacturer and installer.
3. Submit manufacturer's approval of installer.

H. Insertion Valves: Contractor shall submit a written contingency plan outlining methods to mitigate or avoid excessive leakage and failure of the insertion valve, bypass pipe and assembly.

1.6 CLOSEOUT SUBMITTALS

A. Section 017700 “Closeout Procedures”: Requirements for submittals.

B. Project Record Documents: Record actual locations of valves.

C. Operation and Maintenance Data: Submit information for valves.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Section 017300 “Execution”: Requirements for maintenance materials.

B. Tools: Furnish one tee wrench of required length to Owner.

1.8 QUALITY ASSURANCE

A. Cast manufacturer's name, pressure rating, and year of fabrication into valve body.

B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Prepare valves and accessories for shipment according to applicable AWWA standards.

C. Seal valve and ends to prevent entry of foreign matter.

D. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

E. Storage:

1. Store materials in areas protected from weather, moisture, or other potential damage.
2. Do not store materials directly on ground.

F. Handle products carefully to prevent damage to interior or exterior surfaces.

G. Protect threads and seats from corrosion and damage. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until time of use.

PART 2 - PRODUCTS

2.1 GENERAL

A. All buried valves shall open COUNTER-CLOCKWISE (LEFT).

B. The use of a manufacturer's name and/or model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

C. Valves shall be of the size shown on the Drawings or as noted and as far as possible equipment of the same type shall be identical and from one manufacturer.

D. Valves shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard to which they are manufactured cast in raised letters on some appropriate part of the body.

E. Unless otherwise noted, valves shall have a minimum working pressure of 250 psi or be of the same working pressure as the pipe they connect to, whichever is higher, and suitable for the pressures noted where they are installed.

F. Valves shall be of the same nominal diameter as the pipe or fittings they are connected to. Except as otherwise noted, joints shall be mechanical joints, with joint restraint.

G. Valves shall be especially constructed for buried service.

2.2 RESILIENT WEDGE GATE VALVES

A. Manufacturers:

1. A2360 by Mueller, American Flow Control No. 2500, or approved equal
2. Description:
3. Comply with AWWA C509 and/or AWWA C515
4. Materials:

    a. Body: Ductile iron.

5. Bonnet and gland bolts and nuts shall be either Type 304 or 316 stainless steel. The hot-dip process in accordance with ASTM A153 is not acceptable. Allen-wrench type bonnet and gland fastening shall not be acceptable and will be rejected.
6. Cast the word "OPEN" and an arrow indicating direction to open on each valve body or operator.

7. Seats: Resilient
8. Wedges shall be totally encapsulated.
9. Stem:

    a. Type: Non-rising.
    b. Material: Bronze.

10. Operation:
11. 2-in square operating nut.

    a. Direction of Opening: Open COUNTER-CLOCKWISE (LEFT).

12. End Connections: mechanical joint.
13. Coatings:

    a. All internal and external coatings, except rubber coatings, shall be coated with fusion bonded epoxy to a minimum thickness of 8 mils.
    b. Coatings shall be non-toxic, impart no taste to water, and shall conform to AWWA C550

14. Pressure Rating: 250 psig minimum working pressure and a 400 psi minimum test pressure
15. Valves shall have mechanical joint ends compliant with AWWA C111 unless otherwise noted.
16. Thrust collars and stems shall be integrally cast (not pinned on) and shall feature copper alloy valve stems.
17. Valves shall be provided with a minimum of two O-ring stem seals.
18. Units shall be, in addition, UL and FM approved.
19. The pH of the fluids flowing through the valves is expected to be between 6.5 and 8.5 pH units.
20. A 10-year warranty shall be provided for all resilient seated gate valves furnished on the Project
21. All valves shall be fully manufactured in the United States.

2.3 VALVE BOXES

A. Description:

1. Material: Cast iron
2. Drop lid shall be heavy duty cast iron and have the word “WATER” and an arrow indicating the direction of opening cast into the cover in raised letters.
3. Valve box barrel shall not be less than 5-¾ inches in diameter.
4. Shall be two piece sliding type, providing a minimum overlap of 6 inches and allow for 5 feet of bury.
5. The upper section of each box shall have a top flange of sufficient bearing area to prevent settling. The lower section shall enclose the operating nut and stuffing box/gear box of the valve and shall have a minimum diameter of 8 inches.
6. The valve box shall not transmit shock or stress to the valve.
7. Valve boxes shall be fully manufactured in the United States.
8. Extension shafts shall be Type 304 stainless steel and the operating nut shall be 2-in square. Shafts shall be designed to provide a factor of safety of not less than four. Operating nuts shall be pinned to the shafts.

9. Top of the operating nut shall be located 2 inches below the rim of the valve box.
10. All fasteners shall be Type 316 stainless steel.
11. Two tee handled gate wrenches of suitable length shall be furnished to operate all valves with valve boxes.

2.4 TAPPING SLEEVE AND VALVE

A. Tapping Sleeve:

1. As manufactured by Mueller Co. (H-615), American Flow Control, or approved equal.
2. Size as specified
3. Mechanical end joints conforming to ANSI/AWWA C111/A21.11
4. Outlet flange dimensions and drilling shall comply with ANSI B16.1, Class 125 and with MSS SP-60.
5. Cast iron/ductile iron body
6. Epoxy coating (min 10 mils)
7. Certified to ANSI/NSF 61
8. O-ring seals on outlet and flange connections
9. Stainless steel nuts and bolts
10. Rated for 250 psi and tested to 400 psi
11. 3/4-inch NPT test plug
12. Tapping sleeves shall be manufactured in the United States

B. Tapping Valve:

1. Taping valve shall conform to the requirements specified above for gate valves, except that one end shall be flanged and the other one mechanical joint.
2. Tapping valves shall be provided with an oversized opening to permit the use of full-size cutters.
3. Size as specified.

2.5 INSERTION VALVE

A. Insertion valves shall conform to the requirements specified above for gate valves, except:

1. Valves shall be constructed of a two (2) piece ductile iron casting, pieces to be bolted together using ductile iron bolts with zinc alloy anodes manufactured to comply with ASTM A536 65-45-12.
2. Ductile iron gate valve wedge shall have a resilient rubber seal 360 degrees around the gate which is expandable to the inside diameter of the pipe.
3. The valve assembly shall be designed to enable the valve to be rotated 120 degrees, perpendicular across the top of the pipe, while riding on two gaskets constructed of EPDM, by using a perpendicular rotary feed mechanism, driven by chain.
4. ACCESSORIES

B. Concrete for Thrust Restraints: Concrete type as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

C. Valve Box Aligner: High-strength plastic device designed to automatically center valve box base and to prevent it from shifting off center during backfilling.

D. Extension Stems: Shall be fabricated from solid stainless Type 304 steel. Stems shall not be smaller in diameter than the valve stem. Equip stem with wrench nut. Ensure all stem connections are pinned.

2.6 SURFACE PREPARATION AND SHOP COATINGS

A. The interior ferrous metal surfaces, except finished or bearing surfaces, shall be blast cleaned in accordance with SSPC SP-10 and painted with two coats of an approved two-component epoxy coating specifically formulated for potable water use. The coating shall be NSF certified to Standard 61.

B. Exterior ferrous metal surfaces of all buried valve shall be blast cleaned in accordance with SSPC SP-6 and given two shop coats of an approved two-component coal tar epoxy paint or fusion bonded epoxy coating.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017700 “Closeout Procedures”: Requirements for installation examination.

B. Determine exact location and size of valves from Drawings.

C. Verify that invert elevations of existing work prior to excavation and installation of valves are as indicated on Drawings.

3.2 PREPARATION

A. Section 017300 “Execution”: Requirements for installation preparation.

B. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

C. Identify required lines, levels, contours, and datum locations.

D. Locate, identify, and protect from damage utilities to remain.

E. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Engineer not less than one week in advance of proposed utility interruption.
2. Do not proceed without written permission from Engineer.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in Section 312333 “Trenching and Backfilling.”

B. Install valves in conjunction with pipe laying.

C. Buried valves shall be cleaned and manually operated before installation. Buried valves and valve boxes shall be set with the stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping pipe-bedding material under the sides of the valve. The valve box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade. The valve box shall be set so as not to transmit traffic loads to the valve.

D. Air release valves shall be installed as shown on the Drawings. The air release valves shall prevent backflow of water from flooded valve boxes.

E. Set valves plumb.

F. Before backfilling, all exposed portions of all bolts shall be coated with two coats of bituminous paint.

G. Provide buried valves with valve boxes installed flush with finished grade.

H. Disinfection of Water Piping System:

1. Flush and disinfect system as specified in Section 331300 “Disinfecting of Water Utility Distribution.”

3.4 FIELD QUALITY CONTROL

A. Pressure test system according to AWWA C600.

3.5

3.5 CLEANING AND DISINFECTION

A. All items (including valve interiors) shall be cleaned and disinfected prior to installation, testing, and final acceptance in accordance with AWWA 651 standards. Flush and disinfect system as specified in Section 331300 “Disinfecting of Water Utility Distribution.”

END OF SECTION 331216

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SECTION 331219 - WATER UTILITY DISTRIBUTION FIRE HYDRANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire hydrants.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete”: Concrete for thrust restraints and concrete collars installed on hydrant barrels.
2. Section 310515 “Soils and Aggregates for Earthwork”: Aggregate for hydrant drainage.
3. Section 312333 “Trenching and Backfilling”: Trenching, backfilling, and compaction requirements.
4. Section 331300 “Disinfecting of Water Utility Distribution”: Flushing and disinfection requirements.

1.3 COORDINATION

A. Section 013100 “Project Management and Coordination”: Requirements for coordination.

1.4 PREINSTALLATION MEETINGS

A. Section 013100 “Project Management and Coordination”: Requirements for preinstallation meeting.

B. Convene minimum one week prior to commencing Work of this Section.

1.5 ACTION SUBMITTALS

A. Section 013300 “Submittal Procedures”: Requirements for submittals.

B. Product Data: Submit manufacturer's latest published literature, including illustrations, installation and maintenance instructions, and parts lists.

C. Shop Drawings: Submit description of proposed installation.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 INFORMATIONAL SUBMITTALS

A. Qualifications Statements:

1. Submit qualifications for manufacturer and installer.
2. Submit manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Section 017700 - Closeout Procedures: Requirements for submittals.

B. Project Record Documents: Record actual locations of fire hydrants and service valves.

C. Operation and Maintenance Data: Submit data for hydrants.

1.8 QUALITY ASSURANCE

A. Perform Work according to AWWA standards.

B. Maintain one copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum ten years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements”: Requirements for transporting, handling, storing, and protecting products.

B. Prepare hydrants and accessories for shipment according to AWWA standards and seal hydrant and ends to prevent entry of foreign matter.

C. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

D. Storage:

1. Store materials in areas protected from weather, moisture, or potential damage.
2. Do not store materials directly on ground.

E. Handle materials in a way that prevents damage to interior and exterior surfaces.

PART 2 - PRODUCTS

2.1 FIRE HYDRANTS

A. Manufacturers:

1. Mueller Super Centurion A-423, or approved equal.

B. Dry-Barrel Breakaway Type:

1. Comply with AWWA C502.
2. Barrel Section shall be 5-1/4-inch diameter.
3. 5-1/2-foot bury.
4. Replaceable brass or bronze nozzles.
5. Breakaway flange.
6. Mechanical joint shoe (fusion bonded inside and outside with 8 mil epoxy).
7. Open COUNTER-CLOCKWISE (LEFT).
8. Hydrant operating nut shall conform to National Standard Specification.
9. Each hydrant shall come completely assembled and include all gaskets, flanges, nuts, and bolts required for installation.
10. A bronze or rustproof steel nut and check nut shall be provided to hold the main hydrant valve on its stem.

C. Hose Connections:

1. One (1) 4-1/2-in pumper, two (2) 2-1/2-in hose nozzles
2. Thread type and size shall conform to National Standard Specification.
3. Attach nozzle caps by separate chains. Nozzle cap shall be provided with a Buna N rubber washer.
4. Each hydrant shall be able to deliver 500 gallons minimum through its two 2-1/2-in hose nozzles when opened together with a loss of not more than 2 psi in the hydrant.
5. Hydrants shall be furnished with caps, double galvanized steel hose cap chain, galvanized steel pumper hose cap chain, a galvanized steel chain holder and any other hooks and/or appurtenances required for proper use.

D. Finishes:

1. Factory painted.
2. Primer and two coats of enamel.
3. Color: Factory painted green with white bonnet and hubs. According to Town of Yarmouth requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 017300 “Execution”: Requirements for installation examination.

B. Verify exact location and size of hydrants from Drawings. All hydrant locations shall be subject to field location approval by the Town of Yarmouth.

C. Obtain clarification and directions from Engineer prior to execution of Work.

D. Verify that invert elevations of existing work are as indicated on Drawings prior to excavation and installation of fire hydrants.

3.2 PREPARATION

A. Section 017300 “Execution”: Requirements for installation preparation.

B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.

C. Identify required lines, levels, contours, and datum locations.

D. Locate, identify, and protect from damage utilities to remain.

E. Do not interrupt existing utilities without permission and without making arrangements to provide temporary utility services.

1. Notify Engineer not less than 10 days in advance of proposed utility interruption.
2. Do not proceed without written permission from Engineer.

3.3 INSTALLATION

A. Perform trench excavation, backfilling, and compaction as specified in Section 312333 “Trenching and Backfilling.”

B. Hydrants shall be so arranged that the direction of outlets may be turned 90 degrees without interference with the drip mechanism or obstructing the discharge from any outlet.

C. The hydrants shall be set upon a slab of concrete not less than 4-in thick and 15-in square. During backfilling, additional screened gravel shall be brought up around and 6-in over the drain port. Each hydrant shall be set in true vertical alignment and properly braced.

D. Concrete thrust blocks shall be placed between the back of the hydrant inlet and undisturbed soil at the end of the trench. Minimum bearing area shall be as shown on the Drawings. Felt roofing paper shall be placed around hydrant elbow before placing concrete. Care shall be taken to ensure that concrete does not plug the drain ports.

E. The hydrant shall be tied to the pipe with suitable rods or clamps, galvanized, painted, or otherwise rustproof treated or other restraint system. Hydrant paint shall be touched up as required after installation.

F. Provide support blocking and drainage gravel while installing wet barrel fire hydrants; do not block drain hole.

G. Set fire hydrants plumb with pumper nozzle facing roadway.

H. Set fire hydrants with centerline of pumper nozzle 18 inches above finished grade, and with safety flange not more than 6 inches nor less than 2 inches above grade.

I. Paint hydrants according to color scheme of local authorities having jurisdiction.

J. After hydrostatic testing, flush hydrants and check for proper drainage.

3.4 FIELD QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Requirements for inspecting and testing.

B. Pressure test water distribution system according to AWWA C600.

3.5 CLEANING AND DISINFECTION

A. All items shall be cleaned and disinfected prior to installation, testing, and final acceptance in accordance with AWWA C651 standards.

END OF SECTION 331219

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SECTION 331300 - DISINFECTING OF WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Disinfection of potable water distribution and transmission system.
2. Testing and reporting of results.

B. Related Requirements:

1. Section 330519 “Ductile Iron Utility Pipe for Water Service.”
2. Section 331213 “Water Service Connections.”
3. Section 331216 “Water Utility Distribution Valves.”
4. Section 331219 “Water Utility Distribution Fire Hydrants.”

1.3 ACTION SUBMITTALS

A. See Section 013300 “Submittal Procedures” for detailed submittal.

B. Product Data: Procedures, proposed chemicals, and treatment levels.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Certify cleanliness of water distribution system meets or exceeds specified requirements.

C. Certify water conforms or fails to conform to bacterial standards of authority having jurisdiction.

D. Certify water conforms to quality standards of authority having jurisdiction.

E. Test and Evaluation Reports: Testing results comparative to specified requirements.

F. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

G. Disinfection and Chlorination Water Disposal Plan: To be submitted by Contractor for review and acceptance by Owner and Engineer.

A. Qualifications Statements: Qualifications for water treatment firm and testing firm. Include operator's license to perform the disinfection Work as required by Authorities Having Jurisdiction.

1.5 CLOSEOUT SUBMITTALS

A. See Section 017000 "Execution and Closeout Requirements" for detailed submittal requirements.

B. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Special disinfecting procedures used for connections to existing pipes.
5. Name of person collecting samples.
6. Initial and 24-hour disinfectant residuals in treated water in ppm for each outlet tested.
7. Date and time of flushing start and completion.
8. Disinfectant residual after flushing in ppm for each outlet tested.

C. Bacteriological Report:

1. Date issued, project name, and testing laboratory name, address, and telephone number.
2. Time and date of water sample collection.
3. Name of person collecting samples.
4. Test locations.
5. Initial and 24-hour disinfectant residuals in ppm for each outlet tested.
6. Coliform bacteria test results for each outlet tested.
7. Submit bacteriologist's signature and authority associated with testing.

1.6 QUALITY ASSURANCE

A. Perform Work according to AWWA C651; continuous feed and Commonwealth of Massachusetts Department of Transportation standards.

B. Perform Work according to AWWA C655 – Field Dechlorination.

C. Perform Work according to NSF 61 – Drinking Water System Components Health Effects.

D. Maintain a copy of each standard affecting Work of this Section on Site.

1.7 QUALIFICATIONS

A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years' documented experience.

B. Testing Firm: Company specializing in examining potable water systems, certified by Commonwealth of Massachusetts..

PART 2 - PRODUCTS

2.1 DISINFECTION CHEMICALS

A. Water

1. Water for flushing of water mains, preparation of chlorine solutions, and filling water mains for disinfection shall be potable drinking water.

B. Chemicals:

1. Chlorine for preparation of chlorine solutions for disinfection shall be sodium hypochlorite or calcium hypochlorite and shall conform to the requirements of ANSI/AWWA B300.
2. Chorine solution shall be neutralized prior to disposal using sodium bisulfite, sodium sulfite, or sodium thiosulfate.

C. Water Sample Bottles:

1. Sterile sample bottles shall be obtained from a state certified laboratory.

a. Sterile bottles for bacteriological analyses shall be treated with sodium thiosulfate to neutralize any residual chlorine.
b. Two samples are required for each sampling point. One shall be analyzed for the presence of coliform bacteria and one sample shall be analyzed for the presence of heterotrophic plate count (HPC) bacteria.

PART 3 - EXECUTION

3.1 EXAMINATION

A. See Section 017300 “Execution” for installation examination requirements.

B. Verify that piping system has been cleaned, inspected, and pressure tested.

C. Perform scheduling and disinfecting activity with startup, water pressure testing, adjusting, and balancing, and demonstration procedures, including coordination with related systems.

3.2 GENERAL

A. Disinfection of all water mains and valves shall be in accordance with AWWA C651 and Town of Yarmouth Water Department standards.

B. Furnish all necessary equipment and labor for cleaning and testing and chlorinating the pipelines. The procedures and methods shall be approved by the Engineer.

C. Make taps and furnish all necessary caps, plugs, etc., as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

3.3 CLEANING PIPELINES

A. Ends of existing pipelines cut into shall be covered and capped during the construction duration to protect them from debris entering the existing pipelines until the final connections are made.

B. Thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed.

3.4 TESTING PRESSURE PIPELINES

A. All new pressure pipelines shall be pressure and leakage tested. Pipelines shall be subjected to a hydrostatic pressure of 150 psig or 50 percent above the normal operating pressure, whichever is greater, and this pressure maintained for at least 2 hours. The leakage test shall be conducted at the maximum operating pressure as determined by the Engineer, and this pressure shall be maintained for at least two hours. The test pump and water supply shall be arranged to allow accurate measurement of the water required to maintain the test pressure. Where applicable, hydrant branch gate valves shall remain open during this test. The amount of leakage which will be permitted shall be in accordance with AWWA C600, latest edition.

3.5 CHLORINATION OF PIPELINES

A. Before being placed in service, all new potable water pipelines shall be chlorinated using the continuous feed method specified in AWWA C651 as modified in the Town of Yarmouth Water Department Standard Documents for Water Materials and Installation, dated August 2021. The procedure shall be approved by the Engineer in advance.

B. The location of the chlorination and sampling points will be determined by the Engineer in the field. Taps for chlorination and sampling shall be installed by the Contractor and shall meet AWWA C651 requirements. The Contractor shall uncover and backfill the taps as required.

C. The general procedure for chlorination shall be first to flush all dirty or discolored water from the lines and then introduce chlorine in approved dosages through a tap at one end, while water is being withdrawn at the other end of the line.

1. The chlorine solution shall remain in the pipeline for 24 hours. Disinfection shall be in accordance with AWWA C561 standard, latest edition.

2. Transmission mains that are taken out of service to facilitate the installation of valves, piping and appurtenances shall be disinfected including all existing pipeline that has been dewatered.
3. Potable water discharged into storm drains shall be in accordance with the requirements of all Federal, State and local laws and regulations.
4. Water main dewatering shall be accomplished through existing hydrants, existing blow-offs, proposed taps for dewatering, and other methods proposed by the Contractor and accepted by the Engineer and Owner.
5. The Owner will operate all valves and hydrants.
6. Dewatering will require the Contractor to provide pumping and treatment labor and equipment for dewatering.
7. The Contractor shall not release any water from existing potable water lines into the surroundings, drainage and sewer systems prior to dechlorination and permission of the Owner.
8. Chlorine discharge limits in water releases into receiving streams and wetlands shall not exceed 0.01 mg/L.

D. Following the chlorination period, all treated water shall be flushed from the lines at their extremities and replaced with water from the distribution system.

1. All treated water flushed from the lines shall be disposed of by discharging by means approved by the Owner and Engineer in accordance with all Federal, State and local standards.
2. Water main dewatering shall be accomplished through existing hydrants, existing blow-offs, proposed taps for dewatering, and other methods proposed by the Contractor and accepted by the Engineer and Owner.
3. The Owner will operate all valves and hydrants.
4. Dewatering will require the Contractor to provide pumping and treatment labor and equipment for dewatering.
5. The Contractor shall not release any water from existing potable water lines into the surroundings, drainage and sewer systems prior to dechlorination and permission of the Owner.
6. Chlorine discharge limits in water releases into receiving streams and wetlands shall not exceed 0.01 mg/L.

E. Engineer will require bacteriological sampling and analysis of the replacement water by the Contractor in full accordance with the latest edition of the AWWA C651 standard.

1. Contractor shall make payment for bacteriological sampling and testing required by the Engineer and in accordance with Owner’s Construction Specifications.
2. The Contractor will be required to rechlorinate, if necessary, and the line shall not be placed into service until all requirements of the Commonwealth of Massachusetts and the Owner are met.
3. Additional testing by a qualified individual for heterotrophic plate count (HPC) and volatile organic carbon (VOCs) shall be completed and recorded on forms as required by the Commonwealth of Massachusetts.
4. Contractor shall forward to the Engineer all sampling and analysis forms to the Commonwealth of Massachusetts as required.

5. Disinfection and final water quality results shall be consistent with the existing water quality in the Owner's water system in accordance with the Owner's Construction Standards and Specifications.

F. Special disinfecting procedures shall be used in connections to existing pipelines and where the method outlined above is not practical. Special disinfection procedures shall be submitted to the Engineer in advance for approval.

G. The Owner shall be notified at least two days prior to chlorination and shall witness the procedure. If no one from the Owner is available, the procedure shall be rescheduled to accommodate the Owner.

H. Discharge of chlorinated water shall comply with all Federal, State and local standards, including in full accordance with the latest edition of the AWWA C655 standard. Provide sodium bisulfate or an approved equal method for dichlorination prior to discharge.

3.6 FIELD QUALITY CONTROL

A. See Section 014000 "Quality Requirements" for inspecting and testing requirements.

B. Disinfection, Flushing, and Sampling:

1. Disinfect pipeline installation.
2. Use of liquid chlorine is permitted.
3. Upon completion of retention period required for disinfection, flush pipeline until chlorine concentration in water leaving pipeline is no higher than that generally prevailing in existing system or is acceptable for domestic use.
4. Disposal:

    a. Legally dispose of chlorinated water.
    b. When chlorinated discharge may cause damage to environment, apply neutralizing chemical to chlorinated water to neutralize chlorine residual remaining in water.

5. After final flushing and before pipeline is connected to existing system or placed in service, employ an approved independent testing laboratory to sample, test, and certify that water quality meets quality standards of authority having jurisdiction.

END OF SECTION 331300

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SECTION 333113 - PUBLIC SANITARY UTILITY SEWERAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sanitary sewerage gravity pipe and fittings.
2. Pipe markers.
3. Connection to manholes.
4. Wye branches and tees.
5. Sanitary laterals.
6. Bedding and cover materials.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-In-Place Concrete” for concrete type for manhole base pad construction.
2. Section 036000 “Grouting” for non-shrink grout.
3. Section 310515 “Soils and Aggregates for Earthwork” for soils and aggregate for backfill in trenches.
4. Section 312333 “Trenching and Backfilling” for execution requirements for trenching and backfill required by this Section.
5. Section 330513 “Manholes and Structures.”

1.3 COORDINATION

A. Section 013100 “Project Management and Coordination” for coordination requirements.

B. Coordinate Work of this Section with municipal department having jurisdiction.

C. Notify affected utility companies at least 72 hours prior to construction.

1.4 PREINSTALLATION MEETINGS

A. Section 013100 “Project Management and Coordination” for preinstallation meeting requirements.

B. Convene minimum one week prior to commencing Work of this Section. At the pre-installation meeting, discuss at a minimum, construction schedule, coordination with others, known deviations

from the specifications, communication protocols and quality control / testing procedures and system start-up procedures.

C. Attendance Roster: Include affected utility companies and appropriate local and county officials.

1.5 ACTION SUBMITTALS

A. Product Data: Submit manufacturer catalog cuts and other information indicating proposed materials to be used, accessories, details, and construction information.

B. Shop Drawings:

1. Drawings showing layout and details of pipe, reinforcement, joints, gaskets, special fittings and the name of the pipe manufacturer. A schedule of pipe lengths (including the length of individual pipes by diameter) for the entire job.

C. Permits: Submit 2 copies of State construction permit, roadway opening permit, and soil erosion permit,.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Test and Evaluation Reports: Documenting field tests made and results obtained.

C. Manufacturer Instructions: Procedures required to install specified products.

D. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

E. Qualifications Statements:

1. Qualifications for manufacturer and installer.
2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, and manholes.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Perform Work according to Massachusetts Department of Transportation and Town of Yarmouth Department of Public Works standards.

B. Maintain a copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 016000 “Product Requirements” for transporting, handling, storing, and protecting products requirements. Refer to specific pipe material specifications for additional information.

B. Inspection: Accept materials on Site in manufacturer’s original packaging and inspect for damage.

C. Storage: Store materials according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Provide additional protection according to manufacturer instructions.
4. Protect materials from weather and UV exposure.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Field verify fit-up to existing infrastructure prior to fabrication.
3. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SANITARY SEWERAGE PIPE AND FITTINGS

A. Ductile-Iron Pipe:

1. Minimum Special Thickness Class: 52.
2. End Connections: Bell and spigot.
3. Outside Coating Type: Asphaltic coating, minimum 1 mil uniform thickness. Per AWWA C151.
4. Lining: Protecto 401 ceramic epoxy lining.
5. Fittings: Ductile iron.
6. Joints: Rubber gasket joint devices per AWWA C111.

B. Plastic Pipe: Polyvinyl chloride (PVC) per ASTM D3034 (sizes 4- through 15-inch) and ASTM F679 (sizes 18- through 30-inch), SDR-35.

1. Inside Nominal Diameter: As shown on Drawings.
2. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.
3. Fittings: PVC.

a. All fittings and accessories for sewers shall have bell and/or spigot configurations compatible with the pipe.

4. Joints: Elastomeric gaskets per ASTM F477.

C. Pressure Sewer:

1. Pipe: SDR-21 PVC per ASTM D2241 (2-inch) and Schedule 40 PVC per ASTM D1785 (1.5-inch).
2. Inside Nominal Diameter: As shown on the Drawings.
3. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.
4. Gaskets: ASTM F477.
5. Fittings: PVC per ASTM D2241 (2-inch) and ASTM D2466 (1.5-inch).

a. All fittings and accessories for pressure sewers shall be compatible with the pipe.

2.2 FLEXIBLE COUPLINGS

A. Manufacturers:

1. Substitutions: In accordance with Paragraph 7.05 of the General Conditions.
2. Furnish materials according to Town of Yarmouth Department of Public Works standards.

B. Description: Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.

1. Attachment: Two Series 300 stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Manufacturers:

1. A-Lok Products, Inc.
2. Press-Seal Corporation.
3. Trelleborg Pipe Seals Milford Inc.
4. Substitutions: In accordance with Paragraph 7.05 of the General Conditions.
5. Furnish materials according to Town of Yarmouth Department of Public Works standards.

B. Description: Ethylene propylene rubber (EPDM) per ASTM C923.

1. Attachment: Series 300 stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete: As specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type as specified in Section 310515 “Soils and Aggregates for Earthwork.”
2. Cover: Fill Type as specified in Section 310515 “Soils and Aggregates for Earthwork.”
3. Soil Backfill from Above Pipe to Finish Grade:

    a. Soil Type as specified in Section 310515 “Soils and Aggregates for Earthwork.”
    b. Subsoil with no rocks over 6 inches in diameter, frozen earth, or foreign matter.

2.6 MIXES

A. Grout: As specified in Section 036000 “Grouting.”

2.7 FINISHES

A. Galvanizing: Hot-dip galvanize after fabrication per ASTM A123.

2.8 ACCESSORIES

A. Underground Pipe Markers:

1. Manufacturers:

    a. Mutual Industries, Inc.
    b. Berntsen International Inc.
    c. Terra Tape, Div. of Reef Industries Inc.
    d. Substitutions: In accordance with Paragraph 7.05 of the General Conditions.

2. Ribbon Tape:

    a. Material: Polyethylene silver metal detectable tape
    b. Brightly colored, green, continuously printed with the warning message for the utility such as "CAUTION – SEWER LINE BURIED BELOW".
    c. Size: Minimum 6 inches wide by 5 mil thick.
    d. Meet American Public Works Association (APWA) requirements
    e. Manufactured for direct burial service.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and excavation base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over-excavation with screened gravel as specified in Section 310515 “Soils and Aggregates for Earthwork”.

B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.

C. Protect and support existing sewer lines, utilities, and appurtenances.

D. Utilities:

1. Maintain profiles of utilities.
2. Coordinate with other utilities to eliminate interference.
3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 312333 “Trenching and Backfilling.”
2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of encasement.
3. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 315000 “Excavation Support and Protection.”
5. Placement: Place bedding material at trench bottom.

    a. Level materials in continuous layer not exceeding 8 inches compacted depth.
    b. Compact to 95 percent of maximum density.

B. Piping:

1. Install pipe, fittings, and accessories according to ASTM D2321, and seal joints watertight.
2. Lay pipe to slope gradients as indicated on Drawings.
3. Maximum Variation from Indicated Slope: 1/8 inch in 10 feet.
4. Begin at downstream end and progress upstream.
5. Assemble and handle pipe according to manufacturer’s instructions, except as may be modified on Drawings or by Engineer.

6. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.
7. Cap open ends during periods of Work stoppage.
8. Lay bell and spigot pipe with bells upstream.
9. Backfill and compact as specified in Section 312333 “Trenching and Backfilling.”
10. Do not displace or damage pipe when compacting.
11. Install underground pipe markers as shown on the Drawings.

C. Wye Branches and Tees:

1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.
2. Use standard fittings of same material and joint type as sewer main.
3. Maintain minimum 5 feet separation distance between wye connection and manhole.
4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
5. Mount saddles with solvent cement or gasket and secure with metal bands.
6. Lay out holes with template and cut holes with mechanical cutter.

D. Sanitary Laterals:

1. Construct laterals from wye branch to terminal point at right-of-way.
2. Where depth of main pipeline warrants, construct riser-type lateral chimneys from wye branch as shown on the Drawings.
3. Minimum Depth of Cover over Piping: 5 feet.
4. Minimum Separation Distance between Laterals: 5 feet.
5. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral.
6. Hammer tapping into the sewer main is not permitted.
7. Marker Stake:

    a. Install temporary marker stake extending from end of lateral to 6 inches below finished grade.
    b. Paint top 6 inch of stake with fluorescent orange paint.

E. Backfilling: Maintain optimum moisture content of bedding material as required to attain specified compaction density

1. Backfill around sides and to top of pipe as specified in Section 312333 “Trenching and Backfilling.”

3.4 FIELD QUALITY CONTROL

A. Request inspection by Engineer prior to and immediately after placing bedding.

B. Testing: If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

C. Testing of Gravity Sewer Piping:

1. Low Pressure Air Testing:

a. Test each reach of gravity sewer piping between manholes.
b. Introduce air pressure slowly to approximately 4 psig.

1) Determine groundwater elevation above spring line of piping.
2) For every foot of groundwater above spring line of piping, increase starting air test pressure by 0.43 psi.
3) Do not increase pressure above 10 psig.

c. Allow pressure to stabilize for at least five minutes.
d. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
e. Testing: Determine test duration for reach of sewer with single pipe size from following table; do not make allowance for laterals.

NOMINAL PIPE SIZE, INCHES	MINIMUM TESTING TIME, MINUTES/ 100 FEET
3	0.2
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

1) Record drop in pressure during testing period.
2) Test Acceptance: If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
3) Test Failure: If air pressure drops more than 1.0 psi during testing period, piping has failed.

a) If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.

2. Exfiltration Testing of Pipes Larger than 36 inches in Diameter:

a. Maximum Allowable Exfiltration: 100 gal/inch of pipe diameter for each mile per day for each reach of piping undergoing testing.
b. Perform testing with minimum positive head of 2 feet.

3. Infiltration Testing:

a. Maximum Allowable Infiltration: 100 gal/in of pipe diameter for each mile per day for reach of piping undergoing testing.
b. Include allowances for leakage from manholes.
c. Perform testing with minimum positive head of 2 feet.

4. Deflection Testing of Plastic Sewer Piping:

a. Vertical Ring Deflection Testing: On PVC and acrylonitrile butadiene styrene sewer piping after backfilling has been in place for 30 days but not longer than 12 months.
b. Allowable Maximum Deflection: For installed plastic sewer pipe; not greater than 5 percent of original vertical internal diameter.
c. Deflection Testing: Using properly sized rigid ball or "go, no go" mandrel.

1) Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe, as determined by ASTM standard to which pipe is manufactured.
2) Measure pipe diameter in compliance with ASTM D2122.

d. Perform testing without mechanical pulling devices.
e. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

D. Cleaning:

1. At the conclusion of the work, thoroughly clean all pipelines by flushing or power jetting with water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Engineer will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired at the Contractor’s expense.

3.5 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 333113

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SECTION 333256 - SUBMERSIBLE PUMPING STATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish all labor, materials, equipment and incidentals required and furnish and install the wastewater pumping stations with all related interior piping and electrical work as shown on the Drawings and as specified herein, complete with all connections made, tested and ready for use.

B. Furnish all labor, materials, equipment and incidentals required to completely install, put in operation and field test the non-clog submersible pumping stations.

C. This Section is intended to give a general description of what is required but does not purport to cover all of the details which will vary in accordance with the requirements of the equipment as offered. It is, however, intended to cover the furnishing, shop testing, delivery and complete installation and field testing of all materials, equipment and appurtenances to complete the pumping stations whether specifically mentioned in these specifications or not.

D. The Contractor shall coordinate his operations and those of the supplier of the pumping stations materials such that the sites are excavated and the stations materials delivered and installed in accordance with the Contractor's Schedule. No extension of Contract time will be allowed due to failure of the subcontracting supplier to furnish the equipment.

E. Any reference to a specific manufacturer or model number is for the purpose of establishing a quality or parameter for specification writing and not to be considered proprietary. In all cases any source or device is acceptable that has the quality and operating capabilities specified.

F. Furnish one complete spare pump with motor, power and signal cable, attachments to the guide rails, and pipe connection adaptor for each wastewater pumping station. Each spare pump shall meet the criteria indicated in this Section.

1.3 RELATED WORK

A. Concrete work, as included in Division 03.

B. Precast concrete wet well, valve vault, meter vault and manholes are included in Section 330513 “Manholes and Structures.”

C. Wet well lining system is included in Section 330130.81 “Epoxy Monolithic Lining.”

D. Access hatches are included in Section 330513 “Manholes and Structures.”

E. Natural gas standby generator, as included in Section 263213 “Gaseous Emergency Engine Generators.”

F. Electrical, except as specified herein, as included in Division 26.

G. Process Instrumentation and Controls, as specified in Division 40.

H. Section 406196 “Process Control Descriptions.”

I. Section 462433 “Open-Channel Grinders.”

1.4 SUBMITTALS

A. Submit, in accordance with Section 013300 “Submittal Procedures”, shop drawings showing details of construction and installation of all equipment furnished under this Section. Submittals shall include the following:

1. Shop drawings and materials of construction and performance of electric motors, pumps, controls, pipes, valves and fittings, equipment, conduit, wiring, wiring devices, transformer and access manhole, rails and bracket.
2. Manufacturer's rating curves as specified in Paragraph 2.3I showing pump characteristics of pressure, capacity, brake horsepower, and efficiency. This information shall be prepared specifically for the pumps proposed. Catalog sheet showing a family of curves will not be acceptable.
3. Literature and drawings describing the equipment in sufficient detail, including materials of construction and parts list, to indicate full conformance with the detail specifications.
4. Complete parts list for equipment furnished.
5. Certified pump test data contained in Paragraph 2 above.
6. Motor data such as Hp, Volts, RPM, FLC, Efficiency, and p.f. as described herein.
7. Complete wiring diagrams and schematics of all controllers, control panels, control devices, operators and associated devices furnished under Division 40.
8. Complete wiring diagrams and schematics of all power and control systems.
9. Floor plans, sections and elevations showing a complete layout to scale of all equipment, piping, electrical conduits and wall sleeve locations.
10. Details of electrical control panel, alarm system and wiring diagrams.
11. Certification of design calculations and plan to prevent flotation of pumping chamber and valve vault.

B. In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all nonconforming aspects.

C. Upon receipt of approval of submitted material, provide six certified prints and one reproducible tracing of all drawings for the pumping station.

1.5 DESCRIPTION OF PUMPING SYSTEMS

A. Pumping Station No. 1:

1. Two non-clog, variable speed, submersible pumps shall be installed in the pumping station as shown on the Drawings. Two of the pumps shall operate in a Duty/Standby configuration but will also operate in alternating lead/lag mode should influent flows rise above the capacity of a single pump.

B. Pumping Station No. 2:

1. Three non-clog, variable speed, submersible pumps shall be installed in the pumping station as shown on the Drawings. The pumps shall operate in alternating lead/lag/standby mode.

C. Pumps shall be manually and automatically started from the SCADA control system as specified in Section 406196 “Process Control Descriptions.” The pumps shall also be capable of manual operation from the VFD control panel.

D. Variable Speed Pumping System

1. A pumping rate controller (PLC) shall be provided for operation of the pumping units.
2. The pump, motor drive and control system shall consist of an AC adjustable frequency drive controller for each of the motors.
3. The AC adjustable frequency drive controller shall respond to the signal of a radar level element specified under Division 40 to automatically start, change speeds and stop pumps in accordance with the control descriptions specified in Section 406196 “Process Control Descriptions.”
4. The pump station PLC control panel is specified in Section 406343 “Programmable Logic Controllers.” Motor controllers (VFD’s) are specified in Section 262923 “Variable-Frequency Motor Controllers.”

1.6 QUALITY ASSURANCE

A. The equipment shall be the product of manufacturers who are fully experienced and qualified in the manufacture of the equipment to be furnished. The system components shall be designed, constructed, delivered and installed in accordance with the best practices and methods.

B. The system shall be furnished by a single supplier who shall be responsible for the coordination of the system design and who shall assume complete responsibility for the proper operation of each system. The packaged pumping stations shall be as supplied by Flygt Corporation; Wilo, Sulzer/ABS; or equal.

C. Should equipment of a different type, weight, size or location or should equipment which otherwise differs from this Section be offered and determined to be the equal to that specified, the equipment will be acceptable only on the basis that any revisions in the design and/or construction of the structural work, piping, electrical work, etc required to accommodate such a substitution shall be made at the Contractor's expense and responsibility and be as approved by the Engineer.

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1.7 OPERATING INSTRUCTIONS

A. Operating and maintenance instructions shall be furnished as provided for in Section 017823 "Operation and Maintenance Data." The instructions shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc. that are required to instruct operating and maintenance personnel unfamiliar with such equipment.

B. Factory representatives who have complete knowledge of proper operation and maintenance shall be provided for a minimum of two days at each pumping station (minimum four days total) to instruct representatives of the Owner on proper operation and maintenance. This work may be conducted in conjunction with the inspection of the installation and test run as provided under Paragraph 3.4. If there are difficulties in operation of the equipment due to the manufacturer's design or fabrication, additional service shall be provided at no additional cost to the Owner.

1.8 SPARE PARTS AND TOOLS

A. Furnish one set of all special tools required for the proper servicing of all equipment supplied under this Section for the pumping stations, packed in a suitable steel tool chest with a lock. Special tools shall include any tools not available in ordinary hardware stores.

B. Furnish one complete spare pump for each size provided, with motor, power and signal cable, attachments to the guide rails, and pipe connection adaptor for the wastewater pumping station. Deliver to Owner for storage.

C. Furnish the manufacturer's standard set of spare parts including at least the following for each pumping station:

1. Complete set of O-rings and gaskets.
2. One complete seal.
3. One set of snap rings.
4. One complete set of rubber sealing flange gaskets.

D. Refer to Division 26 for required spare parts.

E. Refer to Division 40 for required instrumentation and controls spare parts.

1.9 SHIPPING INSTRUCTIONS

A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.

B. All equipment and parts shall be properly protected against any damage during a prolonged period at the site.

C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.

D. The finished surfaces of all exposed flanges shall be protected by wooden blind flanges, strongly built and securely bolted thereto.

E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

F. No shipment shall be made until approved by the Engineer in writing.

1.10 POWER SUPPLY

A. The pumping stations shall be designed for operation on a 480 Volt, 3 Phase, 4 Wire, 60 Hz power supply.

PART 2 - PRODUCTS

2.1 PUMPING STATION WET WELL, VALVE VAULT AND METER VAULT

A. Furnish and install two complete underground pumping stations of precast concrete construction conforming to Section 330513 “Manholes and Structures.”

B. The size and design characteristics of the pumping stations shall be as shown on the “M” Drawings.

C. Precast concrete barrel sections, and precast bases shall conform to Section 330513 “Manholes and Structures”, ASTM C478.

D. Pumping station wet wells shall have an interior lining as specified in Section 330130.81 “Epoxy Monolithic Lining”.

E. Access hatches shall be as specified in Section 330513 “Manholes and Structures” and have clear openings as indicated on the drawings Coordinate with each equipment manufacturer to provide adequately sized hatches for the equipment being located below each hatch.

F. Manhole fames and covers shall be as specified in Section 330513 “Manholes and Structures.”

G. Manhole rungs shall as specified in Section 330513 “Manholes and Structures.”

H. Exterior Damp-proofing:

1. An exterior damp-proofing coating shall be factory applied to the below grade vertical surfaces of the wet well, valve vault, and meter vault (including “Valve and Meter Vault”). Damp-proofing shall be Karnak 83AF or approved equal.
2. Damp-proofing material shall meet ASTM# D-4471 Type 1 and Federal Spec# SS-A-694d(AF).
3. Installation of Damp-proofing

    a. Surface to be treated shall be free from oil and dirt and shall be in the proper condition as indicated by the manufacturer prior to the application of the damp-

proofing material. The concrete shall have been completely cured and the surface shall be dry and free from frost at the time of application.

b. Damp-proofing material to be cold-applied solvent based asphalt mastic brush or roller applied at a rate of 1-gal per 25SF.

c. Particular care shall be given to the application of damp-proofing at all assembly joints which are encountered.

d. The coat specified is in addition to primer coats as recommended by the manufacturer.

e. Damp-proof the surfaces of all concrete walls which are in contact with soil from the top of the base mat up to 6-in below finished grade and the bottom of slabs.

I. Wall Penetrations:

1. All wall penetrations shall be formed utilizing hole-formers or cored drilled holes for manhole boots, and galvanized threaded couplings with water stops for electrical connection.

2. Where wall penetrations are called for on the plans; mechanical piping shall utilize cast or cored openings with flexible manhole boots or mechanical seals.

a. Flexible rubber boots shall consist of EPDM polymer compounds meeting ASTM C923 material performance requirements. Expansion banding and strap shall be 304-stainless material and the connection between boot and structure shall utilize an expansion wedge system with Type 304-stainless wedge and hardware components.

b. Mechanical seals shall be Link Seal by Thunderline Corp. or approved equal and shall utilize Type 304-stainless assembly hardware.

2.2 PUMPING SYSTEMS

A. Furnish and install two complete automatic, underground pumping systems. The principal equipment included in each of the pumping systems shall include non-clog submersible pumps; pump frames, braces and lifting mechanism; piping; valves within a separate valve chamber; flow meter and pressure transmitter within a separate vault, control panel and variable speed controls mounted in the adjacent control building room; level monitoring equipment; and combustible gas detection monitoring equipment.

B. The stations shall be supplied with pump mounting plates with upper and lower rail supports attached to the concrete station with stainless steel expansion bolts. Two 2-in (wastewater pumping station) stainless steel pipe rails shall be installed between the mounting plates. The rails shall be used to raise and lower the pumps into the stations. A stainless steel lifting cable shall be attached to the top of each station chamber and to the top of each pump assembly. Plates, rails and lifting cables to be provided for all pumps.

C. Each pump shall be provided with a tandem double mechanical seal running in an oil reservoir, composed of two separate lapped seal faces. Each seal face shall consist of one stationary and one positively driven rotating tungsten-carbide ring with each pair held in contact by a separate spring, so that the outside pressure assists spring compression in preventing the seal faces from opening. The compression spring shall be protected against exposure to the pumped liquid. The pumped liquid shall be sealed from the oil reservoir by one face seal and the oil reservoir from the air-filled motor chamber by the other. The seals shall require neither maintenance nor

adjustment and shall be easily replaced. Conventional double mechanical seals with a single spring between the rotating faces, requiring constant differential pressure to effect sealing and subject to opening and penetration by pumping forces shall not be considered equal to tandem seal specified and required. No seal damage shall result from operating without water, nor shall the sealing system rely on the pumped media for lubrication.

2.3 PUMPS

A. The non-clog pumps and motors shall be designed and manufactured so they can operate completely submerged in the sewage or groundwater and with motor unsubmerged indefinitely without overheating.

B. The centrifugal pump impeller unit shall be attached to a common motor and pump shaft of stainless steel. Pump and motor housings shall be high quality gray iron castings. Impeller shall be single vane cast iron. All fasteners shall be of Type 316 stainless steel.

C. The pump-motor shaft shall be sealed by two mechanical tungsten carbide faced seals within an oil filled chamber to provide clean, constant lubrication. The shaft shall be supported by an upper ball radial and thrust bearing and a two row angular contact lower bearings both grease lubricated. The upper bearing shall be supported by an O-ring sealed, movable cap so that impeller clearance may be adjusted externally for most efficient operation.

D. The shaft shall be supported by an upper ball radial and thrust bearing and a two-row angular contact lower bearings both grease lubricated. The upper bearing shall be supported by an O ring sealed, movable cap so that impeller clearance may be adjusted externally for most efficient operation.

1. Pump and motor bearings shall be anti-friction type with a B-10 life of 20,000 hours minimum.

E. The motor winding and rotor shall be mounted in a sealed, submersible type housing which is able to transmit heat from motor winding to outer housing. Motor winding shall be Class F insulated and securely held in the housing with machine screws so that it may be removed in the field without the use of heat or a press.

F. Pump motors shall be inverter duty rated and shall be air filled and have cooling characteristics suitable to permit continuous operation in a totally, partially or non-submerged condition. Jacket water cooling shall not be required. The pump and motor shall be capable of running without damage for extended periods. Pump and motor shall be explosion-proof, suitable for Class 1, Division 1, Group C or D applications. Motor shall be provided with pilot thermal sensors embedded in the stator windings. Pumps shall have factory installed moisture detectors (seal failure probes) in the seal chamber.

G. The power cable shall be suitable for submersible pump and Class 1, Division 1, Group C or D applications. Cable sizing shall conform to National Electrical Code specifications for pump motors. Cable entry to each pump motor shall be designed for submersible pump applications. The cable entry junction box and motor shall be separated by a stator load sealing gland which shall isolate the motor interior from foreign materials gaining access through the pump top. The electrical power cords shall be sealed by use of a cord grip, with individual conductors additionally sealed into the cord cap assemblies with epoxy sealing compound. The cord grip

shall have a male tapered pipe thread, threaded into a female tapered pipe thread in a cord cap. The cord cap shall be sealed into the motor housing with an O-ring. The pumps shall be supplied with a sufficient length of cord to connect to junction boxes inside the station. A minimum of 10 feet of additional power cord shall be provided with each pump to facilitate future removal of each pump and re-installation of seal-offs.

H. Pumping Station No. 1:

1. Pump Design Criteria:

Number of Pumps	2 (Duty/Standby)
Configuration	On Rails, Non-Clog
Capacity and Head	1270 gpm at 45-ft
Min. Efficiency at Design Capacity	70 percent
Pump Speed (Max.)	1775 rpm
Min. Solids Size	3-in
Shut-off Head (Min)	85-ft
Net Positive Suction Head Available	Flooded Suction
Type of Drive	Close Coupled
Maximum Motor Hp	35
Motor Type	Submersible, Variable Speed
Minimum Pump Discharge Size	6-in

2. Minimum pump efficiency (percent): 55% throughout the flow range 500 gpm to 1600 gpm.
3. Maximum run out capacity (gpm): 1650 gpm (one pump)
4. The pumps shall be Flygt Model NP 3171 MT 3-436 / 25 HP submersible pumps, Wilo EMU FA15.52E / 23.5 HP submersible pumps, or equal.

I. Pumping Station No. 2:

1. Pump Design Criteria:

Number of Pumps	3 (Lead/Lag/Standby)
Configuration	On Rails, Non-Clog
Capacity and Head (parallel operation)	2460 gpm at 90.5-ft
Min. Efficiency at Design Capacity	65 percent
Pump Speed (Max.)	1775 rpm
Min. Solids Size	3-in
Shut-off Head (Min)	160-ft
Net Positive Suction Head Available	Flooded Suction
Type of Drive	Close Coupled
Maximum Motor Hp	51
Motor Type	Submersible, Variable Speed
Minimum Pump Discharge Size	6-in

2. Minimum pump efficiency (percent): 55% throughout the flow range 800 gpm to 2400 gpm.
3. Maximum run out capacity (gpm): 1800 gpm (one pump)

4. The pumps shall be Flygt Model NP 3202 HT 3-462 / 44 HP submersible pumps, Wilo EMU FA15.66E / 50.3 HP submersible pumps, or equal.

J. The manufacturer shall submit rating curves and details of construction for the pumps to the Engineer for approval. The curves shall indicate head, discharge, efficiency, and horsepower characteristics throughout the full operating range.

K. The impellers shall be of the semi-open, single vane, non-clog type with the forward ends of the blades generously rounded to avoid catching trash. The blades shall be tapered toward the periphery of the impeller to generate the maximum possible shutoff head, and the outer tips of the blades shall occupy only a negligible portion of the area of the impeller throat or periphery. The impellers shall be accurately balanced before assembling.

L. Damage due to pump runout will be prevented by flow rate interlocks as specified in Section 406196 “Process Control Descriptions”.

M. Each pump discharge elbow connection shall be permanently installed in the wet well along with the discharge piping. Each pump shall be automatically connected and sealed to its discharge connection elbow when lowered into place and shall be easily removable. Each pump shall be mounted on a sliding guide bracket which is used to guide the pump into place with the discharge connection elbow. The sliding guide bracket and the pump casing shall have a machined angle connection with yoke to connect with the cast iron discharge connection, which shall be bolted to the floor of the wet well and so designed as to receive the pump angle connection without the need of any bolts or nuts. Provide Type 316 stainless steel anchor bolts for attachment to the floor.

N. Sealing of a pumping unit to its discharge connection shall be accomplished by a simple linear downward motion of the pump with the entire weight of the pumping unit guided to the wedging tightly against the angled discharge connection; no portion of the pump shall bear directly on the sump floor and no rotary motion of the pump shall be required for sealing. Sealing at the discharge connection by means of a diaphragm or similar method of sealing will not be accepted as an equal to a metal contact of the pump discharge and mating discharge connection as specified and required.

O. The lower guide holders shall be integral with the discharge connection. Each pump shall ride on dual guide bars when raised and lowered in the sump. Guide bars shall be of standard weight 2-in Type 304 stainless steel pipe. The discharge connection elbow shall have a flanged connection to the discharge piping. Guide bars shall be furnished with intermediate and upper supports per manufacturer’s recommendations.

P. The motors shall be submersible, vertically mounted induction type, suitable for a service as called out on the electrical plans with a 1.15 service factor. They shall have adequate starting torque and low starting current characteristics. The motor shall not be overloaded beyond the nameplate rating at any point on the pump head capacity curve. The motor shaft shall be of adequate strength and stiffness for the service intended. It shall be supported on heavy grease-lubricated ball bearings.

Q. Motors shall have encapsulated windings with void free slot penetration and be capable of passing water immersion test as outlined in NEMA MGI 20.48 to provide protection against moisture ingress and condensation when the motor is not running.

2.4 FACTORY PUMP INSPECTION AND TESTS

A. General

1. The Engineer shall have the right to inspect, test or witness tests of all materials or equipment to be supplied under these specifications, before their shipment from the point of manufacture.
2. The Engineer shall be notified in writing before initial shipment, in ample time so that arrangements can be made for inspection testing or witnessing by Engineer.
3. The Engineer or their representative shall be furnished all facilities, including labor, and shall be allowed proper time for inspection and testing of material and equipment if they so desire.
4. Materials and equipment shall be tested and inspected as required by the Engineer, and the cost of such work shall be included in the cost of the Equipment. The Contractor shall anticipate that delays may be caused because of the necessity of inspecting, testing and accepting materials and equipment before their use is approved.

B. Factory Tests

1. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for the pumps. Certified pump horsepower curves shall be submitted, including head, capacity, brake horsepower, and pump efficiency for each pump supplied. Notification of such test and a list of equipment and test procedures shall be forwarded to the Engineer at least 10 working days before the scheduled test date. All testing required to determine acceptance of individual pumps may be witnessed by a representative of the Engineer. All meters, gauges and other test instruments shall be calibrated within 30 days of the scheduled test. The cost of calibration shall be included in the cost of the equipment.
2. Each pump shall be hydrostatically tested at 100 psig internal pressure and 30 psig external pressure. Motor and cable insulation shall be tested for moisture content and defects before and after the above tests. Manufacturer shall submit written report with the details and results of the tests.
3. Each pump shall be factory tested at the specified design speed and at varying head conditions. During each test, the pumps shall be run at each head condition for a sufficient time to accurately determine discharge, head, power input and efficiency for the entire range of operation the pump could be expected to achieve. The pump efficiency shall be determined at the specific design points. Perform test to demonstrate pumps meet ANSI/HI 11.6, acceptance grade 1U for specified design point. The pumps under test shall be modified until the foregoing conditions are met. Any pump failing to meet the minimum efficiency at the specified design point shall be rejected without further consideration.
4. No equipment shall be shipped unless the above satisfactory test results have been received by the Engineer.

2.5 PAINTING

A. Pumps, Motors and Associated Equipment

1. Pumps, motors and associated equipment shall be shop primed and finish coated in accordance with the manufacturer’s standard practice as approved, prior to shipment.

B. Exterior non submerged ferrous metals (pressed metal doors and frame)

1. 1 coat TNEMEC Series 66 (4.0 DFT), 1 coat TNEMEC Series 73 (3.0 DFT).

C. Interior Non-Submerged Ferrous Metals

1. 2 coats TNEMEC Series 66 (3.0 DFT).

D. Ductile Iron Pipe & Fittings Coating

1. Exterior pipe and fitting surfaces shall receive a compatible prime coating for select 2-part epoxy top coat. Exterior top coat shall be Polyamidoamine Epoxy high-build application, applied at a rate sufficient for 6DMT per coat, and 2-coats required. Color shall be selected from manufacturer's standard color chart.
2. Epoxy exterior top coat shall be Tnemec Series N69, or approved equal.

E. Gears, bearing surfaces and other similar surfaces obviously not to be painted shall be given a heavy shop coat of grease or other suitable rust-resistant coating. This coating shall be maintained as necessary to prevent corrosion during all periods of storage and erection and shall be satisfactory to the Engineer up to the time of the final acceptance test.

F. Other painting requirements see Division 09.

2.6 LOCAL CONTROLS

A. Radar level elements shall be supplied to control wet well level and alarm signals.

B. Radar level meters are included in Section 407223 "Radar Level Meters."

C. Each instrument shall be supplied with a sufficient length of cord, be intended for submersible service and Class 1, Division 1, Group C or D applications, such that the switches can be connected to junction boxes inside the station.

2.7 CONTROL PANELS

A. The control panels shall be mounted in the pumping station control building as shown on the Drawings.

B. Provide control panels in accordance with Section 406717 "Industrial Enclosures."

C. Provide variable frequency controllers as specified in Section 262923 "Variable Frequency Motor Controllers."

D. Provision to padlock unit disconnect handles in the ON and OFF position with up to three padlocks shall be provided.

E. Provide control panel mounted indicating lights and nameplates as indicated on the "I" Drawings.

2.8 PIPING AND VALVES

A. Ductile iron pipe shall conform to the physical and chemical requirements of AWWA C151, and shall have dimensions and wall thicknesses and flanges in accordance with AWWA C115, Thickness Class 53, and a rated working pressure of 250 psi. Flanges shall be faced and drilled after being screwed on the pipe, with flanges true to 90 degrees with the pipe axis and shall be flush with end of pipe. Gaskets shall be full face rubber with cloth insertion, 1/8-in thick and shall conform to the dimensions shown in Table A.1 of AWWA C115. Interior piping details, shall be submitted to the Engineer for approval before the station manufacture is started.

1. Flanged joints shall be supplied with bolts, bolt studs with a nut on each end, or studs with nuts where the flange is tapped. The number and size of bolts shall conform to the same standard as the flange. Bolts and nuts shall, except as otherwise specified or noted on the Drawings, conform to the ASTM A307, Grade B.
2. Fittings shall be ductile iron or gray-iron as specified above. Except as specified below, flanges and flanged fittings shall conform to AWWA C110 for 150 psi minimum pressure rating.
3. All pipe and fittings shall have a double thick cement mortar lining and bituminous seal coat on the inside and a bituminous seal coat on the outside, all-in accordance with AWWA C104.

B. Solid Wedge, Resilient-Seated Gate Valves

1. Description:

   a. Wastewater service.
   b. Comply with AWWA C509.
   c. Minimum Working Pressure 150 psig.
   d. Maximum Process Fluid Temperature 100 deg F.
   e. End Connections: ASME B16.1, ASME B16.5 and ASME B16.42, flanged.
   f. Body: No recesses in valve body.

2. Operation:

   a. Stem: Rising.
   b. Handwheel Operated.

3. Materials:

   a. Wedge: Resilient, ASTM A126, cast iron, fully encapsulated with molded rubber, Buna-N or ASTM D2000 EPDM encapsulated, ASTM D429 Method B bonded and vulcanized.
   b. Body and Disc: ASTM A126, cast iron.
   c. Stem, Stem Nuts, Glands and Bushings: Type 316 stainless steel.
   d. Connecting hardware: Type 316 stainless steel.

4. Finishes:

   a. Body, Internal and External, Including Bonnet: AWWA C550, Epoxy, 4-mil minimum thickness.

5. Valves shall open to the left or counterclockwise.

C. Rubber Flapper Swing Check Valves (3-in and larger):

1. Description:

a. Comply with AWWA C508.
b. Type: Swing, rubber encapsulated metal disc, movement provided via flexing of reinforced rubber tab.
c. Seat: Resilient, integral with rubber disc encapsulation.
d. Minimum Working Pressure: 175 psig.
e. Maximum Fluid Temperature: 100 deg. F
f. Mounting: Horizontal
g. End Connections: ASME B16.1, ASME B16.5 and ASME B16.42, flanged.

2. Materials:

a. Body and Cover: ASTM A536 Ductile Iron.
b. Disc: Steel encapsulated with reinforced EPDM rubber.
c. Seat: Integral to disc encapsulation.
d. Cover Hardware: Type 316 stainless steel.
e. Connecting Hardware: Type 304 stainless steel.

3. Finishes:

a. Body, Internal and External: AWWA C550, Epoxy, 4-mil minimum thickness.

D. Vacuum Breaker Valve:

1. Description:

a. Globe-Style.
b. Valve design shall incorporate a center guided, spring loaded disc, guided at opposite ends and having a linear stroke, generating a flow area equivalent to the pipe size.
c. All component parts shall be field replaceable without the need for special tools.
d. A replaceable guide bushing shall be held in position by the spring. The spring shall be designed to withstand 100,000 cycles without failure and provide a cracking pressure of 0.25 psi and to fully open at a pressure differential of 2 psi.
e. Valve disc and seat shall have a seating surface of 32 micro-inch or better to ensure positive seating at all pressures. The resilient seal on the seat shall provide zero leakage at both high and low pressures without overloading or damaging the seal.

2. Materials:

a. Body and Cover: ASTM A536 ductile iron.
b. Seat and Plug: ASTM A351 Grade CF8M stainless steel.
c. Internal Spring: ASTM A313Type 316 stainless steel with ground ends.
d. Seal: Buna-N.
e. Hardware: Type 316 stainless steel.

3. Minimum Working Pressure: 150 psig.
4. Size: 3-in minimum.
5. Finishes:

    a. Body, Internal and External: AWWA C550, Epoxy, 4-mil minimum thickness

6. Options:

    a. Screened hood to be provided.
    b. An air release valve (as specified here-in) shall be furnished and integrally piped with bronze full port ball valve.

7. Manufacturer:

    a. Val-Matic Model VMC-1803AVBS.1
    b. or approved equal.

E. Air Release Valves for Wastewater Service:

1. Description:

    a. Stems and Bodies: Long-float type to minimize clogging.
    b. Small orifice assembly air release valves shall automatically release air accumulations from pipe while under positive pressure. When valve body fills with air, float mechanism shall fall to open small orifice and exhaust air to atmosphere. When air has been exhausted, float mechanism shall be buoyed up and shall tightly close small orifice.
    c. Shall be specifically designed for grit and sewage service without the need for backwashing.
    d. Air release valves shall be supplied with shutoff gate, butterfly or ball valves.
    e. Air release valves shall be supplied with ½-in ball valve to drain valve body/release pressure.

2. Materials:

    a. Body and Cover: Stainless steel.
    b. Float: Type 316 stainless steel.
    c. Seat: Type 316 stainless steel.
    d. Internal Trim: Type 316 stainless steel.
    e. Hardware: Type 316 stainless steel.

3. Working Pressure: 150 psig.
4. Size: 2-in minimum
5. End Connections:

    a. Size 1/2 to 3 inches: Threaded.
    b. Size 4 inches and larger: Flanged.

6. Manufacturer:

    a. Val-Matic Model VM-48AS-M

b. or approved equal.

F. "Duckbill" Elastomeric Check Valves

1. Description:

a. Check Valves are to be all rubber of the flow operated check type with a slip-on connection. The Check Valve is designed to slip over the specified pipe outside diameter and attached by means of vendor furnished stainless steel clamps (Type 316). The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The valve shall be one piece rubber construction with nylon reinforcement.
b. Manufacturer must have available flow test data from an accredited hydraulics laboratory to confirm pressure drop data. Company name, plant location, valve size and serial number shall be bonded to the check valve. Valves shall be manufactured in the USA.
c. When line pressure inside the valve exceeds the backpressure outside the valve by a certain amount, the line pressure forces the bills of the valve open, allowing flow to pass. When backpressure exceeds the line pressure by at the same amount, the bills of the valve are forced closed. The flat bottom allows the valve to be installed where minimal bottom clearance exists.

2. The check valves to be at locations shown on the drawings shall be Tide Flex Series TF-2 by Tideflex Technologies, CLA-VAL Series DBO, or approved equal.

G. Flanged Couplings:

1. Flange couplings shall be mounted on each pump base elbows to ensure proper pressure seal while providing a minimum of assembly flexibility. The flange couplings shall be fusion bond epoxy coated and supplied with Type 316-stainless assembly and mounting hardware for harsh & wet environments. The pipe gasket and O -ring seal shall be Nitrile (Buna N) NFS 61 Listed.
2. To ensure correct fitting of pipe and couplings, all flange couplings shall be furnished by the pipe supplier and shall be of the pressure rating of at least that of the pipeline in which they are to be installed.
3. The flange couplings shall be Smith-Blair Inc., Model 912 or approved equal.

H. Sleeve type couplings for exposed steel pipe and ductile iron pipe shall be of steel construction and shall be Dresser Style 38, Dresser Div., Bradford, PA; Smith-Blair Style 4B, Smith-Blair, Inc., San Francisco, CA or equal. The pipe stop shall be removed from the middle ring. Gaskets shall be of a composition suitably resistant to the contents of the liquid within the pipe. Bolts and nuts shall be of galvanized steel.

1. Solid sleeve couplings may be an acceptable equal provided the deflection capacity is equivalent to the above couplings and pending Engineer approval

I. Copper piping may be used for vent or drain piping in sizes 2-in and smaller. Pipe shall be Type "L" used with either cast or wrought DWV fittings. No solder containing lead shall be utilized on the project. Flux shall comply with ASTM B813 and NSF 61.

J. PVC Pipe and Fittings:

1. Pipe:

    a. Comply with AWWA C900.
    b. DR 25, Class 165

2. Fittings:

    a. Material: Molded PVC
    b. Type: Push-on, comply with AWWA C907
    c. Gaskets: Comply with AWWA C111.

3. Joints:

    a. Type: Compression gasket ring.
    b. Comply with ASTM D3139.

4. Materials:

    a. Comply with ASTM D3139.

K. Bypass Connection:

1. The quick connect to be of the cam and groove type consisting of a stainless steel female adapter. Male adapters shall be designed to receive a male coupler without requiring threading, bolting, or tools. Connections shall remain tight and leakproof under pressures required for the application. Each adapter shall be furnished with a dust cap.

L. Vent Piping

1. A passive station vent shall be supplied using 6” Sch80 PVC piping & fittings, and a top mounting carbon canister unit. The vent will be factory assembled and mounted to the exterior of the station, where the venting will rise above the station a minimum 3’ above finish grade, and end with a top mounted carbon canister unit with rain shield. The canister housing shall be aluminum with 6” mounting flange, rain shield, with power coat finish. The replaceable canister shall contain a minimum of 12 pounds of activated carbon and shall be safe for recyclable disposal.
2. The carbon canister assembly shall be Purafil PV40 Vent Scrubber or approved equal.

2.9 PRESSURE GAUGES

A. Refer to Section 407313 “Pressure and Differential Pressure Gauges” for pressure gauge requirements.

B. Refer to the ‘I’ Drawings for pressure gauge installation details.

2.10 HANGERS AND PIPE SUPPORTS

A. General:

1. The absence of pipe supports and thrust restraints and associated details on the Drawings shall not relieve the Contractor of the responsibility for providing them. Pipe supports indicated on the Drawings are shown only to convey the intent of the design for a particular location and are not intended to represent a complete system.
2. Support pipe and appurtenances connected to equipment to prevent any strain being imposed on the equipment. Comply with manufacturer's requirements regarding piping loads being or not being transmitted to their equipment. Submit certification stating that such requirements have been met.
3. Support and secure all pipe and tubing in the intended position and alignment to prevent significant stresses in the pipe or tubing material, valves, fittings, and other pipe appurtenances. Design all supports to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact.
4. Supports on the drawings are shown for conceptual purposes only. Pipe supports shall be designed and located by the Contractor.
5. Piping will be supported from a pre-engineered structure. Contractor shall coordinate loads determined by the Contractor's pipe support design engineer with the Contractor's pre-engineered structure manufacturer to ensure the pre-engineered structure is designed to support and accommodate loads from the pipe support system.
6. Piping within the wet well shall be supported by means of a common 304-stainless fabricated angle brace spanning the width of the station wet well and mounted with wall brackets and 316-stainless hardware. All vertical discharge pipes shall be supported from the brace by means of individual 316-stainless U-bolts and bolting hardware.

    a. Common pipe support assembly at mid length shall be required when the vertical discharge pipe lengths exceed 10'-0".
    b. Common pipe support assemblies at equal spacing shall be required when the vertical discharge pipe lengths exceed 14'-0".

7. Interior clamps on plastic pipe shall be plastic coated. Supports for copper pipe shall be copper plated or shall have a 1/16 in plastic coating. All rods, clamps, hangers, inserts, anchor bolts, brackets and components for exterior pipe, submerged pipe and pipe within outdoor structures (wet well, valve chamber) shall be of Type 316 stainless steel.

2.11 DAVIT CRANE ASSEMBLY

A. An exterior, floor mounted manual crane assembly shall be provided. The crane shall have sufficient load carrying capacity and the bases shall be positioned to raise and lower each pump and each grinder for installation and service. It shall consist of a lifting davit, winch and lifting cable.

B. The lifting davit assembly shall be constructed of Type 304 stainless steel. It shall contain a lifting cable and pulley assembly that is field adjustable to any location on the davit arm. The davit arm shall also be capable of vertical angle adjustments up to 45 degrees from horizontal without any loss of load carrying capacity.

C. A turning arm handle shall be provided to effectively rotate the mast under lifting loads. The turning arm handle shall be located on the davit arm. The boom shall be designed to rotate 360 degrees and to remove the pump from the vault in a single lifting and rotation motion.

D. Each winch assembly shall be of marine grade construction, supplied with a sufficient length of cable at a sufficient diameter to remove the pumps. Intermediate pick points will not be acceptable.

E. The crane assembly shall be removable for storage. The only permanent fixtures shall be the bases installed within the top slab at the wet well. The mounting bases shall be flush mounted and permanently anchored to the top slab in accordance with the crane manufacturer recommendations. Base covers shall also be provided to prevent water from collecting in the base after the crane is removed.

F. The lifting assembly shall break down into separate pieces to facilitate removal. Each piece shall weigh a maximum of 70 lbs.

G. The davit crane shall be as manufactured by THERN, Inc. of Winona, MN or equal.

2.12 ANCHORS

A. Expansion anchors, where required, shall be ASTM A276 Type 316 stainless steel wedge type anchors, complete with Type 316 stainless steel nuts and washers, unless otherwise noted, with an approved ICC ESR in accordance with ICC ES AC193 for installation into cracked concrete. The length of the bolt required shall be sufficient to place the wedge portion of the bolt a minimum of 1-in behind the reinforcing steel within the concrete. Expansion anchors shall be Hilti Kwik-Bolt TZ; Simpson Strong-Tie Strong Bolt 2 Wedge Anchor; DeWalt Power-Stud+ SD6 for stainless steel; or equal.

B. Adhesive anchoring system, where required, shall consist of manufactured system consisting of post installed threaded rods, nuts, washers, other anchoring hardware, and chemical dispenser for installation in hammer drilled holes, with an approved ICC ESR in accordance with ICC ES AC308 for installation into cracked concrete. Injection adhesive shall be two-component epoxy system consisting of a hardener and a resin, furnished in pre-measured side-by-side cartridges which keep both components separate. Anchor shall be Type 316 stainless steel, consisting of an all-thread anchor rod with nut and washer. Adhesive anchoring system shall be Hilti HIT-RE 500 V3; Simpson Strong Tie SET-3G; ITW Ramset Red Head Epcon G5; or equal.

C. All hardware used in the wet well shall be Type 316 stainless steel.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Engineer shall have the right to inspect all materials or equipment to be furnished under this Section, prior to their shipment from the point of manufacture.

3.2 EXCAVATION AND BACKFILL

A. Earth excavation and backfill are specified under Section 312333 “Trenching and Backfilling”, but are to be done as a part of the work under this Section, including any necessary sheeting and bracing. The Contractor shall be responsible for dewatering to provide firm, dry undisturbed

subgrade for the structures, shall prevent water rising on new concrete within 24 hours after placing, and shall guard against flotation or other damage resulting from ground water or flooding.

3.3 INSTALLATION

A. Anchor bolts previously set shall be used to secure the station to the concrete base to prevent flotation. Stainless steel bolts shall be protected by painting with two coats of heavy bituminous coating.

B. Ensure against flotation of the station as specified herein. If additional concrete is required to prevent flotation, based on the manufacturer's approved calculations, the Contractor shall furnish and place such concrete as approved by the Engineer. All such additional concrete shall be considered a part of, and incidental to, the station installation, and no additional compensation will be made.

C. All pumps shall be installed by the station manufacturer during fabrication of the station at the manufacturer’s facility. All installation procedures shall be in strict accordance with the instructions of the pump manufacturer and as shown on the Drawings. In addition, the pumps shall be installed under the supervision of a representative of the manufacturer supplying the equipment. Installation shall include the supply of oil and grease for initial operation. The grades of oil and grease shall be in accordance with the manufacturer’s instructions. Anchor bolts shall be set in accordance with the manufacturer’s instructions.

D. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.

E. Submit a certificate from the equipment manufacturer stating that the installation is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.4 FIELD TEST

A. Refer to Section 406121.20 “Process Control System Testing” for testing requirements as it relates to the SCADA control system and connected components.

B. Refer to Section 330513 “Manhole and Structures” for leakage testing and documentation procedures.

C. Conduct in the presence of the Engineer such tests as necessary to indicate that the pumps conform to the head and capacities specified. A 14-day operating period of the pumps will be required before acceptance. If pump performance does not meet the Specifications, corrective measures shall be taken by the Contractor or the pumps shall be removed and replaced with pumps which satisfy the conditions specified. All test procedures shall be in accordance with factory test procedures and certified results of tests shall be submitted. Provide, calibrate and install all temporary gauges and meters, shall make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the Engineer for approval 30 days prior to testing. All costs

associated with the field tests or any required corrective action shall be borne by the Contractor. The decision of the Engineer shall be final.

D. The manufacturer shall furnish the services of a qualified factory representative for 8 hours not including travel time to check over the completed pump installations with the Owner and to observe the testing. Compensation for such services shall be paid for by the Contractor.

E. The pumping station wet well and valve vaults shall be tested as required for manholes under Section 330513 “Manholes and Structures.”

END OF SECTION 333256

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SECTION 333400 - SANITARY UTILITY SEWERAGE FORCE MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Force mains.
2. Bedding and cover materials.

B. Related Requirements:

1. Section 033010 “Miscellaneous Cast-in-Place Concrete”: Concrete material requirements.
2. Section 310515 “Soils and Aggregates for Earthwork”: Aggregate for pipe bedding and backfill.
3. Section 312333 “Trenching and Backfilling”: Excavation, backfilling, and compacting.
4. Section 333113 “Public Sanitary Utility Sewerage Piping”: Connections to sanitary sewerage system.

1.3 PREINSTALLATION MEETINGS

A. Convene minimum one week prior to commencing Work of this Section.

1.4 ACTION SUBMITTALS

A. Product Data: Manufacturer information indicating pipe material used, pipe accessories, valves, restrained joint details and materials.

B. Shop Drawings:

1. Piping piece numbers and locations.
2. Restrained joint locations.

C. Complete description of pipe installation methods.

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1.5 DELEGATED DESIGN SUBMITTALS

A. Signed and sealed Shop Drawings with design calculations and assumptions for restrained joints, including establishing lengths of restrained joint piping required.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Manufacturer Instructions: Recommendations for handling, storing and installing specified products.

C. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

D. Certification that stress regression testing has been performed on specific polyethylene resin being utilized in manufacturing of pipe for this contract per ASTM D2837.

E. Qualifications Statements:

1. Qualifications for manufacturer, installer, and licensed professional.
2. Manufacturer's approval of installer.

1.7 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record invert elevations and actual location of pipe runs and connections.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.8 QUALITY ASSURANCE

A. Design polyvinyl-chloride pipe restrained joints according to DIPRA standards.

B. Maintain a copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

B. Installer: Company specializing in performing Work of this Section with minimum three years' documented experience and approved by manufacturer.

C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Project location.

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1.10 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Where applicable, deliver materials in manufacturer's packaging including application instructions:

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage. Interior of pipe shall be free of cuts, gouges and scratches.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Do not place materials on private property without written permission of property owner.
3. Do not stack pipe higher than recommended by pipe manufacturer.

D. Protection:

1. Avoid dragging pipe over hard or sharp objects.
2. Avoid cutting of pipe's exterior. Any cut or gouge deeper than 5 percent of pipe's wall thickness shall be removed from site.
3. Avoid undue stress in pipe caused by bending.
4. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
5. Store gaskets for mechanical and push-on joints in cool and dry location, out of direct sunlight, and not in contact with petroleum products.
6. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SYSTEMS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design piping system.

B. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

2.2 SEWER FORCE MAIN PIPE AND FITTINGS

A. PVC Force Main Pipe, 8 to 12-inch:

1. Comply with AWWA C900.
2. Class: 165 psi
3. DR: 25.
4. Joints: restrained

    a. Restrained joints shall be installed at all bends and connections to all manholes and structures and shall be Megalug Series 2000PV by EBAA Iron Sales Inc. or approved equal.
    b. Restrained joints shall be installed along straight runs of pipe at intervals of every 100 linear feet and shall be Series 1900 restraint harness by EBAA Iron Sales Inc. or approved equal. For straight runs of pipe less than 100 linear feet in length, a minimum of one restrained joint shall be installed.

B. Fittings

1. Ductile iron per AWWA C110 or AWWA C153 as applicable.
2. Fittings to have the same pressure rating, as a minimum, of the connecting pipe.
3. Interior Lining: Protecto 401 ceramic epoxy lining.

2.3 PRESSURE SEWER

A. PVC Pressure Sewer Mainline Pipe and Fittings, 12-inch Nominal Size and Smaller:

1. Comply with ASTM D2241.
2. PVC 1120 (12454).
3. SDR: 21.

B. PVC Pressure Sewer Services and Fittings, 12-inch Nominal Size and Smaller:

1. Comply with ASTM D1785.
2. Schedule 40.
3. Fittings: Comply with ASTM D2466.

2.4 MATERIALS

A. Bedding and Cover:

1. As specified in Section 310515 “Soils and Aggregates for Earthwork.”
2. Subsoil: No rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.5 MIXES

A. Concrete: As specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

2.6 ACCESSORIES

A. Underground Pipe Markers:

1. Manufacturers:

a. Mutual Industries, Inc.
b. Berntsen International Inc.
c. Terra Tape, Div. of Reef Industries Inc.
d. Substitutions: In accordance with Paragraph 7.05 of the General Conditions.

2. Ribbon Tape:

a. Material: Polyethylene silver metal detectable tape.
b. Brightly colored, green, continuously printed with the warning message for the utility such as "CAUTION – SEWER FORCE MAIN BURIED BELOW".
c. Size: Minimum 6 inches wide by 5 mil thick.
d. Meet American Public Works Association (APWA) requirements.
e. Manufactured for direct burial service.

B. Air Release Valves for Wastewater Service:

1. Description:

a. Type: Fully automatic, float operated.
b. Comply with AWWA C512.
c. Valves shall be designed to release large amounts of air during pipeline filling, release small amounts of air accumulated during pipeline operation, and allow large volume of air during pipeline drainage or pipe break. Valves shall have an intake orifice area equal to nominal size of valve.
d. Shall be specifically designed for sewage service without the need for backwashing.
e. Valves shall be supplied with shutoff gate, butterfly or ball valves.
f. Valves shall be supplied with 1-in ball valve to drain valve body/release pressure and a 2-in NPT cleanout.

2. Materials:

a. Body and Cover: Stainless steel.
b. Float: Type 316 stainless steel.
c. Seat: Type 316 stainless steel.
d. Internal Trim: Type 316 stainless steel.
e. Hardware: Type 316 stainless steel.

3. Working Pressure: 150 psig.
4. Size: 2-in minimum.
5. End Connections:

a. Size 1/2 to 3 inches: Threaded.
b. Size 4 inches and larger: Flanged.

6. Manufacturer:

    a. Val-Matic Model VM-802AS.
    b. or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut and excavation base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Thoroughly clean pipe and fittings before installation. Keep clean until used in Work and when laid, conform to lines and grades required.

B. Correct over-excavation per Section 312000 “Earthwork” and Section 310515 “Soils and Aggregates for Earthwork.

C. Remove large stones or other hard matter capable of damaging pipe or of impeding consistent backfilling or compaction.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench and place bedding material as specified in Section 312333 “Trenching and Backfilling.”

B. Piping:

1. Install pipe, fittings, and accessories as indicated on the Drawings.
2. Route piping in straight line.
3. Install bedding at sides and over top of pipe to minimum compacted thickness as specified in Section 312333 “Trenching and Backfilling.”
4. Backfilling and Compacting:

    a. As specified in Section 312333 “Trenching and Backfilling.”
    b. Do not displace or damage pipe while compacting.

5. Underground Pipe Markers: As shown on the Drawings.

C. Thrust Restraints:

1. Pressure pipeline with restrained joints or concrete thrust blocking at bends, tees, and changes in direction.
2. Construct concrete thrust blocking as indicated on Drawings.

D. Cradles and Encasements for Pipelines: Where indicated on Drawings and as specified in Section 033010 “Miscellaneous Cast-in-Place Concrete.”

3.4 FIELD QUALITY CONTROL

A. Inspections: Request inspection by Engineer prior to and immediately after placing bedding.

B. After Installation: Test pipe for compliance as specified below. Furnish necessary equipment and labor for hydrostatic pressure test on pipelines.

C. Submit detailed test procedures and method for Engineer's review. In general, conduct testing per AWWA C605.

1. Hydrostatic pressure test methods and procedures must be approved by Engineer.
2. Submit testing plan to Engineer 10 days before testing.

D. Subject pressure pipelines to a hydrostatic pressure no greater than 50 percent above normal operating pressure in lowest portion and no less that 25 percent above normal operating pressure in highest portion of pipeline segment being tested:

1. Maintain test pressure a minimum of 2 hours.
2. Hydrostatic testing allowances must not exceed those indicated in AWWA C605.
3. Provide suitable restrained bulkheads as required to complete hydrostatic testing specified.

E. Make taps and furnish necessary caps, plugs, and other appurtenances as required in conjunction with performing testing.

F. Valves and Valve Boxes: Properly located and installed and operable prior to testing.

1. Provide bulkheads with sufficient number of outlets for filling and draining line and for venting air.

G. Hydrostatic Pressure Tests: Per Section 7.3 of AWWA C605.

1. Furnish gauges, meters, pressure pumps and other equipment needed to fill line slowly and perform required hydrostatic pressure tests.

H. Owner will provide a source of supply from existing treated water distribution system for Contractor's use in filling lines. Maintain an air break at all times between Owner's distribution system and Contractor's equipment to prevent cross-connection Owner will supply a maximum quantity of water equal to 110 percent of volume of pipelines for testing. Additional water required by Contractor will be provided at standard billing rates for volume required.

1. Slowly fill lines with water and maintain specified test pressure in pipe for entire test period by means of a pump furnished by Contractor.
2. Provide accurate means for measuring makeup water volume required to maintain pressure.
3. Pressure Test Duration: Not less than 2 hours.

    a. Repair leaks evident at surface and eliminate leaks regardless of total leakage as shown by test.
    b. Lines Failing to Meet Tests: Repaired and retested as necessary until test requirements are met.
    c. Remove and replace defective materials, pipes, valves and accessories.

3.5 CLEANING

A. As pipe laying progresses and at conclusion of work thoroughly clean all new pipelines by flushing with water or other means to remove dirt, stones, pieces of wood or other material which may have entered during construction period:

    a. If, after this cleaning, obstructions remain, they shall be removed.

3.6 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 333400

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SECTION 334113 - PUBLIC STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Storm drainage piping.
2. Piping accessories.
3. Bedding and cover materials.

B. Related Requirements:

1. Section 036000 “Grouting” for nonshrink grout.
2. Section 310515 “Soils and Aggregates for Earthwork” for soils and aggregate for backfill in trenches.
3. Section 310519.13 “Geotextiles for Earthwork” for geotextile fabric.
4. Section 312000 “Earthwork” for product and execution requirements for excavation and backfill required by this Section.
5. Section 312333 “Trenching and Backfilling” for execution requirements for trenching and backfilling required by this Section.
6. Section 330513 “Manholes and Structures” for concrete manholes, frames and grates for storm drainage.

1.3 COORDINATION

A. Coordinate Work of this Section with termination of storm sewer, trenching, connection to public storm drainage system.

1.4 ACTION SUBMITTALS

A. Product Data: Submit data indicating pipe, and pipe accessories.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of pipe, materials, invert elevations, diameter, and connections.

1.6 QUALITY ASSURANCE

A. Perform Work according to Massachusetts Department of Transportation Standard Specifications for Highways and Bridges (SSHB) and Town of Yarmouth DPW standards.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

B. Storage:

1. Store materials according to manufacturer instructions.
2. Block individual and stockpiled pipe lengths to prevent moving.
3. Do not place pipe or pipe materials on private property or in areas obstructing pedestrian or vehicle traffic.
4. Do not place pipe flat on ground; cradle to prevent point stress.

C. Protection:

1. Keep UV-sensitive materials out of direct sunlight.
2. Provide additional protection according to manufacturer instructions.

PART 2 - PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Piping:

1. Pipe:

a. Comply with ASTM C76, Class IV, with Wall Type B or C.
b. Reinforcement: Mesh.
c. Inside Nominal Diameter: 12 inches.
d. Ends: Bell and spigot

2. Fittings: Reinforced concrete.

3. Joints:

    a. Comply with ASTM C443.
    b. Gaskets: Rubber compression.

2.2 DRAINAGE STRUCTURES

A. Description: As specified in Section 330513 “Manholes and Structures.”

2.3 MATERIALS

A. Bedding and Cover:

1. Bedding: Fill Type, as specified in Section 310515 “Soils and Aggregates for Earthwork”.
2. Cover: Fill Type, as specified in Section 310515 “Soils and Aggregates for Earthwork”.
3. Soil Backfill from above Pipe to Finish Grade: Soil Type, as specified in Section 310515 “Soils and Aggregates for Earthwork.”
4. Subsoil: No rocks more than 6 inches in diameter, frozen earth, or foreign matter.

2.4 MIXES

A. Grout: As specified in Section 036000 “Grouting”

2.5 ACCESSORIES

A. Drainage Structures:

1. Catch Basins and Manholes: As specified in Section 330513 “Manholes and Structures.”

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that trench cut or excavation base is ready to receive Work.

B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

A. Correct over-excavation with coarse aggregate.

B. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.

3.3 INSTALLATION

A. Excavation and Bedding:

1. Excavate pipe trench as specified in Section 312333 “Trenching and Backfilling”.
2. Hand trim excavation for accurate placement of piping to indicated elevations.
3. Dewater excavations to maintain dry conditions to preserve final grades at bottom of excavation.
4. Provide sheeting and shoring as specified in Section 312333 “Trenching and Backfilling”.
5. Place bedding materials at trench bottom.
6. Level materials in continuous layers not exceeding compacted depth of 12 inches.
7. Maintain optimum moisture content of bedding material to attain required compaction density.
8. Install pipe on compacted subgrade meeting bedding requirements.

B. Piping:

1. Install pipe, fittings, and accessories according to ASTM D2321.
2. Seal joints watertight.
3. Place pipe on minimum 12 inch -deep bed of compacted subgrade meeting bedding requirements.
4. Verify that drainage system is as indicated on Drawings. Drawing details should describe location of coarse and fine aggregate in relation to pipe and pipe bedding, dimensions of cut trench width, and details of connections to other Work.
5. Lay pipe to slope gradients as indicated on Drawings.
6. Connect piping to drainage structures.
7. Install aggregate at sides and over top of pipe.

C. Backfilling and Compaction:

1. As specified in Section 312333 “Trenching and Backfilling”.
2. Do not displace or damage pipe while compacting.

D. Drainage Structures:

1. Catch basins and manholes: As specified in Section 330513 “Manholes and Structures.”

3.4 TOLERANCES

A. Section 014000 “Quality Requirements” for requirements for tolerances.

3.5 FIELD QUALITY CONTROL

A. Sections 017300 "Execution” and 017700 “Closeout Procedures”: Requirements for testing, adjusting, and balancing.

B. Request inspection by Engineer prior to and immediately after placing aggregate cover over pipe.

C. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.

D. Cleaning:

1. Clean all new pipe by flushing with water or other means to remove all debris that may have entered during the construction period.

3.6 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 334113

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SECTION 334437 – STORMWATER TREATMENT DEVICE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes Equipment and materials necessary to install the in-line stormwater treatment devices and appurtenances.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork.”
2. Section 312333 “Trenching and Backfilling.”
3. Section 334113 for “Public Storm Utility Drainage Piping” for connections to the stormwater treatment device.

1.3 DEFINITIONS

A. SWTD: Stormwater treatment device.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Include notarized certificate indicating compliance with ASTM C478/C478M.

1. Include plans, elevations, sections, and details indicating dimensions for the in-line SWTD for base sections and riser sections.
2. Include details of pipe connections to SWTD, indicating pipe diameters, and inverts.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificate: Provide certification letter indicating that the SWTD and castings meet H-20 load rating.

B. Design Data: In accordance with ASTM C478/C478M for precast structures.

C. Performance Certification: Provide certificate from the SWTD manufacturer certifying that the SWTD is capable of achieving the specified removal efficiencies listed in these specifications.

1. Include certification supported by independent third-party research for removal efficiencies.

D. Source quality control reports as indicated in Article “Source Quality Control.”

E. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and final orientation of treatment unit and accessories.

B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

C. Manufacturer’s product Operation and Maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer of the SWTD that is regularly engaged in the engineering design and production of systems deployed for the treatment of storm water runoff with at least five years and which have a history of successful production.

B. All SWTD components are subject to inspection by the Engineer at the place of manufacture and/or installation. All components are subject to being rejected or identified for repair if the quality of materials and manufacturing do not comply with the requirements of this specification.

1.8 DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be shipped with suitable in-transit protection and shall be outfitted with lifting lugs, cleats or other suitable means for unloading and erecting. Manholes or other fittings shall not be used for lifting equipment.

B. Finished surfaces, which may be damaged during erection, shall be protected by removable tape or suitable alternate.

C. After hydrostatic or other factory tests, all entrapped water shall be drained and care taken to prevent the entrance of water or dirt during shipment, storage and handling.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SWTD’s that fail(s) in materials or workmanship within specified warranty period. The manufacturer shall upon its determination repair, correct or replace any manufacturer originated defects advised in writing to the manufacturer within the referenced warranty period. The use of SWTD components shall be limited to the application for which it was specifically designed.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. "SciClone" by Bio Clean, Oceanside, CA.
2. "Cascade Separator" by Contech Engineered Solutions of West Chester, OH.
3. "Downstream Defender" by Hydro International, Portland, MA.

2.2 PERFORMANCE REQUIREMENTS

A. Provide SWTD sized to either achieve an 80 percent average annual reduction in the total suspended solid load or treat a flow rate. Both methods should be sized using the OK-110 particle distribution having particles ranging from 53 microns to 212 microns with a d50 of around 110 microns. Sizing requirements are as follows:

1. Provide SWTD to treat first 1 inch of runoff.
2. Minimum Treatment Capacity: 1.01 cubic foot per second.
3. Minimum Sediment Storage Capacity: 0.41 cubic yard.
4. Minimum Oil Storage Capacity: 59.0 gallons

B. Design the SWTD with a sump chamber for the storage of captured sediments and other negatively buoyant pollutants in between maintenance cycles. Provide the minimum storage capacity for the sump chamber in accordance with the volume listed in this Article. Limit the boundaries of the sump chamber to that which do not degrade the SWTD's treatment efficiency as captured pollutants accumulate. Provide the sump chamber separate from the treatment processing portion(s) of the SWTD to minimize the probability of fine particle re-suspension. In order to not restrict the Owner's ability to maintain the SWTD, provide a minimum dimension providing access from the ground surface to the sump chamber of 16 inches (405 mm) in diameter.

C. The SWTD shall convey the flow from the peak storm event of the drainage network, in accordance with required hydraulic upstream conditions as defined by the Engineer. If a substitute SWTD is proposed, submit supporting documentation that demonstrates equal or better upstream hydraulic conditions compared to that specified herein. This documentation shall be signed and sealed by a Professional Engineer registered in the Commonwealth of Massachusetts. Provide all costs associated with preparing and certifying this documentation.

D. The SWTD shall be designed to capture and retain Total Petroleum Hydrocarbons generated by wet-weather flow and dry-weather gross spills and have a capacity listed in this Article.

2.3 MATERIALS

A. SWTD Housing Unit: Constructed of precast or cast-in-place concrete.

1. Precast Concrete Components: Conform to applicable sections of ASTM C478/C478M, ASTM C857 and ASTM C858 and the following:

a. Concrete: Minimum 28-day compressive strength of 4000 psi (27.6 MPa).

b. Unless otherwise noted, design the precast concrete sections to withstand lateral earth and AASHTO H-20 traffic loads.
c. Cement: Type III Portland Cement conforming to ASTM C150/C150M.
d. Aggregates: Conform to ASTM C33/C33M.
e. Reinforcing Steel: Deformed billet-steel bars, welded steel wire or deformed welded steel wire conforming to ASTM A615/A615M or A1064/A1064M.
f. Joints: Sealed with preformed joint sealing compound conforming to ASTM C990.
g. Shipping of Components: Not initiated until a minimum compressive strength of 4000 psi (27.6 MPa) is attained or five calendar days after fabrication has expired, whichever occurs first.

B. Internal components and appurtenances: Conform to the following:

1. Hardware: ASTM A320/A320M, Type 316 stainless steel.
2. Support brackets: 5052 aluminum.
3. Fiberglass Components: ASTM D4097.
4. Polypropylene copolymer components: Conform to a tensile strength of 3,600 psi (ASTM D-638), and Izod impact value of "no break" (ASTM D-256).
5. Manhole Castings: Designed to withstand AASHTO H-20 loadings and manufactured of cast-iron conforming to ASTM A48/A48M; Class 30.

2.4 SOURCE QUALITY CONTROL

A. Provide a SWTD that has completed field testing following TARP Tier II protocol requirements.

2.5 BEDDING MATERIALS

A. Bedding: Fill Type as specified in Section 310515 "Soils and Aggregates for Earthwork.
B. Cover: Fill Type, as specified in Section 310515 "Soils and Aggregates for Earthwork."

1. Soil Backfill from Above Pipe to Finish Grade: Soil Type, as specified in Section 310515 "Soils and Aggregates for Earthwork."
2. Subsoil: No rocks over 6 inches in diameter, frozen earth, or foreign matter.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify layout and orientation of unit accessories and piping connections.

B. Verify that excavation base is ready to receive Work.

C. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. If many general requirement paragraphs are needed, create a "General Erection/Installation/Application Requirements" Article and insert these paragraphs there.

B. Exercise care in the storage and handling of the SWTD components prior to and during installation.

C. Construct the SWTD according to the sizes indicated on the Drawings and as specified herein. Install at elevations and locations indicated on the Drawings or as otherwise directed by the Engineer.

D. Install the SWTD in accordance with the manufacturer's recommendations and as shown. Provide manufacturer installation instructions and offer on-site guidance during the important stages of the installation as identified by the manufacturer at no additional expense. A minimum of 72 hours' notice shall be provided to the manufacturer prior to their performance of the services included under this subsection.

E. Place the precast base unit on a granular subbase of minimum thickness of six inches after compaction or of greater thickness and compaction unless specified elsewhere. Check the granular subbase for level prior to setting and check the precast base section of the trap for level at all four corners after it is set. If the slope from any corner to any other corner exceeds 0.5 percent, remove the base section and the granular subbase material and relevel.

F. Add joint sealant between all structure sections in conformance with ASTM C990 along the construction joint in the section that is already in place.

G. After setting the precast roof section of the stormwater treatment system, set precast concrete manhole riser sections, to the height required to bring the cast iron manhole covers to grade, so that the sections are vertical and in true alignment with a 1/4 inch (6 mm) maximum tolerance allowed. Backfill in a manner to bring the fill up in 6 inch (150 mm) on all sides and compacting the granular bedding to 95 percent Standard Procter Density per ASTM D698. If leaks appear, clean the inside joints and caulk with lead wool. Set precast sections in a manner that will result in a watertight joint. In all instances, installation of Stormwater Treatment Systems shall conform to ASTM C891.

H. Where holes must be cut in the precast sections to accommodate pipes, do all cutting before setting the sections in place to prevent any subsequent jarring which may loosen the mortar joints. Make all pipe connections.

I. Fill all holes made in the concrete sections for handling or other purposes provided by the manufacturer. Fill these voids with non-shrinking grout providing a finished surface consistent with adjacent surfaces. Trim all protruding lifting provisions flush with the adjacent concrete surface in a manner, which leaves no sharp points or edges.

J. Remove all loose material and pooling water from SWTD prior to the transfer of operational responsibility to the Owner.

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3.3 FIELD QUALITY CONTROL

A. Test SWTD sections according to ASTM C497.

B. Leakage Tests for SWTD

1. Engineer will visually inspect structure(s) for possible leaks before backfilling of the SWTD is allowed. All joints shall be sealed to the satisfaction of the Engineer.

3.4 CLEANING

A. Clean the SWTD to be free of silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION 334437

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SECTION 334623 – SUBSURFACE STORAGE SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes a precast concrete modular subsurface storage system for stormwater.

B. Related Requirements:

1. Section 310515 “Soils and Aggregates for Earthwork.”
2. Section 312000 "Earthwork."
3. Section 312333 “Trenching and Backfilling.”
4. Section 330513 “Manholes and Structures.”
5. Section 334113 for “Public Storm Utility Drainage Piping.”

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for subsurface storage systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For subsurface storage systems to include in maintenance manuals.

B. Record Documents:

1. Manufacturer’s shop drawings, including plans, elevations, sections, and details indicating layout, dimensions, foundation, cover, and joints.
2. Indicate size and location of roof openings and inlet and outlet pipe openings.
3. Indicate sealing of joints.

1.7 QUALITY ASSURANCE

A. Delegated Design Engineer: Licensed professional engineer experienced in design of specified Work and licensed in the Commonwealth of Massachusetts of Project location.

B. Fabricator Qualifications: Precast production facility certified by NPCA or PCI.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery of Accessories: Deliver to site in manufacturer’s original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage of Accessories:

1. Store in accordance with manufacturer’s instructions.
2. Store in clean, dry area, out of direct sunlight.

C. Handling: Protect materials during handling and installation to prevent damage.

1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace subsurface storage systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Oldcastle Infrastructure (Stormcapture), Rehoboth, MA.
2. Retain-It, Gorham, ME.
3. StormTrap, LLC, Romeoville, IL.

2.2 PERFORMANCE REQUIREMENTS

A. Precast Concrete Modular Stormwater Detention/Retention: Comply with ASTM C858.

B. Underground precast concrete stormwater management system: Size in accordance with the design requirements provided by the Engineer of Record (EOR) and approved by the reviewing agency. Storage volume provided under exit outlet shall be at least 620 cubic feet.

C. Design the system so that the modules are aligned and have channels that extend to the bottom of the modules allowing for relatively unrestricted fluid flow in both directions.

D. Minimum Structural Design Loading: ASTM C857.

1. Total Cover:

a. Minimum: As indicated on Drawings.
b. Maximum: As indicated on Drawings.

2. Concrete Chamber: AASHTO HS-20-44 wheel load.
3. Soil Strength: Minimum 3,000 psf soil being capacity

4. Determine vertical and lateral soil pressures using the following:

a. Groundwater: At or below invert of system for structural and buoyancy conditions.
b. Lateral soil pressures to be based on active earth pressure.

1) Lateral soil pressure = 35 pcf for 120 pcf backfill unit weight

c. Vertical soil pressures:

1) Live load = HS-20-44 and Dead load = 120 pcf cover fill unit weight

5. Use concrete density of 150 psi for structural buoyancy calculations. Soil above units can be considered in calculations, assuming soil density of 120 pcf. Do not use sidewall friction in calculation.

2.3 MATERIALS

A. All material shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

B. Stormwater Detention/Retention Modules: Provide engineered, precast concrete, modular stormwater detention.

1. Size: As indicated on the drawings.
2. Concrete: Manufacturer’s Approved Mix design providing a minimum compressive strength of 5,000 psi at 28 days.
3. Reinforcing Bars: ASTM A615/A615M, Grade 60.
4. Reinforcing Mesh: ASTM A1064/A1064M, Grade 80.
5. Cover for Reinforcing Bars: ACI 318.

2.4 AGGREGATE STONE FOUNDATION

A. Provide an aggregate stone foundation for the subsurface storage system.

B. Stone base foundation shall be properly installed and compacted in accordance with the manufacturer's drawings.

1. Minimum soil bearing capacity supporting (below) the aggregate foundation shall be 3000 psf as indicated on the Drawings and verified in the field by others.
2. Aggregate foundation shall extend a minimum of 24 inches past the outside of the system footprint as indicated on the drawings.
3. Properly compact and seat the aggregate foundation consisting of a minimum of:

a. Topping Course: 3 inches thick bed of 3/4 inch angular washed stone with no fines.
b. Base course is a 12 inch thick bed of 3 inch angular stone with no fines.

4. The above thicknesses are the minimum recommendations, and a qualified (project) geotechnical engineer shall be used to determine the exact requirements for the locations that the system is to be located.

C. Field conditions and subgrade bearing capacity requirements shall be verified in the field by others or by the project geotechnical engineer.

2.5 ACCESSORIES

A. Joint Wrap: 6 inch wide x 0.065 inch thick polyolefin backed exterior joint wrap with butyl rubber adhesive per ASTM C877, Type III.

1. Conseal CS-212 or approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Verify in field before installation, dimensions and soils conditions, including groundwater and soil bearing capacity.

3.2 INSTALLATION

A. Do not use stormwater detention modules that are damaged, as determined by manufacturer.

B. Field modifications to the modules is strictly prohibited without prior written consent of the manufacturer.

C. Install stormwater detention modules in accordance with manufacturer's instructions and ASTM C891.

D. Install modules plumb, on line, and to proper elevation.

E. Compact subgrades to a 95 percent density.

F. Place crushed stone base on 95 percent compacted level subgrade on top of nonwoven geotextile filter fabric in the bottom of the excavation.

G. Install modules with an average 1/4-inch gap or less, not to exceed a maximum of 1/2-inch gap. Top slab surfaces should be plumb and level with 1/2-inch maximum difference. If the space exceeds allowable limits, reset the modules with appropriate adjustment made to line and grade to bring the space into compliance.

H. Joint Wrap:

1. Seal exterior joints between adjacent modules with joint wrap on the outside top surfaces along all joints between units in accordance with ASTM C891.
2. Surfaces shall be clean and dry prior to placement.

I. Excavation and fill shall be as specified in Sections 312000 "Earthwork."

J. Fill:

1. Backfill material: select native material, structural fill or structural stone as indicated on the drawings.
2. Separate native materials from backfill materials with a nonwoven geotextile filter fabric unless the drawings indicate separation is not required.
3. Deposit fill on both sides of modules at same time and to approximate same elevation. Place fill in 9-inch lifts at 95 percent compaction. All fill should not contain any deleterious materials or stones larger than 3 inches in diameter within 6 inches of system top.
4. Do not disrupt or damage joint wrap during backfilling.

K.

K. Installation of Concrete Splash Pad:

1. Precast concrete (or cast in place) inlet splash pads shall be installed to the specified grade and locations per plan.

L. Installation of Pipes/Risers:

1. Clean and lightly lubricate all of pipe to be inserted into the stormwater detention module.
2. If pipe is cut, care should be taken to allow no sharp edges, bevel and lubricate lead end of pipe.
3. Hole shall be clean and smooth and free of loose or foreign material.
4. Align center of pipe to correct elevation and insert into opening.
5. For infiltration systems use a non-shrink grout for pipe connection.

6. For internal piping configurations, use a rubber boot system or non-shrink grout for pipe connections.
7. Internal flow control structure shall be installed per plan specifications.

M. Installation of Access Opening:

1. Install all manhole access structures as shown on the Drawings.
2. Use precast adjusting rings as needed to meet grade. For cover over 24 inches, use precast barrel or cone sections.

END OF SECTION 334623

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SECTION 400593.23 – LOW-VOLTAGE MOTOR REQUIREMENTS FOR PROCESS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Single- and three-phase motors for application on process equipment provided under other Sections.

B. The manufacturer of the driven equipment shall provide the associated motor.

C. Related Requirements:

1. Section 260526, “Grounding and Bonding for Electrical Systems”.
2. Section 260553, “Identification for Electrical Systems”.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

B. VFC: Variable-frequency motor controller. See VFD.

C. VFD: Variable-frequency drive. Used interchangeably with the term VFC.

1.4 SUBMITTALS

A. Product Data: For each type and rating of motor indicated.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include nameplate data, compliance with specified standards, electrical ratings and characteristics, physical dimensions, frame size, weights, mechanical performance data, support points and the following:

a. Descriptive bulletins, including full description of insulation system.
b. Bearing design data.
c. Efficiency at 1/2, 3/4 and full load.
d. Power factor at 1/2, 3/4 and full load.
e. Conduit entry points and sizes.

f. Special features and accessories (i.e. space heaters, temperature detectors, etc.).
g. Power factor correction capacitor rating and type (when required).

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Qualifications Statements:

1. Submit qualifications for manufacturer and testing agency.

1.5 QUALITY ASSURANCE

A. Electric motors driving identical equipment shall be identical

B. Motors shall be listed under UL recognized component file as applicable.

C. Motor manufacturer to maintain a documented ISO 9001 quality assurance program implementing suitable procedures and controls to monitor all aspects of production and testing.

D. When electrically driven equipment differs from that indicated, adjust the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed.

E. Testing Agency Qualifications: Member company of NETA.

1.6 DELIVERY, STORAGE AND HANDLING

A. Ship motor fully assembled, capable of being lifted in one piece. Comply with Section 016000, "Product Requirements" for transporting, handling, storing, and protecting products.

B. Inspection: Accept materials on site in manufacturer's original packaging and inspect for damage.

C. Storage:

1. Store materials according to manufacturer instructions.
2. Energize motors furnished with space heaters to prevent condensation throughout the storage and construction period. Perform periodic motor insulation resistance tests per manufacturer’s storage recommendations.
3. For extended outdoor storage, remove motors from equipment and store separately.
4. Maintain bearings during storage and construction period, and periodically rotate the motor shaft per manufacturer’s storage recommendations.
5. Lubricate per manufacturer’s recommendations and inspect purged grease for water, rust, or other contaminants.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Provide additional protection according to manufacturer instructions.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of motors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One-year(s) from date of Substantial Completion for inverter duty motors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:

1. Nidec (US Motors)
2. ABB (Baldor-Reliance)
3. TECO-Westinghouse
4. Toshiba
5. WEG
6. General Electric
7. Or equal

2.2 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with the latest revision of the following as applicable:

1. NEMA MG 1, “Motors and Generators”.
2. IEEE 841 for TEFC motors where driven equipment specification indicates equipment requires motors to be severe-duty, chemical duty, or mill duty.

C. Unless otherwise noted, all motors ½ through 100 horsepower shall be rated 230/460 Volt, three-phase, 60 Hertz A.C.; motors 125 horsepower and above shall be rated 460 Volt, three-phase, 60 Hertz; and motors below ½ horsepower shall be rated 115/230 Volt, single phase, 60 Hertz A.C.

D. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

E. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

F. Horsepower rating: Size for operation within the full load nameplate rating without applying the service factor, throughout the full range of mechanical or hydraulic operating condition.

G. Specific motor application data such as Hp, rpm, enclosure type, accessories, etc., are specified under the detailed driven mechanical equipment specification.

H. Nameplates: Engrave or emboss on Type 316 stainless steel fastened to the motor frame with stainless steel screws or drive pins with information per NEMA MG 1.

I. Space heater: Include 120-volt space heater for moisture control on all motors rated 50 horsepower and larger.

J. Service Factor: 1.15 service factor on sine wave power and 1.0 service factor on VFD power in a 40 degrees C ambient, unless otherwise noted.

K. Motors and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

L. Enclosures: Conform to one of the NEMA standard enclosure designs as specified under the detailed driven mechanical equipment specification. If no enclosure type is specified, provide TEFC (Totally Enclosed Fan Cooled) enclosures.

M. Motors connected to VFCs: Inverter duty rated and comply with NEMA MG 1, Part 31. First or second torsional critical speed shall be outside the operating speed range for all VFC controlled motors.

N. Three-phase motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Efficiency: Meet or exceed requirements for NEMA MG 1, Part 12 for Premium Efficient motors 1 HP and larger.
3. Service Factor: 1.15.
4. Multispeed Motors: Variable torque.
    a. For motors with 2:1 speed ratio, consequent pole, single winding.
    b. For motors with other than 2:1 speed ratio, separate winding for each speed.
5. Rotor: Random-wound, squirrel cage.
6. Code Letter Designation:
    a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
    b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
7. Accessories: Where specified herein, or under process mechanical specification.

2.3 THREE PHASE MOTOR CONSTRUCTION

A. Enclosure and Frame:

1. NEMA enclosure type as specified in the process equipment specification.
2. NEMA frame for the associated horsepower.
3. Motor frames: Cast iron or welded heavy plate steel construction, stiff enough to withstand the rotating forces and torques generated and designed to limit or avoid any undesirable harmonic resonances.

4. Provide a threaded, forged steel, shouldered eyebolt blind tapped into the motor frame for lifting on all frames 254T and larger.
5. Condensate drain openings: Locate drain holes at the low points in the end brackets to allow removal of accumulated moisture from enclosures. Provide corrosion resistant, breather drain plugs for severe-duty motors.
6. Hardware: Hex head, SAE Grade 5 or better, plated for corrosion protection.
7. Nameplates: Engraved or embossed stainless steel plates fastened to the motor frame with stainless steel screws or drive pins. Clearly indicate all items of information listed in the applicable part of NEMA MG 1.
8. Main terminal box: Fabricated steel or cast iron, sized per the NEC for number and size of conduit connections and conductor bending and terminations as indicated on the Drawings. Split box top to bottom with capability to rotate entry point to any quadrant. Provide gaskets between the box and motor frame and between box and its cover. Include ground lug for equipment grounding conductor termination.
9. Bearing housings: Provide machined surfaces for attaching a magnet mounted accelerometer to monitor the motor vibration in the vertical, horizontal, and axial directions at each bearing housing.
10. Frame grounding: provide motor frame grounding pad or threaded stud where supplemental grounding to frame is indicated on the drawings.
11. Corrosion resistant mill and chemical duty paint.

B. Windings:

1. Copper
2. Insulation rating: Class F.
3. Temperature rise: Class B at 1.0 SF, Class F at 1.15 SF.
4. Insulation: Non-hygroscopic, epoxy encapsulated windings for enclosure types WP I and WP II. Provide upgraded insulation by additional dips and bakes to increase moisture resistance for totally enclosed designs. Provide vacuum pressure impregnated (VPI) epoxy insulation for moisture resistance for outdoor motors.
5. Provide chemical and humidity resistance insulation system when IEEE 841 motors are specified.
6. Provide winding surge withstand capability per NEMA 1, Part 31 for VFC driven motors.
7. Provide specified temperature sensing devices for VFC driven equipment. If not specified, provide a winding temperature detector per the accessories paragraph.

C. Motor leads: Non-wicking type, minimum Class F temperature rating and permanently numbered for identification.

D. Stator: Built up core using high grade, low loss silicon steel laminations keyed or dovetailed to the stator frame and securely held in place at each end.

E. Rotor:

1. Forged or rolled steel shaft, machined, smooth finished, with sufficient strength for operation including 25 percent overspeed condition.
2. Shaft end coordinated with driven equipment coupling.
3. Entire assembly coated with protective coating.
4. Inpro seals on both ends of the shaft to prevent grease leakage and entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest. Severe duty motors to have improved sealing per IEEE 841.

5. Vertical Motor Shafts:

    a. Provide hollow shaft and P flange mounting to allow driven shaft to extend through provide for vertical pump applications.
    b. Coupling for connecting the motor shaft to the driven shaft is located in the top of the motor.
    c. Where solid shaft is provided couple the driven shaft below the P flange face.

6. Rotor Core:

    a. Solid, built-up stack of fully processed and coated, high-grade, low-loss silicon steel laminations.
    b. Die cast aluminum or fabricated copper bars or their respective alloys.
    c. Rotors on frames 213T and above to be keyed to shaft and rotating assembly dynamically balanced.

7. Rotor Assembly:

    a. Coated with corrosion resistant epoxy insulating varnish or other protective coating, thermally stable, statically and dynamically balanced.
    b. Balance weights securely attached to the rotor resistance ring by welding or similar permanent method.

F. Horizontal Bearings: roller type, grease lubricated.

1. Bearings: Anti-friction open or single-shield, vacuum-degassed steel ball or roller bearings, electric motor quality, designed for 45 degrees C maximum temperature rise. Metric size bearings are not acceptable.
2. Life: L 10 life of 100,000 hours for direct coupled applications and 26,000 hours for belted applications based. IEEE 841 motors, L 10 life increased to 150,000 and 50,000 hours respectively.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

G. Vertical Bearings: per manufacturer, thrust type.

1. Bearings: Manufacturer's standard design, constructed with thrust bearings on top to allow inspection and/or replacement without requiring complete disassembly of motor, of type and size to satisfy thrust loading requirements.
2. Life: Rated for an in-service L 10 life of 100,000 hours, designed to support the weight of the rotor plus, if required, the weight of the rotating driven equipment parts and the hydraulic thrust created by the driven equipment, with a 40 degrees C maximum temperature rise. Metric bearings are not acceptable.
3. Shaft seals: Provide to prevent grease leakage and the entrance of foreign materials, such as water and dirt, into the bearing area while running, coasting, or at rest.
4. Shaft currents: Provide mitigation per process equipment specification.
5. Comply with ABMA and refer to process equipment specification for stricter or additional requirements.

2.4 THREE PHASE MOTOR ACCESSORIES

A. Space heaters: Silicone rubber strip type, accessible for inspection, rated 120 Volt, single phase, designed to prevent condensation inside the enclosure when the motor is idle, with leads brought out to a separate terminal box. Emboss the heater wattage and voltage on the motor nameplate.

B. Winding temperature switch: Three embedded bi-metallic temperature thermostat switches with normally open or normally closed per process equipment specification and leads terminating in the main conduit box.

C. Winding temperature relay: Three embedded PTC thermistors with epoxy-encapsulated 115 VAC, single phase, solid state control relay with dual Form C contacts. Wire thermistor leads brought out to separate terminal box on the motor frame.

D. Winding temperature RTDs: Six 100 Ohm platinum (PT 100), three-wire resistance-type temperature detectors (RTDs) embedded in the stator windings, two per phase, symmetrically installed between stator coils where highest temperature will occur. RTD leads brought out to separate terminal box on the motor frame. One RTD set in each phase to be operational and one RTD set to be spare.

E. Bearing temperature sensing: Number, type, and location for motor and driven equipment per process equipment specification.

1. RTD: Replaceable 100 Ohm platinum (PT 100) three-wire RTD's, with spring loaded tip. Mount RTD as close as possible to outer surface of each bearing. RTD includes conduit connection head, terminal block, and cabling brought out to a common terminal box.
2. Dial type thermometer.
3. Temperature relay, furnished with indicating scale.
4. Iron or copper constantan thermocouple.

F. Motor shaft currents: insulate the ODE bearing and provide a shaft grounding strap. Insulate bearing probes to prevent shorting out bearing insulation.

G. Shaft grounding rings: maintenance free, circumferential micro fiber type, AEGIS™ SGR by electro Static Technology or equal to discharge shaft currents to ground.

H. Vibration Sensors: Number, type, and location for motor and driven equipment per process equipment specification. Provide machined surfaces at each bearing housing for attaching a magnetic mounted accelerometer in order to monitor motor vibration in vertical, horizontal and axial directions. Coordinate with the supplier of the machine monitoring equipment.

I. Anti-Backspin Device: Provide shaft mounted, mechanical non-reverse ratchet rated at 100 percent of motor full load torque for immediate protection against reversing due to phase reversals or from backspin at shutdown.

J. Encoder for vector drive motors: Provide encoder on opposite drive end to sense rotor speed and provide closed loop feedback (quadrature signal with line driver output) to a control device. Provide sufficient length of encoder cable to connect encoder to variable frequency controller.

2.5 POWER FACTOR CORRECTION CAPACITORS

A. Select the PFCC rating to provide an operating power factor of the motor between 93 to 95 percent at full load and 95 to 98 percent when partially loaded. The capacitor current shall not exceed the motor no-load magnetizing current.

B. Provide the required capacitor and capacitor information to the motor control center (MCC) manufacturer for inclusion inside the MCC.

C. Capacitors: UL listed, NEMA rated and tested, three phase dry film or non-PCB dielectric liquid insulated, with three current limiting fuses rated for 100 kA interrupting capacity at 480 Volts, equipped with internal discharge resistors and fuse loss indicators, mounted in hermetically sealed steel enclosures suitable for conduit connection. Covers shall be gasketed, bolt-on type.

2.6 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Motors 1/20 HP and Smaller: Shaded-pole type.

D. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

E. Insulation: Class F or better, with Class B temperature rise of 80 degrees C above ambient, 1.15 service factor. Locked rotor current to be no greater than specified in NEMA MG 1, Design "N".

F. Standard enclosure: Fully gasketed, totally-enclosed air over or fan cooled in conformance with NEMA MG 1.

G. Washdown duty enclosure: Where motor is installed in wet or corrosive areas routinely exposed to washdowns, high humidity or caustic chemicals, provide stainless steel, paint free washdown motors with Inpro bearing isolators, stainless steel T-type condensation drains, nitrile conduit box gasket, and corrosion resistant fans.

H. Bearings: Sealed ball bearings permanently lubricated for 10 years normal use, furnished with shaft slinger.

I. Class 1, Division 1 and 2 locations: Explosion proof, marked with a T3B temperature code label, and UL listed for use in Class 1, Division 1, Groups C & D, and Class II, Groups E, F, & G hazardous location. The temperature code marking to appear on the nameplate.

2.7 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.

B. Factory Testing: Prior to shipment perform manufacturer’s standard tests in accordance with NEMA MG 1 and IEEE 112.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Upon delivery of motor and prior to unloading, inspect equipment for damage.

B. Comply with DELIVERY, STORAGE, AND HANDLING article within this specification.

3.2 INSTALLATION

A. Prepare rigid foundation or mounting surface to minimize vibration and maintain alignment between motor and load shaft.

B. Install the motors per manufacturer's installation instructions.

C. Anchor motor base to load bearing surface with grade 5 steel bolts or better.

D. Align the motor shaft with driven equipment according to manufacturer’s written instructions. Adjust axial position of motor frame with respect to load shaft.

E. Accurately adjust flexible couplings for direct drive according to machine manufacturer’s guidelines. Check alignment to minimize vibrations. Coupling spacing shall be according to coupling manufacturer guidelines.

F. Install motor branch circuit conduits and conductors in accordance with NEC and local code requirements. Connect motors to rigid conduit system by a short section of liquid-tight flexible conduit to isolate the conduit system from motor vibration. Where motors are installed outdoors, bring conduit into bottom of motor terminal box to avoid standing water at connection point.

G. Terminate the motor leads as shown on the connection diagrams using products intended for vibration applications.

H. Ground equipment according to Section 260526 “Grounding and Bonding for Electrical Systems.”

I. Tighten electrical connections and terminals according to manufacturers' published torque values.

J. Install conduit and wiring between motor auxiliary devices and associated indicators, controllers and protective devices in accordance to installation drawings.

K. Connect devices sensitive to electromagnetic interferes such as RTD's, thermistors, thermal protector switches, vibration sensors with shielded instrumentation wiring per installation drawings.

L. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553, "Identification for Electrical Systems." Identify field-installed conductors, interconnecting wiring, and components.

3.4 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until motors are ready to be energized and placed into service.

B. Lubrication and Shaft Rotation: Lubricate parts and rotate shaft periodically according to manufacturer’s written instructions until motors are ready to be energized and placed into service.

3.5 FIELD QUALITY CONTROL

A. Perform inspections and tests Inspect and test according to the Inspection and Test Procedures for Rotating Machinery state in NETA Acceptance Testing Specification paragraph 7.15.1. Options tests are not required unless called for within the process equipment specification.

B. Perform the following infrared (thermographic) scan tests and inspections, for all motors 20 hp and larger, and prepare reports:

1. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each motor exterior for detection of hot spots in stator or bearings.
2. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each motor 11 months after date of Substantial Completion.
3. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

C. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Motors will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies the motor and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP AND ADJUSTMENT

A. Complete installation and startup checks according to manufacturer's written instructions. Confirm motor is structurally, mechanically, and electrically ready for start-up. Checks include support system, vibration isolation, alignment, lubrication system, and cleanliness.

B. Start-up motor in accordance with process equipment specification.

C. Verify correct phase rotation at motor with driven equipment uncoupled. Correction for phase rotation to be made in the motor terminal box.

D. Prepare inspection and test reports.

3.7 DEMONSTRATION / SYSTEM FUNCTION TESTS

A. Run motor for system testing as required in motor controller and driven equipment specifications.

B. Confirm correct operation of all protective and metering devices.

C. Measure voltage and motor running current and evaluate relative to load conditions and nameplate full load amperes. Corrective action is required for any current imbalance 10 percent or greater.

D. Prepare driven equipment system testing report. Include results of all tests and check made, meter readings and recordings, and summary adjustments made. Clearly identify any discrepancies and concerns.

END OF SECTION 400593.23

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SECTION 406100 - PROCESS CONTROL AND ENTERPRISE MANAGEMENT SYSTEMS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes procurement of the services of a Process Control System Supplier (PCSS) to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.

B. Section includes procurement of the services of an Application Engineer System Supplier (AESS) to provide all materials, equipment, labor, programming, software, and services required to achieve a fully integrated and operational system as specified herein, in "Related Requirements" under this Article, and in related drawings, except for those services and materials specifically noted.

C. The Radio Telemetry System Supplier (RTSS) for this project shall provide all materials, equipment, labor, and services required to achieve a fully integrated and operational LFR system as specified in specification 406650 "Radio Telemetry Equipment." The RTSS shall be sole sourced, see specification 406650 "Radio Telemetry Equipment" for LFR contractor and equipment details.

D. Applications Engineering System Supplier (AESS) programming services will be performed by Contractor.

1. Coordination with the AESS during construction is required to successfully integrate PCSS provided equipment with control system programming by the AESS. Reserve the appropriate time for coordinating with AESS in the PCSS project schedule as specified throughout Division 40.

E. Items specifically excluded from the PCSS scope include the following:

1. Licensed frequency radio path study. Path study has already been completed under a separate contract.

F. Include auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, whether indicated on the Drawings or not.

G. All equipment and installations to satisfy applicable Federal, State, and local codes. Refer to Electrical drawings for area classifications for Class and /Division ratings.

H. Use the equipment, instrument, and loop numbering scheme indicated on the Drawings and in the specifications in the development of the submittals. Do not deviate from or modify the numbering scheme.

I. Related Requirements:

1. Section 406121.20 “Process Control System Testing” for testing requirements, submittal requirements, and coordination requirements between PCSS, AESS, Contractor, VFD Manufacturer, Owner, vendor system manufacturers, and instrument manufacturers.
2. Section 406126 “Process Control System Training” for training requirements and coordination requirements between PCSS, AESS, Contractor, VFD Manufacturer, Owner, vendor system manufacturers, and instrument manufacturers.
3. Section 406196 “Process Control Descriptions.”
4. Section 406263 “Operator Interface Terminals.”
5. Section 406343 “Programmable Logic Controllers.”
6. Section 4066XX “Sections for Network and Communication Equipment.”
7. Section 4067XX “Sections for Control System Equipment Panels and Racks.”
8. Section 4068XX “Sections for Process Control Software.”
9. Section 406863 “Configuration of HMI Software.”
10. Section 406866 “Configuration of Controller Software.”
11. Section 407000 “Instrumentation for Process Systems.”
12. Section 4071XX “Sections for flow measurement.”
13. Section 4072XX “Sections for level measurement.”
14. Section 4073XX “Sections for pressure, strain, and force measurement.”
15. Section 4074XX “Sections for temperature measurement.”
16. Section 4076XX “Sections for gas analytical measurement.”
17. Section 4078XX “Sections for miscellaneous equipment.”

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Maintenance of Plant Operations (MOPO): A construction plan which prevents or limits process disruptions during construction.

D. Leadership in Energy and Environmental Design (LEED): A green building certification indicating that a building was designed and constructed to be environmentally responsible and use resources efficiently.

E. Radio Telemetry System Supplier (RTSS): The entity who provides all radio system equipment hardware, software, programming, configuration, and related services for the radio system.

F. Section 4066XX “Sections for Network and Communication Equipment”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 PREINSTALLATION MEETINGS

A. Conduct a project kickoff coordination meeting within two weeks after submitting the Project Plan. The purpose of the meeting is to discuss the PCSS's Project Plan, to summarize the PCSS's understanding of the project, discuss any proposed substitutions or alternatives, schedule testing and delivery deadline dates, provide a forum to coordinate hardware and software related issues, and request any additional information required from the Owner, AESS, or other parties involved in the project. The meeting will last up to 4 hours.

B. Conduct a submittal review coordination meeting after the Hardware, Panel Drawing, and Loop Drawing Submittal package has been reviewed by the Engineer and returned to the PCSS. The purpose of this meeting is to review comments made on the submittal package; to refine scheduled deadline dates; coordinate equipment installation activities; and provide a forum for any further required coordination between the PCSS, AESS, or other parties involved in the project. The meeting will last up to 4 hours.

C. Weekly or Bi-Weekly on-site or conference call coordination meetings with Engineer, Contractor, Vendors, and AESS as required prior to any field start-up or activity testing begins. Frequency of meetings shall be dictated by the Project Schedule.

D. Schedule the mandatory coordination meetings as described herein. Hold the meetings at the Owner's designated location and include attendance by the Owner, the Engineer, the Contractor, the PCSS's Project Engineer, and the AESS Project Engineer, if applicable. Other Division 40 specifications may require additional meetings. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Schedule the meeting for a minimum of one week before the requested meeting date.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, mountings, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of control equipment, control panels, and instrumentation as specified herein.
4. Include diagrams for power, signal, and control wiring.

C. Qualifications Submittal:

1. For non-listed PCSS', submit, within 30 calendar days after Notice to Proceed, detailed information on staff and organization to indicate compliance with the Quality Assurance requirements of this Section. The Qualifications submittal is required to be submitted and approved before any further submittals will be accepted. Failure to meet the minimum requirements is grounds for rejection as a PCSS. The Qualifications Submittal to contain the following:

    a. Copies of ISA CCST Level 1 certificates for all field technicians or resumes demonstrating field experience.
    b. Notarized statement from the firm's financial institution demonstrating ability for the firm to meet the obligations necessary for the performance of the work.
    c. Copy of UL-508 certificate for panel fabrication facilities.
    d. Project references for water or wastewater projects as defined in the "Quality Assurance" paragraphs.
    e. Documentation to demonstrate the ability to complete this project including resumes of key staff, financial capacities, details on engineering, design, fabrication, and field service capacity, and location of staff responsible for responding to the site within four hours to resolve startup issues.

D. Project Plan, Deviation List, and Schedule Submittal:

1. Submit, within 45 calendar days after Notice to Proceed, a Project plan. Submit for approval the Project Plan before further submittals are accepted. The Project Plan to contain the following:

    a. Overview of the proposed control system describing the understanding of the project work, a preliminary system architecture drawing, interfaces to other systems, schedule, startup, and coordination. Include a general discussion of startup, approach to testing and training, and other tasks as required by these specifications.
    b. Preliminary list of PLC, OIT, and communication system hardware, including version numbers, solely to determine compliance with the requirements of the Contract Documents prior to beginning development of system programming. The review and approval of software and hardware systems as part of this Project Plan stage does not relieve the PCSS of meeting all the functional and performance requirements of the system as specified herein. Substitution of manufacturer or model of these systems after the submittal is approved is not allowed without Engineer's approval.
    c. Project personnel and organization including the PCSS project manager, project engineer, and lead project technicians. Include resumes of each of these individuals and specify in writing their commitment to this project. These do not need to be submitted again if already submitted in the Qualification submittal.
    d. Sample formats of the shop drawings to be submitted and in conformance with the requirements of the Specifications. At a minimum include samples of panel fabrication drawings, control system architecture and I/O wiring diagrams.

2. Define Exceptions to the Specifications or Drawings in a Deviation List consisting of a paragraph-by-paragraph review of the Specifications indicating acceptance or any proposed deviations, the reason for exception, the exact nature of the exception and the

proposed substitution so that an evaluation may be made by the Engineer. Specifically state if no exceptions are taken to the specifications or drawings. If there is no statement by the PCSS, then it is acknowledged that no exceptions are taken.

3. The PCSS must coordinate their work with the General Contractor's overall schedule. PCSS schedule incorporates all PCSS milestones including but not limited to the following:

    a. Schedule for all subsequent project submittals. Include the time required for Contractor's submittal preparation, Engineer's review time, and a minimum of two complete review cycles.
    b. Proposed dates for all project coordination meetings.
    c. Hardware purchasing, fabrication, and assembly (following approval of related submittals).
    d. Software purchasing and configuration (following approval of related submittals).
    e. Shipment of instrument and control system equipment.
    f. Installation of instrument and control system equipment.
    g. Testing: Schedule for all testing.
    h. Schedule for system cutover, startup, and/or going on-line for each major system. At a minimum include the schedule for each process controller and HMI server/workstation provided under this Contract.
    i. Schedule for all training including submittal and approval of O&M manuals, factory training, and site training.
    j. Listing of all major graphics and PLC programs intended to be created or modified for this project. Indicate if graphic or program is new or existing.
    k. Arrange project schedule to accommodate requirements of AESS to develop, test, troubleshoot, and train Owner on PLC and OIT systems. Timing of these coordination efforts to be determined by PCSS; however, include all necessary costs to accommodate the following minimum time slots in their overall project schedule. Exclude on all time allotments any legal holidays, or days lost due to delays caused by Contractor or PCSS.

        1) Deliver detailed I/O listing to the AESS as specified herein.
        2) Deliver early development system to the AESS: 90 calendar days after Contract Award or as early as possible based on approval of submittals.
        3) Completion of AESS's Application Software Test at PCSS's facility: Twenty-one calendar days after successful completion and acceptance by Engineer of PCSS's Unwitnessed Factory Test and Witnessed Factory Tests.
        4) Completion of AESS's Application Software Operational Readiness Tests: Twenty-one calendar days after successful completion and acceptance by the Engineer of PCSS's operational readiness testing.
        5) Completion of AESS's Functional Acceptance Tests: Twenty-one calendar days after successful completion and acceptance by the Engineer of PCSS's functional acceptance testing.
        6) Completion of Training on PLC and OIT equipment: Twenty-one calendar days after successful completion and acceptance by the Engineer of PCSS's training.

4. Component and Wiring Identification and Tagging Plan:

a. All components provided by PCSS require a tag, label, or nameplate. Review specifications and provide a table indicating the tagging and labeling scheme used by the PCSS:

1) Instruments.
2) Panel Hardware.
3) Standalone hardware or communication equipment.
4) Wires and communication cables.
5) Junction boxes.

b. Provide detailed information so Engineer can review the following characteristics for each type of tag, label, or nameplate for the different types of components provided above:

1) Size or range of size of the tag, label or nameplate.
2) Font style.
3) Material.
4) Color(s).

E. Input/Output (I/O) List Submittal:

1. Submit, within 45 days after Notice to Proceed, a complete system Input/Output (I/O) address list for equipment connected to the control system under this Contract.
2. Base the I/O list on the P&ID's, the Drawings, the design I/O list (if included), and requirements in the Specifications.
3. Submit the I/O list in both a Microsoft Excel readable electronic file format and an 8-1/2 inch by 11-inch hard copy.
4. Reflect all active and spare I/O points on the I/O list. Add points to accommodate spare I/O’s as required in the specifications.
5. Arrange the I/O list so that each control panel has a dedicated worksheet, which includes the following information:

a. TAG NUMBER(S): As indicated on the Drawings, the identifier assigned to a device that performs a function in the control system. As part of this information, break out the tag loop number to allow for sorting by loop.
b. DESCRIPTION: A description of the function of the device (text that includes signal source, control function, etc.) Include the text "Spare Points" for all I/O module points that are not connected to equipment.
c. PHYSICAL LOCATION: The Control Panel designation of where the I/O point is wired to.
d. PHYSICAL POINT ADDRESS: Rack, Slot, and Point (or Channel) assignment for each I/O point.
e. I/O TYPE: use DO - Discrete Output, DI - Discrete Input, AO - Analog Output, AI - Analog Input, PI - Pulse Input, or PO - Pulse Output.
f. RANGE/STATE: The range in engineering units corresponding to an analog 4-20 mA signal, or, the state at which the value of the discrete points is "1."
g. ENGINEERING UNITS: The engineering units associated with the Analog I/O.
h. ALARM LIMITS: Include alarm limits based on the control descriptions and the Drawings.

i. P&ID - the P&ID or drawing where the I/O point appears on. Mark as "NA" (Not Applicable) if the I/O point is derived from a specification requirement and is not on the P&IDs.
j. INTERFACE: use Networked – Ethernet I/O, or Hardwired – electrical signal.The following 2 items are good to include if you are migrating existing signals over to a new control system and you do not have confidence in the condition of the existing signals or you just want PCSS to pay a little more attention to these signals. Adding this information and testing will set a baseline for the project so no finger pointing later on between Contractor, Owner, Engineer and PCSS if a signal thought to be functional prior to transitioning over to new control system really never was.

6. Sort the I/O list in order by:

a. Physical location.
b. I/O Type.
c. Loop Number.
d. Device Tag.

7. Once the I/O list is approved, the PLC I/O addresses are not to be modified without approval by the Engineer.
8. For I/O layout requirements, refer to Section 406343 “Programmable Logic Controllers.”

F. Field Instruments Submittal:

1. Refer to the Instruments section for submittal requirements.

G. Hardware Packages Submittal:

1. Refer to the sections below for equipment required as part of the Hardware and Software Packages submittal:

a. Section 406263 “Operator Interface Terminals.”
b. Section 406343 “Programmable Logic Controllers.”
c. Section 4066XX “Network and Communication Equipment.”
d. Section 4067XX “Control System Equipment Panels and Racks.”
e. Section 4068XX “Process Control Software.”
f. Section 406863 “Configuration of HMI Software.”
g. Section 406866 “Configuration of Controller Software.”
h. Section 407000 “Instrumentation for Process Systems.”
i. Section 4071XX “Flow Measurement.”
j. Section 4072XX “Level Measurement.”
k. Section 4073XX “Pressure, Strain, and Force Measurement.”
l. Section 4074XX “Temperature Measurement.”
m. Section 4076XX “Gas Analytical Measurement.”
n. Section 4078XX “Miscellaneous Equipment

2. For each hardware and software packages component specified in the sections above, submit a cover page that lists date, specification number, product name, manufacturer, model number, location(s), and power required. Preferred format for the cover page is

ISA-TR20.00.01-2001 (updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.

3. Complete system architecture drawing(s) showing in schematic form the interconnections between major hardware components including, control panels, computers, networking equipment, control panels with PLC systems and I/O modules, local operator interfaces, process equipment vendor panels (including VFDs) with PLCs, and networked peripherals such as power monitors, security cameras, etc.
4. Develop the system architecture drawing(s) in accordance with the following information and guidelines:

    a. Show power connections to each piece of equipment or grouping of equipment with voltage and power sources noted such as 120VAC UPS battery, 24VDC battery, or 120VAC from LP (lighting panel). Indicate specific UPS number or circuit number whenever possible.
    b. All communication cable types should be uniquely identified with a specific linetype and cable characteristics clearly indicated in a key or legend located on drawing(s). For example, 50/125-micron multimode mode fiber, or CAT6 Ethernet copper cabling. Any multiconductor communication cables will be clearly labeled above each individual communication with a note added to drawing that states if no quantity exists above a linetype, there is only one communication cable between devices. If a multi-conductor cable has multiple colors, legend to clearly indicate which colors are used for which networks (i.e., a multi-pair fiber optic cable used for dedicated networks such as SCADA, Electrical, Security, HVAC, etc.)
    c. All communication cables need to be assigned a unique cable identification label and shown in either a table or above the communication line.
    d. Identify network protocols for each communication path or for system indicated in a key or legend as appropriate. Examples are Allen-Bradley EtherNet/IP, Modbus TCP/IP, or DNP3.
    e. Indicate which port or connection number the communication cable is terminating at any device that has multiple ports or connection points. For multiple devices, this could be shown once in a key or legend and noted on architecture as appropriate.
    f. For each PLC control panel or network communication enclosure provided by PCSS, the architecture drawing clearly references other drawings provided by the PCSS for detailed panel wiring diagrams with a note near that PLC panel or communication enclosure indicating referenced drawing numbers. A placeholder is acceptable at the time of submission if these drawings are to be submitted at a later date.
    g. Use symbology and/or icons whenever possible to represent a device and differentiate between devices that are different form factors (i.e. tower computer vs. desktop computer vs. rack mounted). Vendor CAD libraries are preferred for symbols.
    h. Develop a diagram that will allow a qualified technician to interconnect all equipment without having to refer to additional manuals or literature.
    i. Use a minimum sheet size of 11"x17" and use of more than one sheet is acceptable with a logical breakout between sheets (i.e., head end on one sheet and plant control system on another). Clearly identify line continuations between drawings.

H. Panel Layout Drawings and Wiring Diagrams Submittal:

1. Panel Layout Drawings: Submit Drawings for all panels specified. Draw to scale panel assembly and elevation drawings and detail all equipment in or on the panel. Use 11"x17" sheet size for panel drawings and include the following:

    a. Clearly indicate a legend sheet with all symbols used on drawings and with voltage, color and size of each wire and in accordance with requirements of Section 406733 “Panel Wiring.”
    b. Interior and exterior panel elevation drawings to scale.
    c. Nameplate schedule.
    d. Conduit access locations.
    e. Panel construction details.
    f. Cabinet assembly and layout drawings to scale. Include a bill of material on the assembly drawing with each panel component clearly defined. Cross-reference the bill of material to the assembly drawing so that a non-technical person can readily identify all components of the assembly by manufacturer and model number.
    g. Fabrication and painting specifications including color (or color samples).
    h. Construction details, NEMA ratings, intrinsically safe barrier information, gas sealing recommendations, purging system details, etc. for panels located in hazardous locations or interfacing to equipment located in hazardous areas.
    i. For every control panel, heating and cooling calculations for each panel supplied indicating conformance with cooling requirements of the supplied equipment and environmental conditions. Include on calculations the recommended type of equipment required for both heating and cooling.
    j. Submit evidence that all control panels are constructed in conformance with UL 508 and bear the UL seal confirming the construction. Specify if UL compliance and seal application accomplished at the fabrication location or by field inspection by UL inspectors. Costs associated with obtaining the UL seal and any inspections are be borne by Contractor.

2. Wiring Diagrams Submittal:

    a. PCSS to provide complete wiring diagrams showing all wiring connections in the I/O system where direct hardwired interfaces exist between the PCSS control panels and vendor provided control panels furnished under other Divisions. This includes but is not limited to terminal block numbering, relay contact information, instruments, equipment, and control panel names. Include drawings in Final O&M submittal. Leaving this information blank on Final Documentation drawings is not acceptable.
    b. Panel wiring diagrams depicting wiring within and on the panel as well as connections to external devices. If ISA Loop Wiring Diagrams are specified below, equipment external to the control panel and related external connections do not need to be shown on the Panel Wiring Diagrams. Panel wiring diagrams include power and signal connections, UPS and normal power sources, all panel ancillary equipment, protective devices, wiring and wire numbers, and terminal blocks and numbering. Field device wiring includes the device ISA-tag and a unique numeric identifier. Diagrams identify all device terminal points that the system connects to, including terminal points where I/O wiring lands on equipment not supplied by the PCSS. Wiring labeling used on the drawings match that shown on the Contract Documents or as developed by the PCSS and approved by the

Engineer. I/O wiring numbered with rack number, slot number, and point number. Two-wire and four-wire equipment to be clearly identified, and power sources noted. Submit final wire numbering scheme. Provide panel drawings that are 11-inch x 17-inch in size.

c. ISA Loop Wiring Diagrams: Not required.

I. Human Machine/Operator Interface Submittals:

1. Refer to Section 406863 “Configuration of HMI Software” for specific submittal requirements.

J. Controller Program Submittal:

1. Refer to Section 406866 “Configuration of Controller Software” for specific submittal requirements.

K. Testing Plan Submittals:

1. Refer to Section 406121.20 “Process Control System Testing” for specific testing submittal requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For any named PCSS, submit a statement on company letterhead indicating that the requirements in the “Quality Assurance” paragraph below are met by the firm.

B. Product Test Reports: Refer to individual instrument, component or hardware specifications for specific requirements.

C. Evaluation Reports: Refer to individual instrument, component or hardware specifications for specific requirements.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For all PCSS supplied hardware to include in operation and maintenance manuals.

1. Submit in accordance with Section 017823 “Operation and Maintenance Data.”
2. Include the following information on the operations and maintenance manuals:

a. Table of Contents:

1) Provide a Table of Contents for the entire manual with the specific contents of each volume clearly listed. Include the complete Table of Contents in each volume.

b. Instrument and Equipment Lists:

1) Develop the following lists in Microsoft Excel format:

a) An instrument list or spreadsheet for all instruments supplied including tag number, description, specification section and paragraph number, manufacturer, model number, calibrated range, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

b) An equipment list or spreadsheet for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

c. Network Information:

1) Provide all network information related to the control system network including programming and configuration parameters, and all information included in the “memory maps” specified in Section 406866, “Configuration of Controller Software.”

d. Equipment Operations and Maintenance Information:

1) Provide ISA-TR20.00.01-2001(updated in 2004-2006) data sheets for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA-TR20.00.01-2001(updated in 2004-2006), general data sheet; however, other formats will be acceptable provided they contain all required information.

2) Provide either new documentation written specifically for this project or modified standard vendor documentation to the vendor O&M documentation for each device, piece of equipment, or OEM software. Indicate with arrows or circles all portions that apply to all standard vendor documentation furnished. Neatly line out or cross out all portions that do not apply. Remove groups of pages or sections that do not apply to the specific model supplied.

3) Provide the record documentation of the system audit and completed test forms with sign-offs as specified in Section 406121.20 “Process Control System Testing.”

4) Include instrument/equipment calibration and configuration forms.

e. As-Built Drawings:

1) Complete as-built drawings, including all drawings and diagrams specified in this section under the "Submittals" section. Include on the drawings all termination points on all equipment the system is connected to, including terminal points of equipment not supplied by the PCSS. Provide electronic files for all drawings produced. Provide drawings in AutoCAD ".dwg"

format and in Adobe Acrobat format. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.

2) Include on as-built documentation information from submittals, as described in this Specification, updated to reflect the as-built system. Incorporate errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests.

B. Operations and Maintenance Data - Software Maintenance Manual

1. Include these manuals as part of "Final System Documentation."
2. Software Listings and Databases – Submit hard copies of the same information required in the "Controller Program Submittal" except include files updated to reflect the as-built system. Include PDF versions of these files on the DVDs specified below.
3. PID Loop Tuning Parameters – Submit annotated chart recorder traces or computer system trend screen printouts showing tuned control loop response to plus and minus 40 percent of full span step changes of loop setpoint for each individual loop. For cascade loops, submit charts showing response of the secondary loop with secondary setpoint on manual and also response of the entire cascade control loop in automatic mode. Include a description of tuning methodology used.
4. Supply hardcopies of configuration information for the HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract.
5. Machine Readable Documentation – Provide two sets of as-built software documentation on DVDs or USB thumb drives in original electronic format for all PLC, HMI systems, reporting systems, Historian Systems, and any other programs developed under this Contract. Incorporate all changes made during or after testing, start-up, and commissioning.
6. Include final version of the system standards and conventions manual reflecting as-programmed conditions.
7. System Configuration Section:

    a. Include a printout (or screen capture) of all configuration screens for every device requiring PCSS, AESS, or RTSS configuration. This includes, but is not limited to, the MES', PLC processors, EtherNet/IP and any other communication modules, OITs, and radio equipment.

C. Operations and Maintenance Data - Operators' Manual:

1. Provide Operator's Manuals prior to final acceptance of the system.
2. Separately bind and include in the manual all information necessary for the operator to monitor and control the plant from the control system. Write the manuals in non-technical terms and organize for quick access to each detailed description of the operator's procedure. Include the following information:

    a. A comprehensive table of contents of the manual.
    b. A simple overview of the entire system indicating the function and purpose of major control system components described by area or building.
    c. A detailed description of the operation of the HMI and OIT including all appropriate displays. Including a screenshot of each HMI and OIT display screen and annotating each function in text is an acceptable format for presenting this information.

d. Step-by-step procedures for starting up or shutting down critical component of the control system such as server or a control panel.
e. Login / logout procedures for the operator interface system(s).
f. Complete, step-by-step procedures for printing reports and entering manual data.
g. Complete, step-by-step procedures for performing system or selected file backup and restoration including archiving historical data. Include recommended archiving schedule for historical data and/or frequency system performs an automatic back-up with a listing of all applications that are backed up or need to be backed up.
h. Operational description for operating HMI computer equipment and peripherals including printers, CD-ROMs, removable bulk storage devices, UPS, etc. Include in the description procedures for typical maintenance and troubleshooting tasks.
i. A complete glossary of terms and definition of acronyms.
j. List of personnel to be contacted for warranty and emergency services, including name, address, telephone number, pager or cell phone number, fax number, and email address.

D. Software and Firmware Operational Documentation:

1. Original Licensed Software:

a. Submit original software licenses and keys for all software provided under this Contract. Submit original paper based and electronic documentation for all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, and related information. Provide licenses for all software under this Contract to the Owner at the time of purchase. Provide media in software sleeves within O&M manual.

E. Electronic O&M Information:

1. In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals and data sheets, along with any software back-up of configuration files, on DVD or USB thumb drive. Supply electronic documents in Adobe Acrobat format.
2. Provide electronic files for all custom-developed manuals including training manuals. Supply text in Microsoft Office and Adobe Acrobat formats.
3. Provide electronic files for all drawings produced. Supply drawings in AutoCAD ".dwg" and in Adobe Acrobat formats. Provide drawings using the AutoCAD eTransmit feature to bind external references, pen/line styles, fonts, and the drawing file into individual zip files.
4. Back up each computer system hardware device onto DVD or USB thumb drive after Substantial Completion and turn over to the Owner.
5. If specified in the training section, provide digital copies of all training videos. Format videos so they are readable by standard DVD players and by standard PC DVD drives, a minimum of 800 by 600 pixels, and include sound.

F. Include information as specified in Section 017823 “Operation and Maintenance Data” on the cover and edge of each volume.

1.8 MAINTENANCE MATERIAL SUBMITTAL

A. Furnish extra materials from the same product run**,** that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Refer to individual specification sections in Division 40 for spare equipment requirements and provide one comprehensive spare parts submittal for project.
2. Submit unit and total costs for the additional spare items specified or recommended for each subsystem.

B. Pack all spare parts in individual cartons and label with indelible markings clearly indicating component(s) inside. Supply with the required spare parts complete ordering information paperwork including manufacturer's contact information (address and phone number), part name, part number, equipment name and tag number(s) for which the part is to be used (if applicable). Deliver and store the spare parts in a location directed by the Owner or Engineer.

1.9 QUALITY ASSURANCE

A. Manufacturer Qualifications: PCSS to hold a valid UL-508 certification for their panel fabrication facility.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

C. Responsible for the technical supervision of the installation by providing on-site supervision to the installers of the various components.

D. The Process Control System Supplier (PCSS) to be a “systems integrator” regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a “systems integrator” means an organization that complies with all of the following criteria:

1. Employs personnel on this project who have successfully completed ISA or manufacturer’s training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project. Key personnel to hold ISA CCST Level 1 certification or have a minimum of 10 years of verifiable plant startup experience. Key personnel include, at a minimum, the lead field technician.
2. Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion is defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references for projects where the PCSS's contract was of similar size to this project.
3. Has been actively engaged in the type of work specified in this Section for a minimum of five years.

E. Maintain a permanent, fully staffed, and equipped service facility within 200 miles of the project site with full-time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. Respond to on-site problems within 12 hours of notice.

Provide an on-site response within four hours of notification starting at two months before scheduled startup to two months after startup completion.

F. Listed suppliers will not be required to submit a qualifications proposal (see “Informational Submittals”). Contractors interested in listing an equal to the above listed suppliers to submit PCSS' qualifications for review and approval as specified herein.

G. Select a PCSS from one of the following:

1. R.E. Erickson Co. Inc.
2. Knapp Engineering, Inc.
3. NIC System Corporation
4. Aaron Associates, Inc.
5. or equal.

H. Being listed in this specification does not relieve any potential PCSS from meeting the qualifications specified in this Section.

1.10 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency on manufacturer's standard assemblies.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.12 FIELD CONDITIONS

A. Environmental Requirements: Refer to Electrical Drawings for specific environmental and hazardous area classifications.

B. Elevation: Design equipment to operate at the project ground elevation.

C. Temperature:

1. Outdoor area equipment to operate between -4 to 122 degrees F (-20 to 50 degrees C) ambient.
2. Equipment in indoor locations operate between 50 to 95 degrees F (10 to 35 degrees C) degrees ambient minimum.
3. Storage temperatures range from 32 to 122 degrees F (0 to 50 degrees C) degrees ambient minimum.
4. Furnish additional cooling or heating if required by the equipment specified herein.
5. Relative Humidity. Air-conditioned area equipment operate between 20 to 95 percent relative, non-condensing humidity. All other equipment operates between 5 to 100 percent relative, condensing humidity.

D. Do not ship control system equipment located in the control room until the control room areas comply with specified ambient temperature and humidity and free of dust and debris.

1.13 WARRANTY

A. Warranty Period: 1 year from date of Substantial Completion unless noted otherwise in individual specification sections.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Requirements for Control System:

1. Operate equipment on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above to be provided between power supply and interconnected instrument loop. Supply constant voltage transformers where equipment requires voltage regulation.
2. With the exception for field device network connected devices, all electronic instrumentation utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).
3. Outputs of equipment that are not of the standard signals as outlined, have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero-based signals will be allowed.
4. All switches have double-pole, double-throw (DPDT) contacts rated at a minimum of 600 VA, unless noted otherwise.
5. Switches and/or signals indicating an alarm, failure or upset condition wired in a fail-safe manner as shown on the P&IDs. A fail-safe condition is when an open circuit generates an alarm state (i.e. contact opens).
6. Materials and equipment UL approved whenever such approved equipment and materials are available.
7. All equipment furnished designed and constructed so that in the event of power interruption, the systems specified all go through an orderly shutdown with no loss of memory and resume normal operation without manual resetting when power is restored, unless otherwise noted.
8. Surge protection requirements for control system power, signal, and communication lines are specified in Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine instruments, hardware, and equipment before installation. Reject anything that is wet, moisture damaged, or mold damaged.

C. Examine walls, floors, roofs, and process area for suitable conditions control panels, instrumentation, radio equipment, and enclosures will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. The shield on each process instrumentation cable to be continuous from source to destination and be grounded at only one ground point for each shield.

B. Provide sunshades for equipment mounted outdoors in direct sunlight. Include sunshades standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North to minimize the impact of glare and ultraviolet exposure on digital readouts.

3.3 IDENTIFICATION

A. Provide identification system for all PCSS provided hardware, instrumentation, and communication cabling.

3.4 FIELD QUALITY CONTROL

A. Refer to individual hardware and instrument specification sections.

3.5 STARTUP SERVICE

A. Refer to Section 406121.20 “Process Control System Testing.”

B. Refer to Section 406126 “Process Control System Training.”

C. Engage a factory-authorized service representative to perform startup service as specified in individual hardware and instrument specification sections.

D. Weekly on-site coordination meetings with Engineer, Contractor, Vendors, and AESS as required during active construction period.

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3.6 PCSS MAINTENANCE SERVICE

A. Not required.

3.7 SOFTWARE SERVICE AGREEMENT

A. Not Required.

END OF SECTION 406100

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SECTION 406121.20 - PROCESS CONTROL SYSTEM TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system testing, where the Applications Engineering services are performed by the Contractor.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems and General Provisions” for submittal requirements.
2. Section 406196 “Process Control Descriptions” for Application Engineer System Supplier (AESS) programming scope, monitoring and control requirements, and automatic control strategies.
3. Section 406263 “Operator Interface Terminals” for OIT requirements.
4. Section 406343 “Programmable Logic Controllers” for PLC and PLC accessory component requirements.
5. Section 406613 “Switches and Routers” for network switching and SCADA communication hardware requirements.
6. Section 406650 “Radio Telemetry Equipment” for functionality, testing, and quality control requirements of radio telemetry equipment.
7. Section 406663 “Antennas” for functionality, testing, and quality control requirements of radio antennas.
8. Section 406717 “Industrial Enclosures” for functionality, testing, and quality control requirements of panel/enclosure requirements..
9. Section 406733 “Panel Wiring” for panel wiring requirements.
10. Section 406763 "Control Panel Mounted UPS” for functionality, testing, and quality control requirements pertaining to internally located UPS’s.
11. Section 406863 “Configuration of HMI Software” for OIT graphic display requirements and alarming requirements.
12. Section 406866 “Configuration of Controller Software” for PLC programming and networking requirements.
13. Section 407000 “Instrumentation for Process Systems” for field instrument schedule.
14. Section 262923 “Variable Frequency Motor Controllers” for VFD Ethernet communication requirements.
15. Section 407813 “Indicators and Meters”

C. Furnish all labor, materials, equipment and incidentals required to complete the testing of all devices and systems furnished and installed as detailed on Drawings, and as specified herein.

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1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

C. Federal Communications Commission (FCC): An independent agency of the United States federal government that regulates communications by radio, television, wire, satellite, and cable across the United States.

D. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

E. Licensed Frequency Radio (LFR): Frequency bands reserved by the FCC for sole use by the organization to which it is licensed.

F. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

H. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

I. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Testing Submittals - Submit, in one submittal, the following testing related documents:

1. Status signoff forms:

a. Develop and submit project specific I/O Status, to include both hardwired and networked I/O, and Automatic Control Strategy signoff forms to be used during factory and field testing to organize and track each loop's inspection, adjustment, calibration, configuration, and testing status and sign off. Include sign-off forms for each testing phase showing all loops.

1) Example forms are shown in the Appendices.
2) Separate forms for factory and field testing can be used, or they can be combined, at the discretion of the PCSS.
3) Submit testing forms prior to start of testing.

1. Testing Procedures:

a. Submit detailed procedures proposed to be followed for each of the tests specified herein. The test procedures serve as the basis for the execution of the required tests to demonstrate that the system meets and functions as specified. At a minimum, provide the following test procedures:

1) Network and Communications Testing.
2) I/O Testing.
3) Automatic Control Strategy Testing.
4) Hardware and Software Testing.
5) UPS Testing.
6) Control panel power, indictors, and I/O logic tests.

b. Documents shall be structured in an orderly and easy to follow manner to facilitate an efficient and comprehensive test.
c. Test procedures shall indicate all pre-testing setup requirements, all required test equipment, and simulation techniques to be used.
d. Test procedures shall be structured in a cause and effect manner where the inputs are indicated, and the outputs are recorded.
e. Test procedures shall include the demonstration and validation under normal operating conditions and under various failure scenarios as specified in Contract Documents.
f. Testing may not start until all Testing Submittals have been approved.

C. Test Documentation:

1. Upon completion of each required test, document the test by submitting a copy of the signed off Testing Status forms. Testing shall not be considered complete until the signed-off forms have been submitted and approved. Submittals of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

D. Application Development Submittal.

1. Within twenty-one days after either approval of the PCSS submitted hardware submittal or notification from the Engineer; the PCSS shall deliver to the AESS hardware for completing the PLC and OIT application development. Unless otherwise noted below, if spares of these units are required to be furnished, then this equipment can be counted towards the spare requirements. If spares for these units are not required, then this equipment shall be considered additional scope of supply over equipment specified elsewhere.
2. PCSS shall deliver the following items:

a. One complete PLC system including PLC processor, power supply, I/O modules, and communication modules for each pumping station.

b. Managed Ethernet Switch (MES-PS1CP & MES-PS2CP().
c. Operator Interface Terminal (OIT-PS13CP).

3. PCSS shall be responsible for ensuring all equipment and supplies until received by the AESS. AESS shall be responsible for ensuring all equipment and supplies, until equipment is delivered back to PCSS.
4. Notify AESS in writing a minimum of one week in advance of delivery. All deliveries shall occur during AESS's normal business hours Monday through Friday, legal holidays excluded.

E. PCSS is responsible for all shipping and insurance costs of early development hardware to and from the AESS once configuration and software testing is completed in accordance with the project schedule. The PCSS will deliver the development system to the final installation location and connect all system components in advance of scheduling AESS field software testing.

1.6 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For Test Documentation of system:

1. Upon completion of each required test, document the test by submitting a copy of the signed-off Testing Status forms. Testing is not considered complete until the signed-off forms are submitted and approved. Submittal of other test documentation, including "highlighted" wiring diagrams with field technician notes, are not acceptable substitutes for the formal test documentation.

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 TESTING - GENERAL

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

B. Track results of all testing on a project specific status sign-off form or similar document. The PCSS is responsible for maintaining the sheet. Appendix of this Section has an example template for this sheet.

C. Tests the PCSS is required to perform are as follows:

1. Factory Testing:

a. Unwitnessed Factory Test (UFT).
b. Witnessed Factory Test (WFT).

2. Field Testing:

a. Operational Readiness Test (ORT).
b. Functional Demonstration Test (FDT).
c. Site Acceptance Test (SAT).

D. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment, and data, provide all special testing materials and equipment required for a suitable means of simulation.

E. PCSS to coordinate all required testing with Contractor, affected Subcontractors, Engineer, and Owner.

F. Do not ship equipment to jobsite until Engineer or Owner has received all Factory Testing results and approved the system as ready for shipment.

G. Engineer reserves the right to test or re-test any functions.

H. Correction of Deficiencies:

1. Correct deficiencies in workmanship and/or items not meeting specified testing requirements to meet specification requirements at no additional cost to Owner.
2. Repeat testing, as specified herein, after correction of deficiencies is made until specified requirements are met. Perform work at no additional cost to Owner.

3.2 FACTORY TESTING - UNWITNESSED FACTORY TEST (UFT)

A. Purpose of UFT is for PCSS to check system prior to Engineer and/or Owner attending factory testing. This type of testing is part of any quality firm's internal QA/QC procedures.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Master copy of the PCSS developed factory testing signoff forms.
5. Testing procedures.

C. Temporary network connections are required to confirm the network configuration. Temporary wiring of primary elements, final control elements, and field-mounted transmitters is not required.

D. Hardware to be tested includes all control system devices shown on System Architecture drawings and provided by PCSS except for the LFR.

E. Perform these tests, but not be limited to the following. Address each of these tests in the Test Procedure submittal.

1. All panels and enclosures provided to undergo a thorough inspection to verify integrity of cabinet enclosures, frame structures, paint work and finish, etc. Review panel drawings to ensure they accurately reflect panel layout and wiring.
2. Perform a system audit to verify all components have been staged for test and have been documented properly with correct model numbers, serial numbers, etc. Prove documentation of audit at factory test and submit as part of O&M Manual Documentation:

    a. For each microprocessor-based component connected to control communication backbone in system (PLCs, OITs, managed switches, protocol converters, communication cards on final field devices, radios, etc.), list firmware revision, vendor and local distributor information, and system, warranty information, configuration parameters (e.g., communication settings, fail position settings, etc.)

3. Perform panel wire pull tests to ensure all wiring has been connected with appropriate torque to prevent wires from coming loose.
4. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Perform testing of UPS to determine if they have been sized correctly to maintain specified run time during field testing.
5. Perform a 100 percent I/O point checkout to verify proper operation of input/output points from panel terminations to OIT nodes. At a minimum, I/O checkout consists of four steps.

    a. Jumper discrete input signals at field terminal blocks in control panels to verify proper status in HMI and OIT nodes.
    b. Connect analog input signals to a signal generator at field terminal blocks in control panels to verify proper status in HMI and OIT nodes and verify signals are at zero percent, 50 percent, and 100 percent of full scale.
    c. Test discrete output signals by switching equipment to manual control at HMI and OIT nodes and turning the output on or other means to turn the output on. Then verify the output is on by connecting a digital multimeter to measure continuity at terminations, thus verifying command from PLC has properly executed contact closure.
    d. Test analog output signals by switching the equipment to manual control at HMI and OIT nodes and turning output on or other means to turn the output on. Then verify output by utilizing a digital multimeter to measure current or voltage generated at termination points.

6. Verify all control strategies using simulation or other means to verify logic performs as expected. Verify faults and logical failure conditions for control strategies such instrument failures, equipment failures, loss of communication between OIT and PLC, loss of peer-to-peer communication, out of range testing (over and under scale) for analog inputs, and all other strategies specified in control strategy document.
7. For each hardware enclosure, include with inspection, but not be limited to, cabinet enclosures, frame structure, paint work and finish, dimensions, and hardware operability (i.e., fans, door hinges, keylocks, etc.).
8. For each subpanel, include with inspection, but not be limited to, I/O subsystem physical layout, power supply sizing and mounting, cable routing, wire runs across hinges

properly installed, fans and blowers unobstructed and mounted to maximize air flow, power conditioning correctly installed, and overall layout and installation of components meets manufacturer's recommendations and standard industry accepted practices.

9. All other control panel circuitry.
10. Perform the following systems tests:

    a. Demonstrate ability to share data between PLCs and operator interface terminals (OITs).
    b. Demonstrate ability of each workstation to print reports on all designated report printers.
    c. Demonstrate communication failure and recovering self-healing ring testing.
    d. Demonstrate total power failure and recovery. Remove the UPS for this test.

F. Upon successful completion of UFT, PCSS to submit a record copy of test results as specified in PART 1. As part of this test results submittal, notify Engineer and Owner in writing that system is ready for WFT. No other notice of Factory test will be accepted. Engineer and/or Owner to schedule a test date within 15 days of receipt of this submittal.

3.3 FACTORY TESTING - WITNESSED FACTORY TEST (WFT)

A. Purpose of WFT is to allow Engineer or Owner representatives to witness functionality, performance, and stability of entire hardware and software system as a complete integrated system. WFT to be run by PCSS and conducted at PCSS's facility.

B. Required Documents for Test:

1. Clean set of approved panel drawings and wiring diagrams.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Master copy of the PCSS developed factory testing signoff forms.
5. Testing procedures.

C. Operate the system continuously throughout WFT without failure, except where initiated per established test procedures. Unanticipated failures may, at Owner or Engineer's option, result in overall WFT being deemed unsuccessful. Correct and re-test all deficiencies identified during these tests prior to completing WFT or shipment of panels to jobsite as determined by Owner/Engineer.

D. Perform these tests during the WFT, but not be limited to, the following:

1. A repeat of all tests specified in the UFT.

E. Daily schedule during these tests to be as follows:

1. Morning meeting to review the day's test schedule.
2. Scheduled tests and sign-offs.
3. End of day meeting to review day's test results and to review or revise next day's test schedule.
4. Unstructured testing period by witnesses.

F. Upon successful completion of WFT, PCSS to submit a record copy of test results as specified in PART 1.

3.4 FIELD TESTING - OPERATIONAL READINESS TEST (ORT)

A. Purpose of ORT is to check that process equipment, instrument installation, instrument calibration, instrument configuration, field wiring, control panels, and all other related system components are ready to monitor and control the processes. This test determines if equipment is ready for operation.

B. This test to take place prior to FDT and startup. Prior to starting this test, install relevant process equipment and mechanically test instruments installed, control panels installed, and field wiring complete.

C. Required Documents for Test:

1. Master copy of the PCSS developed field testing sign-off forms.
2. Master copy of VFD manufacturer developed field testing sign-off forms.
3. PCSS and VFD manufacturer testing procedures.
4. Approved PCSS and VFD manufacturer “memory map.”
5. Calibration forms.

D. These inspections, calibrations, and tests do not require witnessing. However, Engineer may review and spot-check testing process periodically. All deficiencies found to be corrected by PCSS prior to commencement of Functional Demonstration Test.

E. PCSS to maintain Sign-off forms and Calibration forms at job site and make them available to Engineer/Owner at any time.

F. Perform the following tests as part of ORT:

1. Instrument calibration, configuration, and set-up.
2. Input/Output (I/O) Testing.
3. Networked Input/Output (I/O) Testing.
4. Testing of control strategies.

G. Instrument calibration, configuration, and set-up:

1. Calibrate, configure, and set-up all components and instruments to perform specified functions.
2. Calibration form:

    a. For any component or instrument requiring dip switch settings, calibration, or custom configuration, maintain a calibration form in field documenting this information. These forms provide a summary of the actual settings used in the field to allow an Instrument technician to replace the device entirely and configure it to function as it did before.
    b. Add this information to Instrument data sheet and to a copy of manufacturer's standard "Configuration Sheet" or create a separate form.

1) If a separate form, list Project Name, Loop Number, ISA Tag Number, I/O Module Address, Manufacturer, Model Number/Serial Number, Output Range and Calibrated Value.

c. Some examples of required information are:

1) For Discrete Devices: Actual trip points and reset points.
2) For Instruments: Any configuration or calibration settings entered into instrument.
3) For Controllers: Mode settings (PID).
4) For I/O Modules: Dip switch settings, module configuration (if not documented in native programming documentation).

d. Maintain a copy of these forms in field during testing and make them available for inspection at any time.

e. For any device that allows a software back-up of configuration files to a laptop, make configuration files available to Engineer/Owner for inspection. Submit as part of Final System Documentation as specified in Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

H. I/O Testing:

1. Purpose of I/O testing is to check that process equipment, instrument installation, calibration, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor shall test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove valve open/close limit switches by operating valve, not by installing a jumper on limit switch contacts. However, if equipment or process is not available to test a signal over its entire calibrated range, PCSS may test using a simulation method and make a note on sign-off form.
3. Perform the following I/O tests:

a. Discrete Input: At device or instrument, change signal condition from inactive to active state. Observe results on all indicators within loop such as OIT screens, pilot lights, horns, beacons, etc.

b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as OIT screens, recorders, digital indicators, etc.

c. Test discrete output signals by switching equipment to manual control at the OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.

d. Test analog output signals by switching equipment to manual control at OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

I. Networked Input/Output (I/O) Testing:

1. Purpose of networked I/O testing is to check that VFD and PLC programming, configuration, field wiring, and control panels are set-up correctly to monitor and control the processes. This test is commonly referred to as a "loop test" or an I/O checkout.
2. PCSS in conjunction with Contractor and VFD Manufacturer's factory-authorized representative shall test signals under process conditions. Preferred test method will always be to execute test wherever possible to end elements. For example, preferred test will prove pump start/stop capability by operating pump, not by verifying change of status in the data array. However, if equipment or process is not available to test I/O, PCSS may test using a simulation method and make a note on sign-off form.
3. Perform the following I/O tests:

    a. Discrete Input: At device or pump, change signal condition from inactive to active state. Observe results on all indicators within loop such as OIT screens, VFD keypads, pilot lights, horns, beacons, etc.
    b. Analog Input: Test analog signal over entire engineering range at various intervals including 0, 50%, and 100% as well as on increasing and decreasing range. Observe results on all indicators within loop such as OIT screens, VFD keypads, recorders, digital indicators, etc.
    c. Test discrete output signals by switching equipment to manual control at the OIT nodes and turning output on or using other means to turn output on. Then verify equipment responds accordingly.
    d. Test analog output signals by switching equipment to manual control at OIT nodes and turning output on or other means to turn output on. Then verify equipment responds accordingly.

J. Testing of Automatic Control Strategies:

1. Verify all automatic control strategies using actual process equipment and instruments, or other means, to verify logic performs as expected. Verify faults and logical failure scenarios for control strategies such as instrument failures, equipment failures, loss of communication between OIT and PLC, loss of communication between VFD and PLC, loss of peer-to-peer communication, out of range testing for analog inputs, loss of power, and all other strategies specified in control strategy document.

K. Repeat all systems tests specified under factory testing.

L. Test UPS to verify UPS switch power correctly while keeping all UPS powered loads online. Also, test sizing of UPS by switching off-line power to UPS and verify if they maintain specified run time.

M. For all panels with enclosures modified by this Contract, test internal control panel temperature under full running conditions to ensure proper cooling/ventilation is being provided.

N. Upon successful completion of ORT, PCSS to submit a record copy of test results as specified in PART 1 and request scheduling of FDT.

3.5 FIELD TESTING - FUNCTIONAL DEMONSTRATION TEST (FDT)

A. After facility is started-up and running treatment process in automatic control to extent possible, perform a Functional Demonstration Test. Purpose of FDT is to allow Engineer or Owner representatives to witness actual functionality, performance, and stability of system while connected to process equipment.

B. Required Documents for Test:

1. Set of panel drawings and wiring diagrams from ORT with corrections noted.
2. Set of Contract Documents - all drawings and specifications.
3. All design-change related documentation.
4. Signed-off master copy of the PCSS developed field testing signoff forms.
5. Signed-off master copy of the VFD manufacturer developed field testing signoff forms.
6. PCSS and VFD manufacturer testing procedures.
7. Approved PCSS and VFD manufacturer “memory map.”
8. Copy of completed calibration forms.
9. One copy of all O & M Manuals for PCSS supplied equipment.

C. Perform a witnessed FDT on entire pumping station. To extent possible, repeat testing performed during ORT.

D. Follow specified daily schedule during factory tests and FDT.

E. After coordinating with Operations, perform a "Black Start" of the pumping station to confirm station operation recovers as specified in Contract Documents. Black start means shutting off power to the plant and turning it back on. Perform separate tests by recovering the plant while on generator (if a generator is specified) and while on utility power.

F. Document punch list items and resolutions noted during test on Punch list/Resolution form. In event of rejection of any part or function test procedure, PCSS to perform repairs, replacement, and/or retest within 10 days.

G. Upon successful completion of the FDT, PCSS to submit a record copy of test results as specified in PART 1.

3.6 FIELD TESTING - SITE ACCEPTANCE TEST (SAT)

A. After completion of FDT, and system is started-up and running treatment process in automatic control to extent possible, perform a test on the system.

B. While this test is proceeding, Engineer and Owner have full use of system. Only allow plant operating personnel to operate equipment associated with live plant processes. Plant operations remain the responsibility of Owner and decision of plant operators regarding plant operations are final.

C. During this test, PCSS personnel to be present as required to address any potential issues that would impact system operation. PCSS is expected to provide personnel for this test who have an intimate knowledge of hardware and software of system. When PCSS personnel are not on-site,

PCSS to provide cell phone/pager numbers that Owner personnel can use to ensure that support staff is available by phone and/or on-site within four hours of a request by operations staff.

D. PCSS to analyze and correct any malfunctions during test. In event of rejection of any part or function, PCSS to perform repairs or replacement within 5 days.

E. Throughout duration of SAT, do not make software or hardware modifications to the system without prior approval from Owner or Engineer.

END OF SECTION 406121.20

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APPENDIX **40 61 21**-A: EXAMPLE INPUT/OUTPUT (I/O) STATUS SIGN OFF FORM

An example template for I/O Status signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific I/O Status signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

APPENDIX **40 61 21**-B: EXAMPLE AUTOMATIC CONTROL STRATEGIES SIGN OFF FORM

An example template for Automatic Control Strategies signoff form to be used for documenting testing results to Owner is attached. PCSS is required, prior to testing, to create a project specific Automatic Control Strategies signoff form based on attached template or approved equal. PCSS may obtain an electronic copy of template from Engineer or develop it on their own.

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[Project Name] Appendix A - Input/Output (I/O) Status Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Field Testing.

Instrument Alarm Setpoint - Setpoint for any alarms set by PCSS

Wiring Complete - Signal wired from field device to PLC

I/O Tested - Signal tested from field device to SCADA HMI

PLC	Signal Tag	Description	Range or Active State when closed	P&ID	Signal	Rack	Slot	Channel	Instrument Alarm Setpoint	Calibrate, config., and Wiring complete	Date	PCSS I/O testing	Date	I/O Testing to the HMI	Date	Notes
PLC-SC	LIT-4000-1	Secondary Clarifier No. 1 Sludge Level	0-10 ft	8	AI	2	1	0								
PLC-SC	LIT-4010-3	Secondary Clarifier No. 3 Sludge Level	0-10 ft	8	AI	2	1	1								
PLC-SC	SI-4100-1	RAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	2								
PLC-SC	SI-4100-4	RAS Pump No. 4 Speed Feedback	0-100%	15	AI	2	1	3								
PLC-SC	FIT-4102-1	RAS Flow Pumps 1-3	0-1900 GPM	14	AI	2	1	4								
PLC-SC	SI-4110-1	WAS Pump No. 1 Speed Feedback	0-100%	14	AI	2	1	5								
PLC-SC	N/A	Spare Slot	N/A	N/A	Spare	2	5	N/A								
PLC-SC	SC-4100-1	RAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	0								
PLC-SC	SC-4100-2	RAS Pump No. 2 Speed Setpoint	0-100%	14	AO	2	7	1								
PLC-SC	SC-4100-3	RAS Pump No. 3 Speed Setpoint	0-100%	14	AO	2	7	2								
PLC-SC	SC-4110-1	WAS Pump No. 1 Speed Setpoint	0-100%	14	AO	2	7	3								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	4								
PLC-SC	Spare	Spare	N/A	N/A	AO	2	7	5								
PLC-SC	TSH-4000-1	Secondary Clarifier No. 1 High Temp	Normal	8	DI	3	1	0								
PLC-SC	XA-4000-1	Secondary Clarifier No. 1 Motor Overload	Normal	8	DI	3	1	1								
PLC-SC	WAH-4000-1	Secondary Clarifier No. 1 High Torque	Normal	8	DI	3	1	2								
PLC-SC	WAHH-4000-1	Secondary Clarifier No. 1 High High Torque	Normal	8	DI	3	1	3								
PLC-SC	YRI-4000-1	Secondary Clarifier No. 1 On/Off	On	8	DI	3	1	4								
PLC-SC	YCI-4000-1	Secondary Clarifier No. 1 In Remote	In Remote	8	DI	3	1	5								
PLC-SC	YFI-4100-1	RAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	6								
PLC-SC	FAL-4100-1	RAS Pump No. 1 Low Flow	Normal	14	DI	3	1	7	50 GPM	RJM	12/18/2011	JAS	12/22/2011	MIC	12/29/2011	Example completed line
PLC-SC	Spare	Spare	Normal	14	DI	3	1	8								
PLC-SC	YRI-4100-1	RAS Pump No. 1 Running	Running	14	DI	3	1	9								
PLC-SC	YCI-4100-1	RAS Pump No. 1 In Remote	In Remote	14	DI	3	1	10								
PLC-SC	YFI-4110-1	WAS Pump No. 1 VFD Fault	Normal	14	DI	3	1	11								
PLC-SC	FAL-4110-1	WAS Pump No. 1 Low Flow	Normal	14	DI	3	1	12								
PLC-SC	Spare	Spare	Normal	14	DI	3	1	13								
PLC-SC	YRI-4110-1	WAS Pump No. 1 Running	Running	14	DI	3	1	14								
PLC-SC	YCI-4110-1	WAS Pump No. 1 In Remote	In Remote	14	DI	3	1	15								
PLC-SC	HSS-4000-2	Secondary Clarifier No. 2 Start Command	Start	8	DO	4	6	0								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	1								
PLC-SC	HSS-4100-2	RAS Pump No. 2 Start Command	Start	14	DO	4	6	2								
PLC-SC	HSS-7000-2	Sludge Holding tank Tank Blower No. 2 Start Command	Start	17	DO	4	6	3								
PLC-SC	HSS-4100-5	RAS Pump No. 5 Start Command	Start	15	DO	4	6	4								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	5								
PLC-SC	HSS-4105-1	Secondary Scum Pump No. 2 Start/Stop	Start	15	DO	4	6	6								
PLC-SC	HSS-4110-2	WAS Pump No. 2 Start/Stop Command	Start	15	DO	4	6	7								
PLC-SC	7160-FQI-1	Sludge Loadout LCP Pumping Indicator	Pumping	17	DO	4	6	8								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	9								
PLC-SC	HSS-7115-2	Sludge Holding Tank Mixer No. 2 Start	Start	17	DO	4	6	10								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	11								
PLC-SC	HSO-7117-2	Sludge Holding Tank Discharge Valve No. 2 Open CMD	Open	17	DO	4	6	12								
PLC-SC	HSC-7117-2	Sludge Holding Tank Discharge Valve No. 2 Close CMD	Close	17	DO	4	6	13								
PLC-SC	HSS-7120-2	TS Transfer Pump No. 2 Start Command	Start	17	DO	4	6	14								
PLC-SC	Spare	Spare	N/A	N/A	DO	4	6	15								

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[Project Name] Appendix B - Automatic Control Strategies Sign-Off Form

All Sections below are required to be filled out by PCSS as part of Testing

Auto. Control Strategies. - Loop operational in Automatic as defined in Control Stategies

Control Strategies Loop #	Control Strategy Description	P&ID	Auto. Control Strategy	Date	Notes
LOOP 281 - 284	LOW FLOW PUMPS	8			
LOOP 290	LOW EQ CHANNEL FLOW NO.4	8			
LOOP 300	MICROFILTRATION AIR SUPPLY LOW PRESSURE	10			
LOOP 351, 352	SITE LIFT STATION PUMP NO.1 AND NO. 2	12			
LOOP 355	SITE LIFT STATION HIGH AND LOW LEVEL CONTROL	12			
LOOP 371, 372	SLUDGE HOLDING TANK NO.1 AND NO. 2 LEVEL	14			
LOOP 381, 382	SLUDGE TRANSFER PUMPS	14			
LOOP 385	SLUDGE TRANSFER PUMPS REMOTE START/STOP COMMAND	14			
LOOP 700	EFFLUENT PUMPING STATION LEVEL	14			
LOOP 701, 702, 703	EFFLUENT PUMP NO.1	14			
LOOP 840	POST AERATION CHANNEL AIR FLOW CONTROL	15			
LOOP 900	SLUDGE TRANSFER PUMPS DISCHARGE FLOW	8			
LOOP 971	CENTRIFUGE SLUDGE FEED PUMP NO.1	8			
LOOP 1001	CENTRIFUGE NO.1 SLUDGE FEED FLOW CONTROL	8			
LOOP 1411, 1412	SODIUM HYPOCHLORITE STORAGE TANKS LEVEL	8			
LOOP 1421, 1422	SODIUM HYPOCHLORITE PUMPS	8			
LOOP 1430	SODIUM HYPOCHLORITE STORAGE TANKS CONTAINMENT AREA HIGH LEVEL DETECTION	14			
LOOP 2051, 2052, 2053	DIESEL ENGINE GENERATOR STATUS	14			
LOOP 2055	TRANSFER SWITCH STATUS	14			
LOOP 2060	GENERATOR KILOWATTS MONITORING	14			
APPENDIX ONE	EQUIPMENT RESTART DURING A POWER LOSS WITH THE GENERATOR RUNNING	14			
APPENDIX TWO	EQUIPMENT RESTART WITH POWER RESTORED AFTER A POWER LOSS	14			
N/A	SELF-HEALING CAPABILITIES OF NETWORK	N/A			
N/A	REDUNDANT SCADA SERVER FAILOVER AND RECOVERY	N/A			

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SECTION 406126 - PROCESS CONTROL SYSTEM TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes process control system training for provided devices and systems.

B. Engage AESS, instrument manufacturers, VFD Manufacturers, and other contractors as necessary to complete training specified herein.

C. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Refer to the Instrument Sections for instruments that require manufacturer startup and training services.
3. Refer to Section 262923 “Variable-Frequency Motor Controllers” for VFD Manufacturer training requirements.

1.3 ACTION SUBMITTALS

A. Preliminary Training Plan Submittal:

1. Prior to preparation of Final Training Plans, submit outlines of each training course including course objectives and target audience, resumes of instructors, prerequisite requirements for each class, and samples of handouts for review.

B. Final Training Plan Submittal:

1. Upon receipt of Engineer's comments on preliminary training plan, submit specific proposed training plan with the following:

a. Definitions, objectives, and target audience of each course.
b. Schedule of training courses including proposed dates, duration, and locations of each class.
c. Complete copy of all proposed handouts and training materials bound and logically arranged with all materials reduced to a maximum size of 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion into the binder.

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1.4 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Directly relate the training and instruction to the system being supplied. Training program represents a comprehensive program covering all aspects of the operation and maintenance of the system.

B. Coordinate all training schedules with and at the convenience of Owner, including shift training required to correspond to Owner's working schedule.

C. All onsite instructors must be intimately familiar with the operation and control of Owner's facilities.

D. Provide detailed training manuals to supplement the training courses including specific details of equipment supplied and operations specific to the project. Provide the manuals in hardcopy for each student. Provide electronic copy of each training manual in PDF format for Owner's future use.

E. Make use of teaching aids, manuals, or slide/video presentations as required. After training services, deliver training materials to Owner.

F. Owner reserves the right to videotape all custom training sessions. Training tapes become sole property of Owner.

3.2 TRAINING SUMMARY

A. Provide following training courses listed in the summary table below:

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	Covered in AESS scope of work			
Operator Control System Training	Covered in AESS scope of work			
Installed Control System	2	2	1	All
PLC Hardware	2	2	1	Maintenance, Administrator

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Instrument manufacturer training	2	4	1	Maintenance, Operations
Instrument training	4	4	1	Maintenance, Operations
Instruments - Operator familiarity	2	8	1	Maintenance, Operations

B. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the OIT / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.
4. Management: Non-daily operations personnel.
5. All: Used to indicate training should be intended for all defined audience roles.

3.3 ONSITE TRAINING

A. Training personnel are required to be intimately familiar with the control system equipment, its manipulation, and configuration. Training personnel are required to command knowledge of system debugging, program modification, troubleshooting, maintenance procedure, system operation, and programming, and capable of transferring this knowledge in an orderly fashion to technically oriented personnel.

B. Installed Control System Training:

1. Provide training for Owner's personnel in the functionality, maintenance, and troubleshooting, of the installed Control System. Conduct training before Functional Demonstration Test (FDT), but not more than 1 month before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system.
4. Provide detailed training on the actual configuration and implementation for this Contract covering all aspects of the system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to the system. Provide training covering the following subjects:

    a. System overview.
    b. System hardware components and specific equipment arrangements.
    c. Periodic maintenance.
    d. Troubleshooting and diagnosis.
    e. Network configuration, communications, and operation.
    f. TCP/IP addressing procedures for all Ethernet devices.

C. Programmable Logic Controller (PLC) Hardware:

1. Provide training for Owner's personnel in operation, maintenance, troubleshooting, etc. with PLC hardware system. Conduct the training before FDT, but not more than one month before.
2. Provide training and instruction specific to the system that is being supplied.
3. Provide training consisting of classroom instructions and hands-on instruction utilizing Owner's system. Provide detailed training on the implementation for this Contract covering all aspects of PLC system that will allow Owner's personnel to maintain, modify, troubleshoot, and develop future additions/deletions to PLC system. Provide training covering the following subjects:

    a. PLC system overview.
    b. PLC system architecture.
    c. PLC system hardware components and specific equipment arrangements.
    d. PLC system startup, shut down, load, backup, and PLC failure recovery.
    e. Periodic maintenance.
    f. Troubleshooting and diagnosis down to the I/O card level.
    g. PLC configuration, communications, and operation.

D. Instrument Manufacturer Training:

1. Provide manufacturer instrument training for those instruments where specifically indicated in the Instruments section. This is on-site training provided by an authorized representative of the manufacturer. Manufacturer's representative is required to be fully knowledgeable in equipment operation and maintenance.

E. Instrument Training:

1. Provide instruction on the maintenance of the field and panel instrumentation for Owner's instrumentation technicians. Conduct this training before FDT, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Training program is required to include the following elements:

    a. Training in standard hardware maintenance for the instruments provided.
    b. Specific training for the actual instrumentation configuration to provide a detailed understanding of how the equipment and components are arranged, connected, and set up for this Contract.
    c. Testing, adjustment, and calibration procedures.
    d. Troubleshooting and diagnosis.
    e. Maintenance and frequency.

F. Instruments - Operator familiarity:

1. Provide operator level instruction on the use of the field and panel instrumentation for Owner's operations staff. Conduct training before the site acceptance test, but no more than 1 month before and at a time suitable to Owner. This training takes place at Owner's facility. Include hands on demonstration of information each transmitter indicates, and method used to retrieve any operator information from transmitter, including use of pushbuttons and interpretation of international graphic symbols used on the instruments.

END OF SECTION 406126

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SSECTION 406196 - PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Applications Engineer System Supplier (AESS) Programming Scope

1. Develop the control system applications to implement the process control descriptions for all new and existing systems. This Section is provided to define control strategies to be used for PLC programming of the system.
2. The Contract Documents are a single integrated document, and as such, all Drawings, Specifications Divisions and Specifications Sections apply. It is the responsibility of the Contractor and Subcontractors to review all Sections to ensure a complete and coordinated project.
3. The AESS is cautioned to read this Section and all related Sections and their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section with the specific requirement called out in the individual control strategy. Implement these general strategies throughout this Contract unless specifically directed otherwise in the individual loop process control descriptions.
4. Follow loop and device tagging criteria shown on the Drawings without exception.
5. Establish programming approach and database/variable identification standards prior to performing any programming work. Review the proposed standards and conventions with the Owner during the coordination workshop required by Section 406863 “Configuration of HMI Software.”

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406863 “Configuration of HMI Software.”
4. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control of machine level equipment. HMI and OIT may be used interchangeably as there are no HMI systems currently installed.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the SCADA system used for device level control and monitoring. OIT and HMI may be used interchangeably as there is no HMI system currently installed.

E. Operator Workstation (OWS): A hardware component of the SCADA system used for supervisory level control and monitoring.

F. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

H. Supervisor Control and Data Acquisition (SCADA): Hardware and software components used for high-level supervisory monitoring of industrial processes. Typical devices that are part of the SCADA network include computers (OWS), PLCs, Ethernet switches, OITs, and HMIs.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Control System Hierarchy

1. The control descriptions are broken into a hierarchical layer concept. There may be one layer or multiple layers per loop, depending upon that loop. An example of a multiple layered loop is shown in Figure 1.

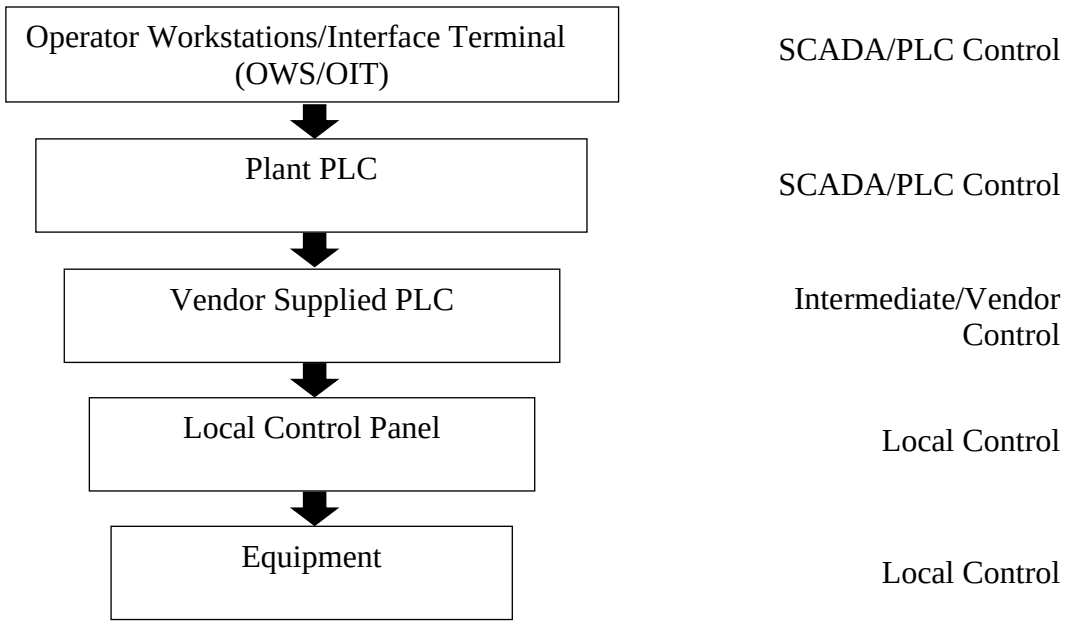

Figure 1. Control System Hierarchy

B. Loop Numbering

1. Refer to Drawings
2. The first two digits of the loop number identify the pump station number.

3.2 GENERAL CONTROLS AND MONITORING

A. Overview

1. The hardware and/or software functions noted by this paragraph reference are to be implemented in the PLC control system.
2. Setpoints, as defined by this section, refer to numerical values adjustable from the HMI.
3. The PLC is responsible for resetting command bits sent from the HMI to the PLC. If the commanded state cannot be achieved for any reason, the PLC resets the bit to allow the operator to set the command bit again. For example, when pressing the AUTO button on the HMI, the PLC resets the AUTO command from the HMI after the device is in the AUTO Mode. If the AUTO Mode is not available for any reason, the PLC resets the bit, so the AUTO button can be selected at the HMI once AUTO control is available.

B. Interlocks

1. Hardwired interlocks will interlock the controls locally, at the vendor PLC, and at the plant PLC. If the interlock occurs, the shutdown will cause the equipment to be inoperable at all levels of control.
2. Software interlocks are represented in a particular layer of the operation description and interlock the controls in that layer and the layers above it. However, the interlock does not interlock the commands in the layer before it. For example, a software interlock implemented at the SCADA/PLC level will not stop equipment from being controlled locally.
3. Interlocks that shutdown (stop a piece of equipment and prevent it from being restarted or moved) are displayed on the faceplate pop-up graphic for that piece of equipment.

C. Motors

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Motors can be started manually by the operator at the HMI, or automatically by the control strategy.
4. Automatic control strategies are defined in individual loop descriptions.
5. The SCADA system stops a motor or drive if the drive does not receive the AUTO or REMOTE status or one of its software interlocks trips. If the drive or motor is in HAND or LOCAL, it will continue to run but the SCADA start/stop output will be open.
6. If a motor stops for any reason, it cannot be restarted automatically once the problem with the motor has been resolved. A manual reset from the OWS or OIT is required to resume operation.
7. Motors that have a HAND-OFF-REMOTE (HOR) selector, indicate to the operator that the pump will run while the selector is in the HAND position. If a motor is being run in HAND the REMOTE position is not true and the run confirm status is true. If not in Hand or in REMOTE, the SCADA PLC’s motor output contact will open and stop (shutdown) the pump.

D. Valves

1. Provide monitoring and control of the signals shown on the P&IDs.
2. Hardwired and software interlocks are defined in individual loop descriptions.
3. Valves with only full travel capability can be opened or closed manually by the operator at the HMI, or automatically by the control strategy.
4. Modulating valves with position feedback can be positioned between 0% and 100% open manually by the operator at the HMI, or automatically by the control strategy.
5. Automatic control strategies are defined in individual loop descriptions with their corresponding process variable used for control.

E. Analog Instruments

1. Analog instruments refer to indicating devices capable of providing a continuous output relative to time.
2. Provide monitoring of the analog signals shown on the P&IDs.
3. Analog signals may be a continuous voltage (-10V to 10V, 0V to 5V, 0V to 10V) or current (0 mA to 20mA, 4mA to 20mA) as determined by the output of the field instrument. The output range corresponds to the minimum and maximum full-scale measurement.
4. The PLC will linearly scale the output range (voltage or current) to the equivalent values in engineering units.
5. Provide cutoff deadbands for when the analog signal is approaching the minimum or maximum full-scale measurement.

    a. An analog signal measuring less than or equal to 2% of full-scale will be forced to zero after an adjustable time delay.
    b. An analog signal measuring greater than 100% of full-scale will be clamped at 100%.

6. Provide a CALIBRATION mode with an adjustable time setpoint (in hours).

    a. When entering CALIBRATION mode, the last good value is held prior to CALIBRATION mode being activated. The value is held until the calibration time setpoint expires.
    b. The Operator may enter a calibration value, which will be the value held until the calibration time setpoint expires.
    c. When active, clearly indicate the instrument is in CALIBRATION mode on any local OITs and in the HMI system.

F. Discrete Instruments

1. Discrete instruments refer to indicating devices with any number of non-continuous defined states (e.g., ON/OFF, 0 or 1)
2. Provide monitoring of the discrete signals shown on the P&IDs.

    a. When a contact or status from the instrument is true, the PLC will receive power to its input channel. The PLC registers this as a binary bit of 1.
    b. When a contact or status from the instrument is false, the PLC will receive no power (open circuit) to its input channel. The PLC registers this as a binary bit of 0.

G. PLC Hardware

1. Monitor status and communication faults at the OIT.

   a. Implement watchdog timers to monitor CPU and I/O module health, and execution time for PLC routines.
   b. Generate an alarm at the HMI if any watchdog timer expires.

2. Program the system time for all PLCs to synchronize with a Network Time Protocol (NTP) server once every 24 hours.

H. Input Validation

1. Provide input validation for setpoints used in process control (e.g., chemical dosage setpoints, pump flow setpoints).
2. The PLC will verify that the HMI setpoint is within an acceptable predefined range.
3. Out of range values will be rejected by the PLC and the current value will be retained.

3.3 HISTORICAL DATA COLLECTION

A. Provide historical data collection for all analog inputs, process control setpoints, flow totals, equipment runtimes, and discrete equipment statuses (ON/OFF), unless otherwise stated in the individual loop descriptions. Historical data collection is as follows:

Collection Options	
Collection Type:	Polled
Collection Interval:	1 minute
Collection Offset:	0 seconds
Time Resolution:	Milliseconds
Compression:	Enabled
Collector Deadband:	0.5 Percent Range
Collector Compression Timeout:	15 minutes

3.4 ACCUMULATORS AND TOTALIZERS

A. Accumulators

1. Display accumulated run time for all equipment with a RUNNING status. Each run time accumulation is resettable from the HMI with a reset push button.
2. The PLC will update the flow totals at 12:00 a.m. local time.

Runtime	**Display Format**
Current Day:	XX.XX Hrs.
Yesterday:	XX.XX Hrs.
Current Month:	XXX.X Hrs.
Previous Month:	XXX.X Hrs.
Accumulated Total:	XXXXXX Hrs.

B. Flow Totalizers

1. Totalize all flow indications.

   a. If the flowmeter provided has a configurable pulse output for totalized flow, perform flow totalization using the pulse output. The PLC calculates totalized flow by multiplying the number of pulses by the volume per pulse.
   b. If the flowmeter provided does not have a configurable pulse output for totalized flow, perform flow totalization using the analog 4-20mA signal.

      1) Do not totalize if the analog signal is outside the 4-20 mA range.
      2) Do not totalize if the value of the flow input is less than 2% of the full range of the input.
      3) Do not totalize if a discrete status exists that can be used to determine if flow is present (for example, no flow can be present unless a pump is running).

2. Each flow totalization is resettable from the HMI/OIT with a reset push button.
3. Display totalized flow in million gallons (MGal), thousands of gallons (kGal), or Gallons (Gal) in accordance with the following:

Totalizer	MGal Format	kGal Format	Gal Format
Current Day:	X.XXX	XXX.XX	XXXX.X
Yesterday:	X.XXX	XXX.XX	XXXX.X
Current Month:	XXX.X	XXX.X	XXXX
Previous Month:	XXX.X	XXX.X	XXXX
Accumulated Total:	XXXX	XXXX	XXXX

4. Use appropriate flow totalizer units for the total volume anticipated for the time period. Unless requested by the Owner, water process flows are totalized in million gallons (MGal) and chemical flows are totalized in gallons (Gal). Auxiliary flow (e.g., backwash) units are determined based on the total flow for the day.
5. Chemical systems which do not have flowmeters will calculate usage based on the chemical tank volume. The PLC will calculate tank volume based on the measured level and the vessel geometry or the measured weight and the specific weight of the chemical.
6. The PLC will update the flow totals at 12:00 a.m. local time.

3.5 ALARMING AND EQUIPMENT FAILURES

A. Analog Alarms

1. Provide analog alarming capability for all analog signals monitored by the PLC.
2. Supervisor level users can set a common time setpoint (initially set to 5 seconds) that is used to generate alarms. The following alarms (setpoints to be Supervisor adjustable) are generated based on the analog feedback value. Each alarm includes the ability for individual enabling and disabling.

   a. High-High
   b. High
   c. Low
   d. Low-Low
   e. Loss of Signal

3. LOSS OF SIGNAL alarm is generated when an analog signal goes outside the 4-20 mA range due to a failure at the instrument or PLC card. The following SCADA programming occurs:

    a. If the analog signal is used in a control loop or ratio control loop, that loop is placed into MANUAL.
    b. If the analog signal is used in a calculation, that calculation uses the last good analog signal. If the calculation is used in a control loop, that loop is placed into MANUAL.

4. SETPOINT REJECTED alarm is generated at the HMI when an analog setpoint is out of range and rejected by the PLC.

B. Discrete Alarms

1. Program all discrete alarm signals wired to the PLC (float switches, pressure switches, overload alarms) to alarm after an HMI adjustable time delay expires.
2. The maximum alarm delay for Safety related alarms (e.g., E-stop) is 500ms. Set each alarm timer during startup.

C. Motor Failure Alarms

1. Supervisor level users can set a common elapsed time setpoint for each scenario below:

    a. Motors being remotely controlled generate a FAIL-TO-START alarm when the PLC sends the START command to the motor and it does not receive a RUNNING status from the motor after a supervisor adjustable time setpoint. When a FAIL-TO-START alarm is generated, the START output command from the PLC is deenergized and the motor is prevented from starting until a reset is issued from the HMI.
    b. Motors being remotely controlled generate a FAIL-TO-STOP alarm when the PLC sends the STOP command to the motor and it continues to run after a supervisor adjustable time setpoint.
    c. Motors with adjustable speed control generate a SPEED DEVIATION alarm when the motor is running and the PLC sends a speed setpoint to the motor and it does not reach the correct speed (within a deadband, initially set to 10%) within a supervisor adjustable time setpoint. The motor remains running if the SPEED DEVIATION alarm is activated.

D. Valve Failures

1. Supervisor level users can set a common time setpoint that is used to generate the following alarms. When a valve position alarm is active, the PLC output is maintained unless explicitly stated in the individual loop descriptions (e.g., a fail to open alarm does not trigger the PLC to close the valve).

    a. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-OPEN alarm when the PLC sends the OPEN command to the valve and it does not reach the OPENED limit within a supervisor adjustable time setpoint.
    b. All discrete valves (OPEN-CLOSE) being remotely controlled generate a FAIL-TO-CLOSE alarm when the PLC sends the CLOSE command to the valve and it does not reach the CLOSED limit within a supervisor adjustable time setpoint.

c. All modulating valves (POSITIONING) being remotely controlled generate a FAIL-TO-POSITION alarm when the valve feedback does not match the PLC commanded position within a supervisor adjustable time setpoint.
d. Failure of any motorized valve to complete a planned jogging sequence shall result in a FAIL-TO-JOG alarm in addition to the FAIL-TO-OPEN, FAIL-TO-CLOSE, or FAIL-TO-POSITION alarm that would typically result.

3.6 AUTOMATIC CONTROLS

A. LEAD/LAG/STANDBY, DUTY/STANDBY Strategies

1. Pump Priority

a. When pumps are called to operate in any automatic sequence, the order of their priority is determined by one of the following mode selections.

1) Operator Mode: The operator manually selects the priority of each pump (LEAD/LAG/STANDBY/OFFLINE) using radio buttons on a popup display. The order can be changed at any time, but no two pumps can be selected to have the same priority. The pump cannot run in automatic mode or be used in any of the following automatic sequences if placed OFFLINE.
2) Alternation Mode: Used for pumps operating in a DUTY/STANDBY configuration. The pump priorities are rotated each time the DUTY pump is stopped by the control strategy.
3) Sequential Mode: Used for groups of three or more pumps (e.g., LEAD/LAG/STANDBY). The pumps are inserted into the sequence in ascending numerical order and the PLC rotates the pumps using a revolving queue. After an adjustable time setpoint expires, the LEAD pump becomes the STANDBY and the previous LAG pump becoming the new LEAD.
4) Timed Mode: The pump priorities are determined by the runtime of the pump. The pump with the lowest runtime becomes the LEAD pump. The second lowest runtime becomes the LAG pump. This pattern continues until all pumps are assigned a priority. The PLC determines the pump priority when either all pumps are stopped by the strategy, or when the pumps have been running for longer than an adjustable time setpoint.

2. Automatic Operation

a. If the individual loop description requires that the pumps operate in the LEAD/LAG/STANDBY mode, the LAG is called to start when the following conditions are met after a time delay. If more than one LAG pump is included in the strategy (LEAD/LAG1/LAG2/STANDBY), the sequence repeats.

1) The LEAD pump is running at maximum speed for an adjustable length of time.
2) The process variable being controlled is more than 5% from the target value. For example, in flow control, the flow must be 5% below the target.

b. If multiple pumps are called to run by the automatic logic, the pumps will run at the same speed.

c. If the automatic strategy determines that a pump is needed and the pump for the required sequence position is unavailable, the pump with the next highest position immediately starts.
d. If the individual loop description requires the pumps to operate in the DUTY/STANDBY mode, the STANDBY pump only starts if the DUTY pump is not available to run when called to start by the automatic strategy.

B. PID Control

1. When individual control loops require PID control, use the PLC manufacturer's standard PID control functions. Provide a PID faceplate with the following parameters:

   a. Setpoint (SP): Reference to the setpoint. This is the setpoint entered (either manually from the HMI or via program logic, as required by the individual loop description) and is maintained by the PID controller.
   b. Process Variable (PV): Reference to the process variable. The process variable is the feedback from a field device or instrument for comparison to the SP by the PID controller.
   c. Output (CV): Reference to the controlled variable. This is the signal varied by the PID controller in order to maintain the PV at the desired SP.

2. PID controller accepts inputs for proportional (P), integral (I), and derivative (D) setpoints used to tune the controller response. PID tuning parameters can be entered manually by the Operator at the HMI or calculated automatically if the PID controller supports autotuning functionality.
3. Operator can place the PID controller in MANUAL or AUTOMATIC mode.

   a. In MANUAL, the Operator will enter the desired output (CV). The PID controller will use setpoint tracking to write the process variable (PV) to the controller setpoint (SP) to ensure bumpless transfer when the controller is switched from MANUAL to AUTO.
   b. In AUTO, the PID controller adjusts the output (CV) to hold the process variable (PV) at the setpoint (SP).

4. Configure PID controller to prevent reset windup when operating in MANUAL mode or when the output (CV) has reached maximum limit.

C. Cascade Level Control for Variable Speed Pumps

1. Cascade level control requires two PID controllers used in series to manipulate one process variable (PV).
2. The primary/outer PID is a level controller, where the setpoint (SP) to the PID controller is in engineering units (feet, inches) and adjustable from the HMI. The output (CV) of the level PID controller is a flow, which becomes the remote flow setpoint (SP) to the secondary/inner PID.
3. The secondary/inner PID is a flow controller, where the flow setpoint (SP) is the output (CV) calculated from the level PID controller. The output (CV) of the flow PID controller is a pump speed (%).

3.7 INDIVIDUAL CONTROL DESCRIPTIONS AND CONTROL SEQUENCES

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LOOP 0100-1 WET WELL GRINDER (VENDOR PACKAGE)

A. General

1. Monitoring and control of the Grinder by means of a hardwired connection to SCADA.

B. Control

1. Provide motor control as described in “General Controls and Monitoring” Articles of this section.

C. Alarms/Monitoring

1. Provide analog alarming as described in “Alarming and Equipment Failures” Articles of this section.
2. Provide accumulated runtime monitoring as described in “Accumulators and Totalizers” Articles of this section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0101-0 WET WELL LEVEL ELEMENT SELECTION

A. General

1. Local selection of primary wet well level element/transmitter (LE/LT) via selector switch dry contact (P/S/R) to SCADA. Selecting remote allows operations to determine the primary level sensing device remotely via SCADA.

B. Control

1. Provide discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.
2. Wet well level element selection indication is used to control the Submersible Pumps described in Loops 0110-1, -2.
3. Local selection to promote remote level element selection via SCADA.

C. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0101-1 WET WELL LEVEL

A. General

1. Continuous monitoring of wet well level by means of a radar level transmitter to SCADA.

B. Control

1. Provide analog instrument monitoring as described in “General Controls and Monitoring” Articles of this section.
2. Wet well level indication used to control the Submersible Pumps described in Loops 0110-1, -2
3. Refer to drawing M-2 for level setpoints.

C. Alarms/Monitoring

1. Provide analog and discrete alarming as described in “Alarming and Equipment Failures” Articles of this section.
2. Provide an alarm when an operator adjustable deadband between the two level signals are exceeded. Range should be in inches.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0101-2 WET WELL LEVEL

A. General

1. Functionally identical to Loop 0101-1.

LOOP 0102-1 WET WELL INTRUSION

A. General

1. Intrusion detection by means of a magnetic reed switch.

B. Control

1. Provide discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.

C. Alarms/Monitoring

2. Provide discrete alarming as described in “Alarming and Equipment Failures” Articles of this section.

D. Data Collection:

3. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0110-1 SUBMERSIBLE PUMP NO. 1

A. General

1. Submersible pump with variable speed drive transfers wastewater from the wet well to the treatment plant (WRRF).

B. Hardwired Interlocks

1. Provide interlocks as described in "General Controls and Monitoring" Articles of this section.
2. The pump cannot run if the following alarms are detected:

    a. E-Stop
    b. High Motor Temperature
    c. Motor Moisture (Leak)
    d. VFD Fault
    e. LE/LIT-0101-1 is selected as the PV and the Wet Well Low-Low Level Alarm (LALL-0101-1) is generated.
    f. LE/LIT-0101-2 is selected as the PV and the Wet Well Low-Low Level Alarm (LALL-0101-2) is generated.

C. Software Interlocks

1. Provide interlocks as described in "General Controls and Monitoring" Articles of this section. All hardwired interlocks shall also be a software interlock.
2. If the valve and meter vault flooding level switch is tripped (LSH-0120-1), the SCADA system shall stop all pumps.
3. If any Submersible pump is confirmed running and the discharge flow meter described in Loop 0122-1 does not register flow within 5 seconds (operator adjustable) the SCADA system shall stop all pumps.

D. Control

1. Provide motor control and input validation as described in "General Controls and Monitoring" Articles of this section.
2. Submersible Pumps 1 and 2 operate in a DUTY/STANDBY configuration. Provide Duty/Standby strategy as described in the "Automatic Controls" of this specification.
3. Provide MANUAL, AUTO, and LEVEL PID control, as described in the "Automatic Controls" Article. The setpoint (SP) to the LEVEL PID controller is the operator-entered wet well level setpoint. The process variable (PV) to the LEVEL PID controller is the measured wet well level (Loop 0101-1 or Loop 0101-2 based on selected PV described in Loop 0101-0) and the output (CV) of the LEVEL PID is pump speed (%).
4. Wastewater pump speed shall be limited to prevent effluent flow from exceeding 1,400 GPM.

E. Alarms/Monitoring

1. Provide analog alarms, discrete alarms, and motor failure alarms as described in the "Alarming and Equipment Failures" Articles of this section.
2. Provide accumulated runtime monitoring as described in the "Accumulators and Totalizers" Article of this section.

F. Historical Data Collection

1. Provide historical data collection as described in "Historical Data Collection" Article of this section.

LOOP 0110-2 SUBMERSIBLE PUMP NO. 2

A. General

1. Functionally identical to Loop 0110-1

LOOP 0120-1 VALVE AND METER VAULT FLOODING

A. General

1. Valve and meter vault flooding indication via ultrasonic gap switch.

B. Control

1. Provide discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.
2. Valve and meter vault flooding indication used to control the Submersible Pumps described in Loops 0110-1, -2.

C. Software Interlocks

1. Provide interlocks as described in the “General Controls and Monitoring” Article of this section.
2. Valve and meter vault high level switch used in control of Submersible Pumps described in Loops 0110-1, -2.

D. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” article of this section.

E. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0121-1 VALVE AND METER VAULT INTRUSION

A. General

1. Functionally identical to Loop 0102-1.

LOOP 0122-1 DISCHARGE FLOW

A. General

1. Continuous monitoring of pump station discharge flow by means of magnetic flow transmitter to SCADA.

B. Control

1. Provide analog and discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.

C. Alarms/Monitoring

1. Provide flow totalization as described in the “Accumulators and Totalizers” Article of this section.
2. Provide analog alarming as described in the “Alarming and Equipment Failures” Article of this section.
3. Generate a NO FLOW alarm if no flow is measured while any Submersible Pump is running.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0123-1 DISCHARGE PRESSURE

A. General

1. Continuous monitoring of pump station discharge pressure by means of Pressure Transmitter to Pressure Indicator 0123-1 and SCADA.

B. Control

1. Provide analog instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide analog alarming as described in the “Alarming and Equipment Failures” Article of this section.
2. Generate a LOSS OF PRESSURE alarm if low pressure is measured while any Submersible Pump is running.
3. Generate a HIGH PRESSURE alarm if pressure exceeds 35 psi.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0180-1 UNINTERRUPTIBLE POWER SUPPLY

A. General

1. Monitoring of the control panel mounted uninterruptible power supply (UPS).

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0181-1 STANDBY GENERATOR

A. General

1. Monitoring of the standby generator by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.
2. Refer to the strategy in APPENDIX ONE for the Generator Startup Sequence.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0182-1 AUTOMATIC TRANSFER SWITCH

A. General

1. Monitoring of the Automatic Transfer Switches (ATS) by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.
2. Refer to the strategy in APPENDIX ONE for the Generator Startup Sequence.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0183-1 ODOR CONTROL (FUTURE)

A. General

1. Monitoring of the Odor Control system by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the "General Controls and Monitoring" Article of this section.
2. All programming specified herein shall be provided to facilitate future connection of odor control system.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the "Alarming and Equipment Failures" Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the "Historical Data Collection" Article of this section.

LOOP 0184-1 WET WELL H_2S GAS MONITORING

A. General

1. Continuous monitoring of wet well H_2S gas level by means of combustible gas transmitter to SCADA.

B. Control

1. Provide analog and discrete instrument monitoring as described in the "General Controls and Monitoring" Article of this section.

C. Alarms/Monitoring

1. Provide analog and discrete alarms as described in the "Alarming and Equipment Failures" Article of this section.
2. Provide operator adjustable H2S High alarm. Alarm value initially set to 5 PPM H2S.
3. Provide operator adjustable H2S High-High alarm. Alarm value initially set to 10 PPM according to NIOSH.

D. Data Collection:

1. Provide historical data collection as described in the "Historical Data Collection" Article of this section.

LOOP 0185-1 WET WELL % LEL GAS MONITORING

A. General

3. Continuous monitoring of wet well gas %LEL by means of combustible gas transmitter to SCADA.

A. Control

1. Provide analog and discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

B. Alarms/Monitoring

1. Provide analog and discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.
2. Provide operator adjustable High alarm. Alarm value initially set to 5% LEL
3. Provide operator adjustable High-High alarm. Alarm value initially set to 10% LEL according to NFPA 20

C. Data Collection

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0190-1 STATION INTRUSION – CONTROL BUILDING

A. General

1. Functionally identical to Loop 0102-1.

LOOP 0191-1 CONTROL BUILDING TEMPERATURE

A. General

1. Continuous monitoring of Control Building temperature by means of temperature transmitter to SCADA.

B. Control

1. Provide analog and discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide analog and discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0192-1 24VDC POWER SUPPLY 1 MONITORING

A. General

1. Monitoring of the 24VDC Power Supply and independent redundancy module by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0192-2 24VDC POWER SUPPLY 2 MONITORING

A. General

1. Functionally identical to Loop 0192-1.

LOOP 0195-1 MANUAL TRANSFER SWITCH

A. General

1. Monitoring of the Manual Transfer Switches (MTS) by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0196-1 MANAGED ETHERNET SWITCH

A. General

1. Monitoring of the Managed Ethernet Switch (MES) by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0200-1 WET WELL GRINDER (VENDOR PACKAGE)

A. General

1. Monitoring and control of the Grinder by means of a hardwired connection to SCADA.

B. Control

1. Provide motor control as described in “General Controls and Monitoring” Articles of this section.

C. Alarms/Monitoring

1. Provide analog alarming as described in “Alarming and Equipment Failures” Articles of this section.
2. Provide accumulated runtime monitoring as described in “Accumulators and Totalizers” Articles of this section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0201 WET WELL LEVEL ELEMENT SELECTION

A. General

1. Local selection of primary wet well level element/transmitter (LE/LT) via selector switch dry contact (P/S/R) to SCADA. Selecting remote allows operations to determine the primary level sensing device remotely via SCADA.

B. Control

1. Provide discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.
2. Local wet well level element selection used to control Submersible Pumps as described in Loops 0210-1, -2, -3.
3. Local selection to allow remote level element selection via SCADA.

C. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0201-1 WET WELL LEVEL

A. General

1. Continuous monitoring of wet well level by means of a radar level transmitter to SCADA.

B. Control

1. Provide analog instrument monitoring as described in “General Controls and Monitoring” Articles of this section.
2. Wet well level indication used to control the Submersible Pumps described in Loops 0210-1, -2, -3.
3. Refer to drawing M-4 for level setpoints.

C. Alarms/Monitoring

1. Provide analog and discrete alarming as described in “Alarming and Equipment Failures” Articles of this section.
2. Provide an alarm when an operator adjustable deadband between the two level signals are exceeded. Range should be in inches.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0201-2 WET WELL LEVEL

A. General

1. Functionally identical to Loop 0201-1.

LOOP 0202-1 WET WELL INTRUSION

A. General

1. Intrusion detection by means of a magnetic reed switch.

B. Control

1. Provide discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.

C. Alarms/Monitoring

1. Provide discrete alarming as described in “Alarming and Equipment Failures” Articles of this section.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0210-1 SUBMERSIBLE PUMP NO. 1

A. General

1. Submersible pump with variable speed drive transfers wastewater from the wet well to the treatment plant (WRRF).

B. Hardwired Interlocks

1. Provide interlocks as described in “General Controls and Monitoring” Articles of this section.
2. The pump cannot run if the following alarms are detected:

a. E-Stop
b. High Motor Temperature
c. Motor Moisture (Leak)
d. VFD Fault
e. LE/LIT-0201-1 is selected as the PV and the Wet Well Low-Low Level Alarm (LALL-0201-1) is generated.
f. LE/LIT-0201-2 is selected as the PV and the Wet Well Low-Low Level Alarm (LALL-0201-2) is generated.

C. Software Interlocks

1. Provide interlocks as described in “General Controls and Monitoring” Articles of this section. All hardwired interlocks shall also be a software interlock.
2. If the valve vault flooding level switch is tripped (LSH-0220-1), the SCADA system shall stop all pumps.
3. If the meter vault flooding level switch is tripped (LSH-0230-1), the SCADA system stops the pump.
4. If any Submersible pump is confirmed running and the discharge flow meter described in Loop 0232-1 does not register flow within 5 seconds (operator adjustable) the SCADA system shall stop the pump.

D. Control

1. Provide motor control and input validation as described in “General Controls and Monitoring” Articles of this section.
2. Submersible Pumps 1 through 3 operate in a LEAD/LAG/STANDBY configuration. Provide LEAD/LAG/STANDBY strategy as described in the “Automatic Controls” section of this article.
3. Provide MANUAL, AUTO, and LEVEL PID control, as described in the “Automatic Controls” Article. The setpoint (SP) to the LEVEL PID controller is the operator-entered wet well level setpoint. The process variable (PV) to the LEVEL PID

controller is the measured wet well level (Loop 0201-1 or Loop 0201-2 based on selected PV described in Loop 0201-0) and the output (CV) of the LEVEL PID is pump speed (%).

4. If one wastewater pump is running the pump speed shall be limited to prevent effluent flow from exceeding 1,600 GPM. If two wastewater pumps are running the pumps' speed shall be limited to prevent effluent flow from exceeding 2,600 GPM.

E. Alarms/Monitoring

1. Provide analog alarms, discrete alarms, and motor failure alarms as described in the "Alarming and Equipment Failures" Articles of this section.
2. Provide accumulated runtime monitoring as described in the "Accumulators and Totalizers" Article of this section.

F. Historical Data Collection

1. Provide historical data collection as described in "Historical Data Collection" Article of this section.

LOOP 0210-2 SUBMERSIBLE PUMP NO. 2

A. General

1. Functionally identical to Loop 0210-1

LOOP 0210-3 SUBMERSIBLE PUMP NO. 3

A. General

1. Functionally identical to Loop 0210-1.

LOOP 0220-1 VALVE VAULT FLOODING

A. General

1. Valve vault flooding indication via ultrasonic gap switch.

B. Control

1. Provide discrete instrument monitoring as described in "General Controls and Monitoring" Articles of this section.
2. Valve vault flooding indication used to control the Submersible Pumps described in Loops 0210-1, -2, -3.

C. Software Interlocks

1. Provide interlocks as described in the "General Controls and Monitoring" Article of this section
2. Valve vault high level switch used in control of Submersible Pumps described in Loops 0210-1, -2, -3.

D. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” article of this section.

E. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0221-1 VALVE VAULT INTRUSION

A. General

1. Functionally identical to Loop 0202-1.

LOOP 0230-1 METER VAULT FLOODING

A. General

1. Functionally identical to Loop 0220-1.

LOOP 0231-1 METER VAULT INTRUSION

A. General

1. Functionally identical to Loop 0202-1.

LOOP 0232-1 DISCHARGE FLOW

A. General

1. Continuous monitoring of pump station discharge flow by means of magnetic flow transmitter to SCADA.

B. Control

1. Provide analog and discrete instrument monitoring as described in “General Controls and Monitoring” Articles of this section.
2. Discharge flow indication used to control the Submersible Pumps described in Loops 0210-1, -2, -3.

C. Alarms/Monitoring

1. Provide flow totalization as described in the “Accumulators and Totalizers” Article of this section.
2. Provide analog alarming as described in the “Alarming and Equipment Failures” Article of this section.
3. Generate a NO FLOW alarm if no flow is measured while any Submersible Pump is running.

D. Data Collection:

1. Provide historical data collection as described in “Historical Data Collection” Article of this section.

LOOP 0233-1 DISCHARGE PRESSURE

A. General

1. Continuous monitoring of pump station discharge pressure by means of Pressure Transmitter to Pressure Indicator 0233-1 and SCADA.

B. Control

1. Provide analog instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide analog alarming as described in the “Alarming and Equipment Failures” Article of this section.
2. Generate a LOSS OF PRESSURE alarm if low pressure is measured while any Submersible Pump is running.
3. Generate a HIGH PRESSURE alarm if pressure exceeds 50 psi.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0280-1 UNINTERRUPTIBLE POWER SUPPLY

A. General

1. Monitoring of the control panel mounted uninterruptible power supply (UPS).

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0281-1 STANDBY GENERATOR

A. General

1. Monitoring of the standby generator by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.
2. Refer to the strategy in APPENDIX ONE for the Generator Startup Sequence.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0282-1 AUTOMATIC TRANSFER SWITCH

A. General

1. Monitoring of the Automatic Transfer Switches (ATS) by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.
2. Refer to the strategy in APPENDIX ONE for the Generator Startup Sequence.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0283-1 ODOR CONTROL (FUTURE)

A. General

1. Monitoring of the Odor Control system by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.
2. All programming specified herein shall be provided to facilitate future connection of odor control system.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0284-1 WET WELL H_2S GAS MONITORING

A. General

1. Continuous monitoring of wet well H_2S gas level by means of combustible gas transmitter to SCADA.

B. Control

1. Provide analog and discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide analog and discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.
2. Provide operator adjustable H2S High alarm. Alarm value initially set to 5 PPM H2S.
3. Provide operator adjustable H2S High-High alarm. Alarm value initially set to 10 PPM according to NIOSH.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0285-1 WET WELL % LEL GAS MONITORING

D. General

3. Continuous monitoring of wet well gas %LEL by means of combustible gas transmitter to SCADA.

E. Control

1. Provide analog and discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

F. Alarms/Monitoring

1. Provide analog and discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.
2. Provide operator adjustable High alarm. Alarm value initially set to 5% LEL

3. Provide operator adjustable High-High alarm. Alarm value initially set to 10% LEL according to NFPA 20

G. Data Collection

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0290-1 STATION INTRUSION – CONTROL BUILDING

A. General

1. Functionally identical to Loop 0202-1.

LOOP 0291-1 CONTROL ROOM TEMPERATURE

A. General

1. Continuous monitoring of Control Building temperature by means of temperature transmitter to SCADA.

B. Control

1. Provide analog and discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide analog and discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0292-1 24VDC POWER SUPPLY 1 MONITORING

A. General

1. Monitoring of the 24VDC Power Supply and independent redundancy module by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0292-2 24VDC POWER SUPPLY 2 MONITORING

A. General

1. Functionally identical to Loop 0292-1.

LOOP 0295-1 MANUAL TRANSFER SWITCH

A. General

1. Monitoring of the Manual Transfer Switches (MTS) by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

LOOP 0296-1 MANAGED ETHERNET SWITCH

A. General

1. Monitoring of the Managed Ethernet Switch (MES) by means of a hardwired connection to SCADA.

B. Control

1. Provide discrete instrument monitoring as described in the “General Controls and Monitoring” Article of this section.

C. Alarms/Monitoring

1. Provide discrete alarms as described in the “Alarming and Equipment Failures” Article of this section.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

APPENDIX ONE GENERATOR STARTUP SEQUENCE

A. General

1. The Automatic Transfer Switch (ATS) will indicate if utility power is lost. On power loss, process equipment will be interlocked, and the generator will be called to START. When the generator is confirmed RUNNING, pumps previously running in AUTO will be sequentially called to restart. Time delays between each step of the sequence shall be implemented to prevent generator overload.

B. Control

1. Each step of the sequence has an HMI/OIT user adjustable step time setpoint (initially set to 20 seconds). The PLC will not proceed to the next step until the current steps’ timer expires.
2. Refer to Section 263213.16 “Gaseous Emergency Engine Generators.DOC” for Generator start-up procedure and sequencing.
3. Refer to Section “263600 - Transfer Switches.DOC” for ATS steps and procedures as they relate to Generator start-up.

C. Alarms/Monitoring

1. The OIT will display START-UP-FAULT alarm if any of the steps in the automatic start-up sequence are not confirmed complete before the step timer expires.

D. Data Collection:

1. Provide historical data collection as described in the “Historical Data Collection” Article of this section.

END OF SECTION 406196

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SECTION 406263 - OPERATOR INTERFACE TERMINALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

1. Section includes operator interface terminals.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406126 “Process Control System Training” for training requirements.
4. Section 406733 “Panel Wiring” for wiring requirements.
5. Section 406343 “Programmable Logic Controllers” for specifications on the PLC the OIT will be networked to.
6. Section 406613 “Switches and Routers” for specifications on the managed Ethernet switch the OIT will connect to.
7. Section 406717 “Industrial Enclosures” for specifications on the enclosure to which the OIT will be mounted.
8. Section 406733 “Panel Wiring” for panel wiring requirements.
9. Section 406863 “Configuration of HMI Software” for specific graphic screens and color code requirements.”

1.3 DEFINITIONS

A. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

B. Human Machine Interface (HMI): A hardware or software through which an operator interacts with a controller.

C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

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1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Operator Interface Terminals: Full-size units equal to 20 percent of quantity installed for each size indicated, but no fewer than 1 units.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years' documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum 10 years' experience.

1.10 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current

version of hardware of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the Hardware Packages Submittal.
2. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit for approval the required data of the latest available hardware equivalent in cost to that which is specified. Do not order equipment more than 3 months prior to when it is needed to be continuously used on the project.
3. The specific hardware in this section that will adhere to this requirement are as follows:

    a. Operator Interface Terminal

1.11 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.12 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.13 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 OPERATOR INTERFACE TERMINAL (OIT)

A. Manufacturers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Allen-Bradley – PanelView Plus 1500 or comparable product by one of the following:

    a. Rockwell Automation Allen-Bradley – PanelView Plus 15 Performance series.
    b. Schneider Electric – Magelis series
    c. Siemens – SIMATIC HMI IPC series.
    d. Or equal

B. General

1. OITs are standalone devices with an integrated hardware/software platform to monitor and control a process through an interactive display.

C. Features

1. Software

a. OITs pre-packaged with all configuration and programming software necessary to perform functions as shown on drawings and within the specifications.
b. Integrated OIT software has the following features:

1) Trending
2) Data logging
3) Alarms
4) Graphic symbols
5) Animations

2. Hardware

a. Minimum one Secure Digital (SD) card slot

D. Communications

1. Ports

a. Minimum two (2) 10/100MB Ethernet
b. Minimum one (1) USB

2. Protocols

a. EtherNet/IP
b. Modbus TCP/IP

E. Display:

1. Minimum of 15" viewable as measured diagonally across screen
2. Minimum display resolution: 1024 x 768 for 12" to 15” displays
3. Color Active Matrix TFT.
4. Display shall support touch screen input and physical keypad input.

F. Environmental:

1. Rating: OIT rated to maintain the rating of the control panel it will be mounted on and meet the area classification.
2. Operating Temperature: 32 to 122 degrees F

2.2 OIT SOFTWARE

A. Not required. The AESS and the manufacturer of vendor provided equipment utilizing OIT’s shall own the OIT software required to execute the Work under this Contract.

B. The OIT shall be programmed on the latest version software at the time construction starts.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine industrial enclosure and process area for suitable conditions where OIT’s will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of each OIT.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Operator interface terminals will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform the following startup service.

1. Complete installation and startup check according to manufacturer's written instructions.
2. Complete I/O testing as defined in Section 406121.02 “Process Control System Testing.”

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units in accordance with 406126 “Process Control System Training.”

END OF SECTION 406263

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SECTION 406343 - PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes programmable logic controllers.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406126 “Process Control System Training” for training requirements.
4. Section 406613 “Switches and Routers” for specifications on the managed Ethernet switch the PLC will connect to.
5. Section 406650 “Radio Telemetry Equipment” for communication requirements.
6. Section 406717 “Industrial Enclosures” for specifications on the enclosure to which the PLC will be mounted.
7. Section 406733 “Panel Wiring” for wiring requirements.
8. Section 406866 “Configuration of Controller Software” for PLC programming and configuration requirements.

1.3 DEFINITIONS

A. Analog Input (AI): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) to be interpreted by a PLC.

B. Analog Output (AO): An electrical signal (1-5 Volts DC or 4-20 milliamps, for example) sent from a PLC to a field device.

C. Digital/Discrete Input (DI): A binary signal (0 or 1) to be interpreted by a PLC.

D. Digital/Discrete Output (DO): A binary signal (0 or 1) sent from a PLC to a field device.

E. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

F. Human Machine Interface (HMI): A hardware or software-based user interface with supervisory level control and of machine level equipment.

G. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

H. Peer to Peer: Communication between two or more devices, typically PLC's, in which each device can control the communication exchange.

I. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

J. Remote I/O (RIO): I/O that is located remotely from the processor. Remote I/O can communicate over a variety of communication protocol and can use standard rack based I/O, or specialized Remote I/O hardware referred to as Distributed I/O.

K. Variable Frequency Drive (VFD): A type of motor controller that drives an electric motor by varying the frequency and voltage of its power supply.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

B. Shop Drawings:

1. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions."

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to Section 406100 "Process Control and Enterprise Management System General Provisions" for additional maintenance material submittal requirements.

B. Furnish extra materials from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. CPU: Provide spare CPU for each unique type installed. Provide 15% of installed quantity or 1, whichever quantity is greater.

2. I/O Cards: Provide spares for each unique I/O module type installed. Provide two (2) or 15 percent of installed quantity, whichever is greater.
3. Network interface, remote I/O, and communication modules: Provide two (2) spare modules for each unique type of module installed.
4. Miscellaneous components (including cables): Provide spares for each unique component installed.
5. Power Supply: Provide two (2) spare power supplies or 15 percent of installed quantity, whichever is greater.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years documented experience, and with service facilities within 100 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum 10 years documented experience.

1.10 TECHNOLOGY OBSOLESCENCE MITIGATION

A. Due to rapidly evolving technology of the equipment specified herein, the requirements specified are to establish a baseline for the type of equipment required. Provide the current version of hardware of similar specification at the time of purchase equivalent in cost to that which is specified. The procedure for submitting and releasing the equipment is as follows:

1. PCSS to submit for approval the required data for the equipment as part of the Hardware Packages Submittal.
2. Order equipment as late as possible dependent on the construction schedule to ensure the latest equipment available is provided. Just prior to ordering, resubmit the required data of the latest available hardware equivalent in cost to that which is specified for approval. Do not order equipment more than 3 months prior to when it is needed to be continuously used on the project.
3. The specific hardware in this section will adhere to this requirement as follows:

    a. Chassis Based PLC System

1.11 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.12 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.13 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Configuration: Standalone programmable controller for controlling a wastewater pumping station, configured to communicate over a licensed frequency radio network for remote monitoring of the station.

2.2 SPARE I/O, SLOTS, AND FUTURE EXPANSION

A. Spare PLC I/O:

1. I/O related to equipment shown as future on the Drawings shall be included in spare I/O calculations.
2. Provide 25 percent, or minimum of four points per type (AI, AO, DI, DO) for future use, regardless of whether any of those point types are used in that panel or not.
3. Provide spare I/O points of same type of I/O modules supplied.

B. Spare PLC Slots (Chassis-Based PLC Systems): Provide at least 2 spare slots for addition of future I/O in each chassis provided.

C. Provide external relays for all spare output points.

D. Wire all unused points on all I/O to terminal blocks in the order that they occur on the I/O modules.

2.3 CHASSIS BASED PLC SYSTEM

A. Manufacturers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Rockwell Automation Allen-Bradley 1756-L82 ControlLogix or comparable product by one of the following:

a. Rockwell Automation Allen-Bradley – 1756 -L82 ControlLogix
b. Schneider Electric – M580

c. Siemens – S7 Series
d. Or equal

B. General:

1. Provide processor, power supply, I/O modules, communication modules, redundancy modules, and remote interface modules as required to meet system requirements.
2. Listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.
3. Contains the required memory and functional capacity to perform the specified sequence of operation with the scheduled inputs and output points.
4. Designed for continuous industrial service.
5. Provide products of a single manufacturer.
6. Provide equipment models that are currently in production.
7. In the event of power interruption, the system undergoes an orderly shutdown with no loss of memory and resumes normal operation without manual intervention when power is restored.
8. Provide PLCs that communicate between workstations, servers, instruments, switches, controllers, process actuators, etc. as shown on the Drawings.
9. PLC capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.

C. Physical:

1. Vibration: 3.5mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 Hz. Vibration tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing. Vibration Rating of 2.0G maximum peak acceleration for 10 to 500 Hz. In accordance with one of the following:

   a. DIN rail mounted PLC, 10 – 57 Hz., amplitude 0.075 mm, acceleration 25-100 Hz.
   b. Panel or plate mounted PLC: 2-25 Hz., amplitude 1.6mm, acceleration 25-200 Hz.
   c. In compliance with IEC 60068 and IEC 61131.

2. Shock: 15G, 11msec. Shock tested in accordance with IEC 68-2-6 and JIS C 0911. The system is to be operational during and after testing.
3. Operating Temperature: 32 to 140 degrees F.
4. Storage Temperature: -13 to 158 degrees F.
5. Relative Humidity: 10 to 95 percent, non-condensing.
6. Noise Immunity: Tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978.
7. Altitude (Operating): 0 to 6,500 feet.
8. Altitude (Storage): 0 to 9,800 feet.
9. Degree of protection: NEMA 1 (IP20).
10. All products have corrosion protection.

D. Identification

1. Identify all major assemblies and sub-assemblies, circuit boards, and devices using permanent labels or markings indicating:

a. Module product type such as analog or digital.
b. Module catalog number.
c. Module major revision number.
d. Module minor revision number.
e. Module manufacturer vendor.
f. Module serial number.

E. PLC Central Processing Unit (CPU):

1. General:

a. Minimum 16-bit microprocessor with system timing and is responsible with scheduling I/O updates with no user programming required to ensure discrete or analog update.
b. Executes user relay ladder logic programs, communicates with intelligent I/O modules, and performs on-line diagnostics.
c. Consists of a single module which solves application logic, stores the application program, stores numeric values related to the application processes and logic, and interfaces to the I/O.
d. Samples all discrete and analog inputs and outputs including internal coils and registers, and service special function modules every scan. The CPU processes the I/O with user programs(s) stored in memory and controls outputs based on the results of the logic operation.
e. Supply the CPU with a battery-backed time of day clock and calendar.
f. CPU family allows for user program transportability from one CPU model to another.

2. Diagnostics:

a. Perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, initiate orderly system shutdown and fail-over. Monitor the following, at a minimum:

1) Memory failure
2) Memory battery low
3) General fault
4) Communications port failure
5) Scan time over run
6) I/O failure
7) Analog or special function I/O module failure

b. Make diagnostic information accessible to the host communications interfaces and to the PLC program.
c. PLC indicators and on-board status area for the following conditions:

1) CPU run.
2) CPU error or fault.
3) I/O failure or configuration fault.
4) Status of Battery or back-up power module.
5) Communications indicator.

3. Memory

    a. Provide non-volatile battery backed memory of type CMOS RAM program memory or equivalent.
    b. Memory Backup System: Provide lithium battery backup or equivalent capable of retaining all memory for a minimum of three months and a Flash memory system capable of reloading program in the event of memory loss.

        1) Backup Storage: Provide backup battery or capable of being replaced without disrupting memory integrity. Provide a visual indication of low battery voltage or module error and an alarm bit in the PLC program.
        2) SD Memory Card: Provide memory card storage with capacity greater than processor memory capacity. Install memory cards in processors for factory testing.

    c. Operating system contained in non-volatile firmware.
    d. The memory containing the operating system is field updateable via a separate update tool.

4. Programming Environment

    a. Programming port: Use PLC Ethernet port for programming.
    b. On-Line programming: Application programs may be modified or stored while the CPU is running, with minimal impact on the scan time.
    c. Online programming including runtime editing.
    d. IEC 61131-3 programming languages supported: Ladder logic, function block, sequential function chart, and structured text.
    e. Supply all hardware necessary to program the CPU in these languages.

5. Communication Ports:

    a. Provide expandable CPU supplied with additional modules to support the required communication interfaces.

6. Remote I/O Communications:

    a. Provide CPU capable of communicating with up to 12 remote base locations. Automatically sample and update all local and remote I/O modules each scan cycle of the CPU.
    b. Provide communication link between the CPU and any RIO chassis as recommended by the PLC manufacturer.
    c. Provide diagnostic and equipment status information from each RIO.
    d. Provide remote I/O system with a remote input/output arrangement capable of operation at locations physically separated from the PLC CPU as detailed on the drawings.
    e. Communicate with the remote I/O arrangement through cable as recommended by the PLC manufacturer and provided by the PLC system supplier under this specification Section.

F. Power Supplies:

1. Power Input: 85 to 265VAC, 47 - 63Hz.
2. Provide DC power supplies capable of handling ripple up to 2.4V peak to peak.
3. Chassis mounted power supplies to power the chassis backplane and provide power for the processor and applicable modules.
4. Provide clearly visible LED to indicate that the incoming power is acceptable, and the output voltage is present.
5. Provide over-current and over-voltage protection designed to operate in most industrial environments without the need for isolation transformers.
6. Size power supplies to accommodate the nominal load plus 30%.
7. Provide power supplies capable of sustaining brown out conditions of at least 1/2 of a cycle, a harmonic rate of 10%, and continuous operation through momentary interruptions of AC line voltage of 10ms or less.
8. Automatically shut down the PLC system whenever its output power is detected as exceeding 125% of its rated power.
9. Provide surge protection, isolation, and outage carry-over up to 2 cycles of the AC line.

G. Chassis:

1. Distribute all system and signal power to the CPU and support modules on the backplane. No interconnecting wiring between these modules via plug-terminated jumpers is acceptable.
2. Provide free air cooling for all system modules, main and expansion chassis. No internal fans or other means of cooling except heat sinks is permitted.
3. Provide means to remove all system modules from the chassis or inserted to the chassis while power is being supplied to the chassis without faulting the processor or damaging the modules.
4. Modules designed to plug into a chassis and to be keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong slot or chassis via an electronic method for identifying a module. Perform an electronic keying check to ensure that the physical module is consistent with what was configured.

H. Discrete Input & Output Modules:

1. General:

a. Digital input and output modules provide ON/OFF detection and actuation capability.
b. Provide cards of I/O type and count as required to implement the functions specified plus an allowance for active spares, as specified herein.
c. Provide modules capable of being installed or removed while chassis power is applied.
d. Provide the following status indicators.

1) On/Off state of the field device.
2) Module's communication status.
3) Module health

2. Module Specifications – 120VAC Input Module

    a. Nominal Input Voltage: 120VAC
    b. On-State Current: 15mA at 132VAC, 47 - 63Hz maximum.
    c. Maximum Off-State Voltage: 20V.
    d. Maximum Off-State Current: 2.5mA.
    e. Number of Points per Card: 16.

3. Module Specifications – Individually Isolated Relay Output Module

    a. Output Voltage Range: 10 - 265VAC, 47 - 63 Hz, 5 - 125VDC.
    b. Output Current Rating:

        1) Per Point: 2.5A maximum.
        2) Per Module: 16A maximum.

    c. Power Rating (Steady State): 250VA maximum for 125VAC inductive output.
    d. Maximum Off-State Leakage: 0 mA per point.
    e. Configurable States:

        1) Fault per Point: Hold Last State, ON or OFF.
        2) Program Mode per Point: Hold Last State, ON or OFF.

    f. Number of Points per Card: 16.

I. Analog Input & Output Modules:

1. General:

    a. Analog input modules convert an analog signal (1 to 5 Volts DC, 4 to 20 milliamps, for example) that is connected to the module's screw terminals into a digital value. The digital value representing the magnitude of the analog signal is transmitted on the backplane.
    b. Furnish analog output modules to convert a digital value that is delivered to the module via the backplane into an analog signal on the module's screw terminals.
    c. Provide modules designed to be installed or removed while chassis power is applied.
    d. Provide the following status indicators:

        1) Module's communication status.
        2) Module health
        3) Input/output devices

    e. Hardware and software indication provided when a module fault has occurred. Each module provided with an LED fault indicator and the programming software displays the fault information.
    f. Provide analog modules that are software configurable through the I/O configuration portion of the programming software.

g. Following status can be examined in ladder logic:

1) Module Fault Word: Provides fault summary reporting.
2) Channel Fault Word: Provides under-range, over-range, and communications fault reporting.
3) Channel Status Words: Provides individual channel under-range and over-range fault reporting for process alarm, rate alarms and calibration faults.

h. Provide 24 VDC power for analog instrument loops as a part of the system. Derive 24 VDC power supply from the 120 VAC input power circuit to the PLC. Group the field side of the 24 VDC power sources(s) as individual or grouped (of logically associated circuits) fusing and provide with a readily visible, labeled blown fuse indicator.

2. Differential Analog Input Module:

a. Input Range: 0-20 mA.
b. Resolution: approximately 16 bits across range.
c. Input Impedance: Greater than 249 Ohms.
d. Overvoltage Protection: 8V ac/dc with on-board current resistor.
e. Normal Mode Rejection: 60 dB at 60 Hz.
f. Common Mode Noise Rejection: 120 dB at 60 Hz, 100 dB at 50 Hz.
g. Isolation Voltage:

1) Channel to Ground/Chassis - 100% tested at 1000 VDC minimum for 1s based on 250 VAC.

h. Provide individual isolators, in addition to the surge suppression devices specified, in the control panels listed in Section 406717 “Industrial Enclosures” for all signals that enter the panel from outside the building. Substitution of isolated analog input cards to meet this requirement is acceptable.
i. Number of Points per Card: 8.

J. Communication Interfaces:

1. Supported protocols:

a. EtherNet/IP.
b. Modbus TCP/IP.
c. PROFINET.

2. Ports:

a. Two (2) 100MB/1G Ethernet.
b. USB.

3. Utilizing in-chassis communication modules or built-in ports on the PLC is acceptable to meet communication interface requirements.

K. Required Accessories:

1. Include all necessary cables as specified by the manufacturer. Assemble and install cables per manufacturer recommendations.

2.4 PLC SOFTWARE

A. Not required. The AESS and manufacturer of vendor provided equipment shall own the PLC software required to execute the Work under this Contract.

B. Program PLC's using the latest version software available at the start of construction and as approved by the Engineer.

2.5 SOURCE QUALITY CONTROL

A. Section 014000 "Quality Requirements" for requirements for testing, inspection, and analysis.

B. Testing: Test programmable controller according to NEMA IA 2.2.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine rooms and industrial enclosures for suitable conditions where Controllers will be installed .

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's instructions for installation of each PLC.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to control system architecture for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Programmable Logic Controllers will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. PCSS and AESS shall both perform startup service. PCSS shall furnish and install PLC in control panel, wire all internal control panel wiring to PLC, and place PLC into operation for AESS. AESS shall configure and program PLC’s in accordance with Section 406196 “Process Control Descriptions”.

1. For all VFD’s provided on the project, the PCSS, AESS, and VFD manufacturer’s startup technician shall perform startup service. PCSS shall be present to correct any faulty internal control panel wiring found during testing. AESS shall configure and program PLC’s in accordance with Section 406196 “Process Control Descriptions.” VFD manufacturer’s startup technician shall be present and trained to provide configuration and startup services for the VFD as it relates to Ethernet communications with the PLC.

B. Perform the following startup service:

1. Complete installation and startup check according to manufacturer's written instructions.
2. Complete I/O testing as defined in Section 406121.20 “Process Control System Testing.”

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units according to 406126 “Process Control System Training.”

END OF SECTION 406343

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SECTION 406613 - SWITCHES AND ROUTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes managed Ethernet switches .

B. AESS is responsible for performing configuration services for equipment provided under this section.

C. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406733 “Panel Wiring” for panel wiring requirements.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Control System Security Provider (CSSP): The entity who provides all programming, configuration, and services related to the implementation of cybersecurity countermeasures.

C. Fiber Optic Ethernet switch (FOES): An Ethernet based networking device with a combination of fiber optic and copper physical connections.

D. Local Area Network (LAN): A localized group of network devices (e.g. buildings, homes, offices, etc..).

E. Managed Ethernet switch (MES): An Ethernet based networking device that permits the management, configuration, and monitoring of a local area network.

F. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

G. Power over Ethernet (PoE): A method of providing electrical current over an Ethernet connection.

H. Small form-factor pluggable (SFP): A hot-pluggable network interface module connecting a device motherboard (Ethernet switch, router, etc.) to a fiber optic or copper networking cable.

I. Unmanaged Ethernet Switch (UMES): An Ethernet based networking device with a fixed configuration (i.e. “plug-and-play” devices).

J. Virtual Private Network (VPN): An encrypted connection between a private network and a public network (the internet).

K. Wide Area Network (WAN): A network that covers a broad geographic area, typically through use of a public network (e.g. communication across cities, national boundaries, etc.).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Managed Ethernet Switch: One Switch for each type installed.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 INDUSTRIAL MANAGED ETHERNET SWITCH

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen-Bradley Stratix 5700 Series
b. Cisco Catalyst IE3400 Series
c. Moxa 5XX series
d. Or equal

B. General:

1. Provide a DIN rail mountable industrial managed Ethernet switch for connection to the network as shown in the Drawings and specified herein.
2. Provide ethernet switches by the same manufacturer for the project, regardless of type.

C. Physical Features:

1. Copper ports: 10/100/1000BaseT(X) ports, quantity as required by the schedule in PART 3.
2. Operating temperature: 0 to 130 degrees F
3. Power: redundant 24VDC power input.
4. Enclosure: Metal case.
5. Rating: UL Class 1, Division 2 Groups A, B, C, and D.

D. Network Features:

1. Layer 2 switching.
2. Spanning Tree Protocol (STP).
3. Rapid Spanning Tree Protocol (RSTP) (IEEE 802.1w).
4. Full duplex on all port.
5. Auto negotiation and manual configurable speed and duplex.
6. Wire speed switching fabric.
7. IGMP snooping.
8. IGMP filtering.
9. Configuration password protected.
10. Configuration backup capability required.
11. SNMP V3.
12. Lock port function for blocking unauthorized access based on MAC address.

E. Additional Features:

1. Provide dry contact rated for 120 VAC 5A to be used for common trouble alarm and programmable alarm. If the contact cannot use 120 VAC 5A, provide the necessary 24 VDC power from the PLC panel and provide interposing relays in the PLC panel.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine enclosures and rooms for suitable conditions where managed Ethernet switches will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of each MES.

B. Comply with NECA 1

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work

C. Switchers and routers will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check’s according to manufacturer's written instructions.
2. For Managed Ethernet Switches:

a. Enable the lock port function to block unauthorized access based on MAC address for each switch and router. Assign static IP addresses to devices connecting to switch.

b. Lock down all spare switch and router ports.
c. Reserve one port and static IP address for a programming port.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

3.8 SWITCHES AND ROUTERS SCHEDULE

A. Provide the devices in the following schedules:

Table 1. Ethernet Switch Schedule

Switch Designation	Type	Mount	Fiber Uplinks (1G/10G SFP)	Copper Ports (10/100/1000 BaseT(X), RJ45)	PoE Copper Ports (10/100/1000 BaseT(X), RJ45)
MES-PS1CP	Managed Ethernet Switch	DIN Rail	0	8	0
MES-PS2CP	Managed Ethernet Switch	DIN Rail	0	8	0

END OF SECTION 406613

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SECTION 406650 - RADIO TELEMETRY EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes radio telemetry equipment

B. Section includes procurement of the services of a RTSS to provide all materials, equipment, labor, and services required to achieve a fully integrated and operational LFR system as specified herein, in “Related Requirements” under this Article, and in related drawings, except for those services and materials specifically noted.

1. The RTSS for this project shall be sole sourced to TCS Communications Corp. The contact information for the RTSS is as follows:

Dean A. Marengi
TCS Communications Corp
85 Lafayette Road
PO Box 5192
Salisbury, MA 01952-5192
Office: 978-465-7932
Cell: 508-726-3482
Email: damtcs@aol.com
Email: dean.marengi@tcscommunications.com
Website: www.tcscommunications.com

C. A radio path study was performed on February 1, 2023 by TCS Communications Corp. The equipment specified herein is based on the results of the radio path study and the recommendations of TCS Communications. A copy of the radio path study is included as an appendix to this Section.

1. The network shall be capable of supporting communications between all servers, operator workstations, PLCs, RTUs, and other communication devices as shown on the system architecture block diagram(s). Furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules; splice kits, etc. required for a complete and operational network. The system architecture diagram(s) are for network understanding only. Some communication devices maybe be required for network operation, which may not be explicitly shown on the Drawings. The system shall be designed to accommodate an increase of 100 percent of network nodes.

D. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provision.”
2. Section 406121.20 “Process Control System Testing” for factory testing requirements.
3. Section 406126 “Process Control System Training.”
4. Section 406663 “Antennas.”
5. Section 406717 “Industrial Enclosures.”
6. Section 406733 “Panel Wiring.”
7. Section 406866 “Configuration of Controller Software.”
8. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”
9. Section 407859 “Power Supplies.”
10. Division 26 for electrical installation requirements.
11. Refer to the E-sheets in the Drawing package.

E. Obtain required Construction permits for equipment installation.

F. LFR radio licenses will be obtained by the RTSS.

G. Meet all applicable federal (FCC, etc.), state, and local codes and regulations.

1.3 DEFINITIONS

A. Licensed Frequency Radio (LFR): Frequency bands reserved by the FCC for sole use by the organization to which it is licensed.

B. Registered Communications Distribution Designer (RCDD)

C. Ratio Telemetry System Supplier (RTSS): The entity who provides all radio system equipment hardware, software, programming, configuration, and related services for the radio system.

D. Transmitter (Tx) and Receiver (Rx): An electrical device that either produces or receives radio wave with an antenna.

1.4 ACTION SUBMITTALS

A. Provide shop drawings and product data, in accordance with Section 013300 “Submittal Procedures”, showing materials of construction and details of installation for:

1. Data sheets and catalog literature for hardware (radios and accessories)
2. Physical dimension drawings
3. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment, in conformance to the requirements specified on the Plans. Detail these drawings to the extent that they may be modified after installation to serve as the "AS-BUILT" drawings.

    a. A complete telemetry system block diagram(s) showing in schematic form, the interconnections between major hardware components. Reference all interconnect-

ing cabling requirements for digital components of the system including any data communication links.

b. Equipment specification sheets that fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. As a minimum the specification sheets include the following:

1) Dimension, rigid clearances.
2) Mounting or installation details.
3) Connection.
4) Electrical power requirements.
5) Materials of construction.
6) Environmental characteristics.
7) Performance characteristics.

c. Submit all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts to enable the Supplier to proceed with the detailed site preparation for the equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each test performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provision”

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Radios: Full-size units equal to 10 percent of quantity installed for each type indicated, including anciallary components, but no fewer than 1 complete radio unit, including anciallary components.

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1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form a complete working system.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 LICENSED NARROWBAND RADIOS

A. Refer to Appendix A – Radio Path Study for all LFR radio and related equipment part numbers.

B. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide CalAmp Viper SC-200+ radio modem that operates in the 215-240 MHz licensed frequency range as specified in Appendix A – Radio Path Study to match Owners standard equipment. No equals shall be accepted.

C. Radio shall be provided with all programming and configuration services necessary to achieve a fully functional LFR communication system.

D. Provide a dedicated redundant 24VDC power supply to power the radio. The 24VDC power supply shall be as specified in Section 407859 “Power Supplies” and at a minimum be capable of providing 48 Watts of power and 2 Amps of current on the output.

1. Redundant 24 VDC power supply shall be powered from the UPS power conditioning system in Section 406763 “Control Panel Mounted UPS.”

E. Required Accessories:

1. Surge Protection in accordance with Section 407856 “Isolations, Intrinsically Safe Barriers, and Surge Suppressors.”
2. Antennas in accordance with Section 406663 “Antennas.”
3. Additional equipment and accessories listed in Appendix A – Radio Path Study.
4. Provide any additional connectors, mounting hardware, and ancillary equipment required to install the radio system and all its components in compliance with the manufacturer’s recommendations and as shown on the Drawings.

2.2 TRANSMISSION CABLE AND ACCESSORIES

A. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide Times Microwave LMR-600 and LMR-400 coaxial cable as specified in Appendix A – Radio Path Study, or comparable product by one of the following:

   a. Or equal.

B. Type:

1. Low-loss foam dielectric coaxial cable.

C. Function/Performance:

1. Cable Impedance: 50 ohms plus/minus 1 ohm.
2. Capacitance: 23.4 pF/ft
3. Dielectric Constant: 1.32

D. Physical:

1. Copper-clad aluminum wire.
2. Jacket material: polyethylene.
3. Dielectric: foam polyethylene.
4. Outer conductor: corrugated copper or aluminum tape.
5. Nominal diameter: 1/2 inch.
6. Operating Temperature: -40 deg F (-40 deg C) to 185 deg F (85 deg C).
7. Connectors: Type N, terminated at both ends of the transmission cable.

E. Required Accessories:

1. Wrap outdoor coaxial connectors with two layers of Scotch Super 88 UV resistant tape, and then coated with two layers of Scotch-Kote.
2. Provide two (2) coaxial cable grounding kits for each transmission cable. Refer to Appendix A – Radio Path Study for requirements.
3. Provide one LMR-400 coaxial jumper cable with type N male to TNC male right angle connectors for the radio to connect between the radio and the surge arrestor. Refer to Appendix A – Radio Path Study for requirements.

4. Provide coaxial cable hanger kits and clamping hardware. Anchor antenna cable in three-foot intervals on the antenna mast/tower.
5. Provide lightning protectors (surge arrestors) between transmission cable and coaxial jumper cable. Refer to Appendix A – Radio Path Study for requirements.
6. Provide miscellaneous hardware and connectors. Refer to Appendix A – Radio Path Study for requirements.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for requirements for testing, inspection, and analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine enclosures and and rooms for suitable conditions where radio telemetry equipment components will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install radio telemetry system as shown on the Drawings and in accordance with manufacturer’s instructions and approved shop drawings.

B. Engineer/Owner to approve exact installation locations during construction. Provide all labor and materials necessary to complete the work in an approved manner.

C. Execute all work in accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the system supplier bears full responsibility for such violations and assume all costs arising there from.

D. Comply with NECA 1.

E. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

F. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. During factory testing and field testing, the PCSS, AESS, and RTSS shall demonstrate communications to the Engineer. Burden of proof of communications is the transfer of 1 analog and 1 discrete register in both directions.

    a. Communications during testing shall be between the pump station PLC (PS1, PS2) and the Water Department PLC (RMCP PLC).

2. Test and inspect components, assemblies, and equipment installations, including connections.
3. All tests and inspections required by the manufacturer to certify installation.
4. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Radio Telemetry Equipment will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service with PCSS, AESS, RTSS and any other affected subcontractors.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration and positioning of directional antennas, oversight of installations of the antennas, testing the configuration of the radio telemetry equipment, and start-up of the LFR communication system in order to provide reliable communications from the pumping station to the radio master control panel at the water

department. Coordinate with the PCSS, AESS, RTSS, and any other affected subcontractors to test and verify the LFR system sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit LFR system commissioning report in order to document the startup procedure of the antennas and LFR system.

3.7 ADJUSTING

A. Adjust transmitter power if needed to comply with FCC rules and regulations before acceptance testing.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406650

Wireless Communications Propagation Study

Provided For:

The Town of Yarmouth Massachusetts

Wastewater Division

Provided By:

CDM Engineering

TCS Communications Corporation

85 Lafayette Road - P.O. Box 5192 - Salisbury, MA 01952
Office: (978) 465-7932 | Fax: (978) 462-8980 | **Web**: www.tcscommunications.com

May 4, 2011

CDM
50 Hampshire Street
Cambridge, MA 02139

Attn: Christopher Costello

Re: Yarmouth MA Wireless Communications Survey, preliminary desktop analysis

Dear Chris,

As defined under the contractor "scope of services" identified as the "Wireless Communications Survey" for the Town of Yarmouth Massachusetts Wastewater Department, TCS Communications has prepared a preliminary desktop analysis, with a series of wireless propagation coverage maps utilizing RF CAD software to calculate the approximate wireless coverage for the Yarmouth system.

These coverage maps are based on information provided by CDM (Street addresses and approximate antenna elevations for the Master and 3 remote stations) comparing the projected radio performance at various frequency bands, including: 902-928 MHz unlicensed spread spectrum, 450-470 MHz licensed, 217-220 MHz licensed, and 150-174 MHz licensed frequency spectrum.

In reviewing the summary of data from this desktop analysis, results suggested that the projected performance on the 900 MHz (902-928) band would be questionable, as the coverage predictions indicated poor to marginal signal strength at pump stations 1 and 2 from the Yarmouth WWTP master location.

To achieve reliable performance on the higher frequency bands such as the 902-928 MHz, 2.4 GHz and 5.8 GHz unlicensed spectrum, it is critical that for paths of these distances that a clear unobstructed line of sight between antennas be available to ensure reliable performance.

RF CAD software that we utilize to perform these types of propagation studies takes into account the typical location data derived from topographical map sources such as the USGS maps, and include a factor for average types of tree concentration and vegetation for the area. The program does not provide specific information as to the actual obstructions that may be present in the radio paths; this would require a preliminary visual inspection to determine if a line of sight is available.

Of the remaining three frequency ranges evaluated, all would suggest acceptable coverage, although the 450-470 band also has some question of performance as the projections indicated signal strength in the order of –90dbm on the perimeter, which is usually considered near the limit of the acceptable "fade margin" threshold for most radio equipment manufacturers.

The VHF 150-174 and 217-220 MHz licensed frequency bands both demonstrated good coverage patterns and suggested reliable performance for this application, as line of sight conditions are less critical at these frequencies.

Consideration of unlicensed vs. licensed radio technologies:

Unlicensed systems are shared by several types of users and applications with minimal protection from interference between users. In addition to wireless communications devices, other equipment such as 2 way radios, paging transmitters and baby monitors also operate on these bands.

The transmitter power output levels are regulated to 1 watt maximum output power, with a variety of different spread spectrum transmission techniques.

While it may be convenient to consider implementation of an unlicensed system, often the interference management and infrastructure requirements to achieve reliable performance outweigh the benefits, and ultimately result in a greater overall cost to the project that with a licensed system

Some examples of the added infrastructure costs would be the construction of towers or high elevation poles to provide sufficient clearance of the tree canopy, or the addition of repeater stations to increase the coverage.

Licensed systems generally offer greater coverage and protection from other users, as the FCC assigns frequencies through a process of "frequency coordination" which takes into consideration the various types of users, coverage requirements, antenna elevation, etc.

Frequency spectrum is a limited resource, with ongoing efforts at the FCC and industry to produce more spectrally efficient equipment.

As part of these efforts, additional spectrum has been made available through FCC narrow banding mandates, improvements in technology, and reallocation of spectrum such as the digital TV transition, which made additional frequencies available for first responders and public safety communications.

Preliminary recommendation for the Yarmouth Wastewater communications system:

Unless it can be confirmed that line of sight conditions exist between the three remote stations and the WWTP master, I would recommend that a licensed wireless system be considered.

Of the three licensed frequency bands evaluated, it would be our recommendation to proceed with performing the study on the 217-220 MHz band, as this frequency range offers the benefits of non line of sight coverage capabilities, and abundant frequency resources for the New England area, with several major equipment manufacturer options available including CalAmp and GE MDS.

Recent frequency searches on the 150-174 and 450-470 MHz bands have yielded very few in frequencies available in the area.

Please review the propagation maps and path profiles provided and advise on how you would like to proceed.

Sincerely;

Dean A. Marengi

Dean A. Marengi
Vice President

Section 1

Yarmouth radio path study summary report

Section 2

RF CAD & topographical map data

Section 3

Site survey results & Installation details

Section 4

Equipment specifications brochures & budgetary pricing

Section 5

FCC license information

85 Lafayette Road - P.O. Box 5192 - Salisbury, MA 01952
Office: (978) 465-7932 | Fax: (978) 462-8980 | **Web**: www.tcscommunications.com

June 1, 2011

Camp Dresser & McKee, Inc.
50 Hampshire Street
Cambridge, MA 02139
Attn: Christopher Costello, Control Systems Engineer

Project: Town of Yarmouth Massachusetts, Wastewater Division
Wireless Propagation Study for SCADA Communications

Scope: For TCS Communications to perform a wireless communications evaluation for CDM Engineering including a desktop propagation analysis with on site field-test to assist CDM in determining the feasibility, projected performance, equipment specifications, installation details and budgetary cost to construct a wireless data communications network for the Yarmouth Sewer infrastructure upgrade

Dear Mr. Costello,

I would like to thank CDM for requesting TCS Communications to provide this wireless communications engineering study for the Town of Yarmouth's Phase 1 sewer system upgrade.

This report provides a summary of information collected during the study, including: field test procedures and measurement references, wireless propagation and topographical maps, radio equipment specifications, budgetary pricing, and installation recommendations which are based on an FCC licensed network, operating on the VHF 217-220 MHz frequency spectrum that we are proposing for the Yarmouth network.

As defined in the scope of services, initial research for this project included performing a preliminary desktop propagation analysis comparing the "projected performance" of several wireless communications technologies, including (4) facilities identified as: The WWTP site at the rear of the Water Department complex, and 3 remote sewer pump station sites along Route 28 in Yarmouth.

A series of RF CAD software based propagation coverage maps were prepared, modeled on communications bands authorized by the Federal Communications Commission for these types of telemetry/data communications applications, including licensed VHF (150-174 MHz), (217-220 MHz), UHF (450-470 MHz) and unlicensed spread spectrum technologies in the 902-928 MHz, 2.4 GHz and 5.8 GHz spectrum.

Upon completion of the preliminary propagation analysis, results suggested that the conditions favored the selection of the 220 MHz VHF frequency band, based on the geographical coverage requirements, proposed infrastructure availability, topography, foliage density and frequency availability.

Please refer to the following pages of the report for additional information on the test procedures and system recommendations.

TEST EQUIPMENT

- **Sitesafe Engineering RF CAD v2.3, Wireless Communication Propagation Software**

RF CAD software was utilized to prepare wireless propagation coverage maps.

The propagation maps provide an illustration of various wireless network configurations to determine the appropriate frequency spectrum and path configurations that would provide the desired coverage objectives.

- **Delorme Earthmate 12 Channel GPS Receiver & Topo USA 8.0 Topographical Map Software**

The GPS receiver provides a specific location reference to each site in the system, utilizing the US DGPS satellite network; typical accuracy is to within 2-5 meters. Topo USA software integrated with the GPS provides a high degree of accuracy for location and elevation data, used in conjunction with RF CAD software

- **CalAmp Viper 200SC, VHF IP-based software defined radio modems**

The Viper modems were configured to simulate the permanent conditions for the proposed wireless system.

Remote diagnostics software included with the Viper radio provides real time field strength measurement RSSI (Received Signal Strength Indication) and data quality for RF links. Signal strength was sampled at various positions around the property at each location and averaged.

Additional Test Equipment:

- **Hewlett Packard DV5 Pavilion mobile computer**
- **Windows Vista OS, with the following software programs installed**

  Viper configuration & diagnostics, Topo USA 8.0, RF CAD 2.3

Antenna assemblies used for field test: All antennas tuned to the 217 to 220 MHz frequency

WWTP site:

Comtelco model BS220XL3-B, 3dbd gain VHF fiberglass omnidirectional antenna installed at 40 foot elevation above grade, on a bucket truck next to the proposed WWTP site. 60' of LMR-400 cable connected to the antenna and Viper.

Remote antennas:

(Mobile unit)

PC TEL ASPH7455 3db gain VHF magnetic mounted antenna, installed at 7' AGL on the mobile unit

(Yagi / tripod mounted)

Comtelco Y3323A-B VHF 6db gain Yagi antenna on 10 foot mast + 3 foot tripod and 25 foot LMR-400 cable

TEST PROCEDURE

Field test date: May 24, 2011

Weather conditions: Cloudy / occasional rain / 60°F

Foliage density: Late spring conditions, 90% foliage density

Test frequency 217.275 MHz

1- Preliminary engineering: RF Propagation & topographical maps, frequency research

Addresses for the Yarmouth wastewater facilities provided by CDM were converted to approximate GPS coordinates to complete the preliminary desktop coverage analysis. RF CAD propagation maps and terrain path profiles calculated the path loss and coverage expectations for VHF, UHF and 900 MHz for the system coverage area.

RF CAD propagation maps illustrated that systems operating on the 900MHz, 2.4GHz and 5.8GHz unlicensed bands would not provide sufficient coverage to all locations as required.

The terrain path profiles were calculated from the WWTP site assuming 40 foot antenna elevation, to each of the remote stations assuming 15 foot elevation above grade. A visual inspection indicated that a clear line of sight was not available based on the desired tower elevations.

An unobstructed line of sight is required to achieve reliable performance for long distance (over 1000') wireless links especially at 900 MHz and above. UHF (450 MHz) and VHF (150 MHz & 220 MHz) frequencies are more tolerant to "non line of sight" conditions, and can produce acceptable results depending on the path distance and severity of attenuation from the terrain, foliage and structures.

Preliminary research indicated that sufficient spectrum is available on the VHF 217 to 220 MHz frequency spectrum in the Yarmouth area, with limited availability on the 150-174 and 450-470 bands.

In order to determine the actual operating frequency, the services of an FCC authorized frequency coordinator are required. UTC spectrum services provide frequency coordination for municipalities and utilities. Budgetary pricing for FCC licensing services is provided in section 4 of the report.

2- Field test procedure:

(1) Installed the omnidirectional antenna on the bucket truck to an elevation of 40 feet AGL, connected to a 60' length of Times LMR-400 cable. Radio was powered by the outlet on the outside of the Water Department office.

(2) Programmed one Viper radio on 217.275 MHz simulating the master

(3) Programmed a 2nd Viper simulating a remote configuration, installed in the mobile, interfaced to the computer operating the Viper configuration and diagnostics software, collecting information including (RSSI) received signal strength, messages sent, received and response times.

(4) Proceeded to each remote location, performed diagnostics, photographed the facility or general area as available, noted installation details with antenna and cable requirements

(5) Concluded the field test and removed equipment from the bucket truck

RF CAD MAP REFERENCES

Propagation Maps:

COLOR	SIGNAL STRENGTH	RESULTS
RED	50/-70dbm	extremely strong signal, very reliable
ORANGE	70/-80dbm	strong signal, still very reliable
YELLOW	80/-90dbm	good signal at -80dbm, fair signal at -90dbm
GREEN	90/-100dbm	weak signal -90dbm (acceptable), -100dbm+ (poor)
BLUE	100dbm +	unreliable performance expected, high error rate
NO COLOR	No signal available	system will not communicate

Terrain Path Profiles:

Top Graph	(Left) output power measured in dbm at the transmitter antenna
	(Right) received signal measured in dbm at the receiver antenna
Bottom Graph	(Left) elevation above ground at the remote transmitter site, Including antenna with structure elevation
	(Right) elevation above ground at receiving site, typically a master or repeater station including antenna with structure elevation

SUMMARY

After completing the field test, the summary of data collected was then reviewed to ensure that performance objectives could be accomplished for the proposed system, and to develop the final configuration maps for the system design.

RF CAD and topographical maps provided in section (2) of the printed copy of this report illustrate the recommended propagation, path profile configurations.

Section (3) of the report provides a summary of information, including GPS coordinates, site elevation above mean sea level, field test results, and installation recommendations, antenna and cable part numbers and approximate antenna elevations with estimated cable length.

System overview:

The proposed wireless communications network is based around the CalAmp Viper radio technology as tested, operating on an FCC licensed frequency operating in the VHF 217-220 MHz band.

Other frequency bands considered for this application including the VHF (150-174 MHz) UHF (450-470) and other spread spectrum technologies were ruled out for various reasons as previously mentioned in the report.

The master terminal unit (MTU) will be located at the Yarmouth wastewater treatment facility. As described for the field test conditions and propagation calculations, we are proposing an approximate elevation of 40 feet AGL for the antenna at the wastewater facility.

This installation can be accomplished by installing the antenna on a rigid conduit above the roof of the building or possibly installing a tower or wooden utility pole next to the facility, as determined by the design of the structure.

For the remote stations, the typical installation is to provide a rigid conduit mast of 1.5” or 2” OD as necessary to support the antenna and wind load. The recommended elevation for antennas is 15 feet elevation above grade or greater.

The (MTU), consisting of a computer and master PLC interfaced to the radio-modem are responsible for initiating “polling” messages to the remote stations in the network for the purposes of monitoring and control.

As a result of the favorable initial RF coverage predictions and subsequent results observed during the field test, it will not be necessary to incorporate a repeater station into the network for the 3 remote stations identified under this phase.

However, if additional stations are added to the network at a future date, depending on the locations of these stations, the coverage area may need to be revaluated to determine if the existing configuration would provide sufficient signal or if repeater coverage will be necessary.

The Viper is a “software defined” radio, which can be configured to operate as a master, remote, or repeater as needed, and will operate in either serial or Ethernet configurations.

Additional information for the Viper and the associated radio equipment is available on the equipment specifications data sheets in section (4) of the report.

Conclusion:

The proposed configurations are based on the summary of field test results and propagation analysis, designed to exceed the manufacturers minimum requirements required for reliable performance.

Any deviation from these recommendations should be verified, prior to confirming final system design.

Certain assumptions have been made for installation recommendations, including approximate elevations of the structures included in the scope of services.

Should the Town decide to proceed with the proposed wireless communications network, It is important to consider as the first step in the process to prepare the necessary forms for obtaining an FCC license, prior to finalizing the system design. On average, this process usually requires 45 to 60 days.

As with any wireless communications system, it is not possible to provide a guarantee of 100% communications, 100% of the time.

Intermittent disruption can occur with of any type of communications network as a result of various sources, including some of the following examples

- **Interference from co-channel or adjacent channel licensed and unlicensed transmitters**
- **Future construction of structures or other obstacles severely impacting the radio paths**
- **Significant increase of foliage density in the radio paths**
- **Installation of electrical or other interference generating sources**

The system design specifications provided are based on industry standards and manufacturer's recommendations for a minimum fade margin of at least 10db, with a preference of 20db, which was attained during the field test.

The fade margin is recommended to provide compensation for typical expected propagation variables, caused by atmospheric conditions, seasonal changes in foliage density and periodic interference.

This concludes the report.

Sincerely;
Dean A. Marengi
Dean A. Marengi
Vice President

Terrain Average

Study: WWTP
Site: WWTP Master

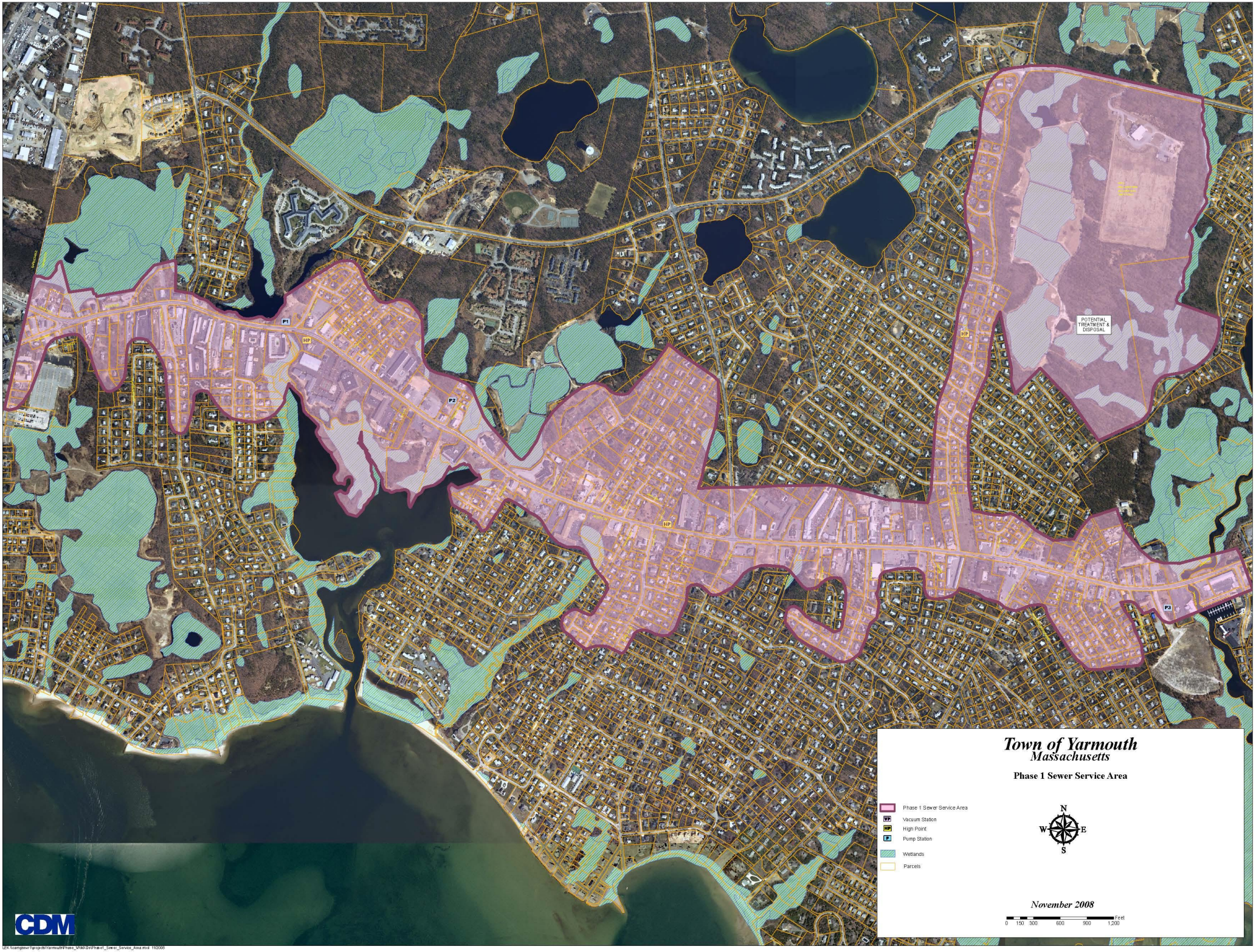
Latitude: N41-39-44.00
Longitude: W70-13-26.00

Bearing (Deg-true)	3.0-16.0 km (meters)	1.9-9.9 mi Average Elevation (feet)
0.0	2.2	7.1
45.0	11.8	38.5
90.0	1.7	5.5
135.0	0.0	0.0
180.0	0.0	0.1
225.0	0.0	0.1
270.0	13.5	44.3
315.0	5.3	17.6
Average (all radials)	4.3	14.2

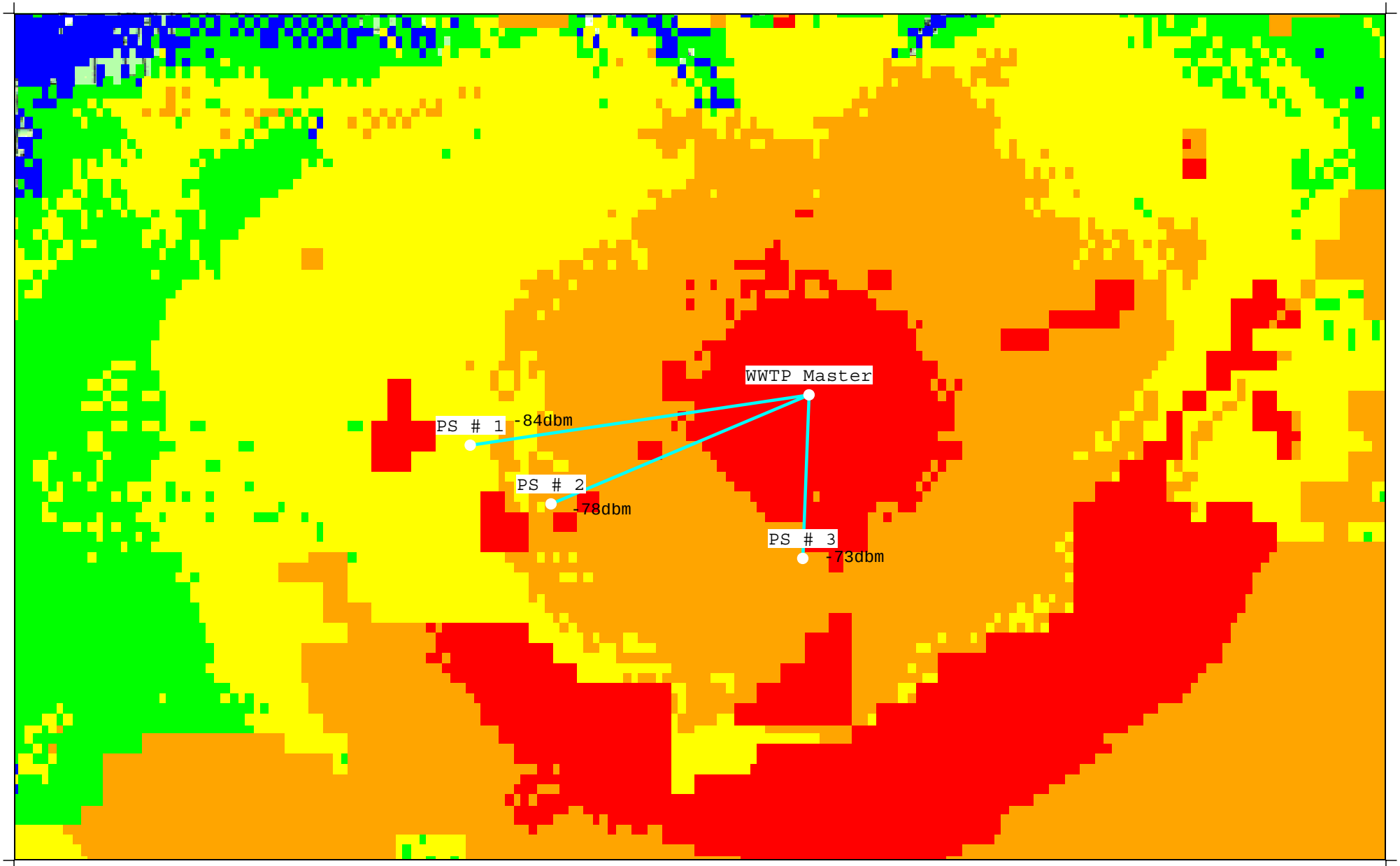
Radiation Center (AGL):	12.2 meters	40.0 feet
Radiation Center (AMSL):	17.1 meters	56.0 feet
Radiation Center (HAAT):	12.8 meters	41.8 feet
Average Terrain (AMSL):	4.3 meters	14.2 feet

Project Summary

Site name	Location	Above mean sea level	Antenna Elevation
WWTP Master	N41-39-44, W70-13-26	16.00	40.00
PS # 1	N41-39-29, W70-15-35	0.00	15.00
PS # 2	N41-39-11, W70-15-04	0.00	15.00
PS # 3	N41-38-55, W70-13-29	0.00	15.00


POTENTIAL TREATMENT & DISPOSAL
P1
P2
P3
HP
HP
HP
Town of Yarmouth
Massachusetts
Phase 1 Sewer Service Area
Phase 1 Sewer Service Area
Vacuum Station
High Point
Pump Station
Wetlands
Parcels
N
W
E
S
November 2008
0 150 300 600 900 1,200
Feet
CDM

Yarmouth Wastewater 220 MHz RF Propagation map. TX from WWTP at 40 feet AGL, RX at remote stations at 15 feet AGL



The red, orange, and yellow colors indicate a strong signal expected at the pump stations on 220 MHz This was confirmed by the field test measurements, and is the recommended configuration for the Yarmouth system.

Prop levels:
- -60.00 dBmW
- -70.00 dBmW
- -80.00 dBmW
- -90.00 dBmW
- -100.00 dBmW

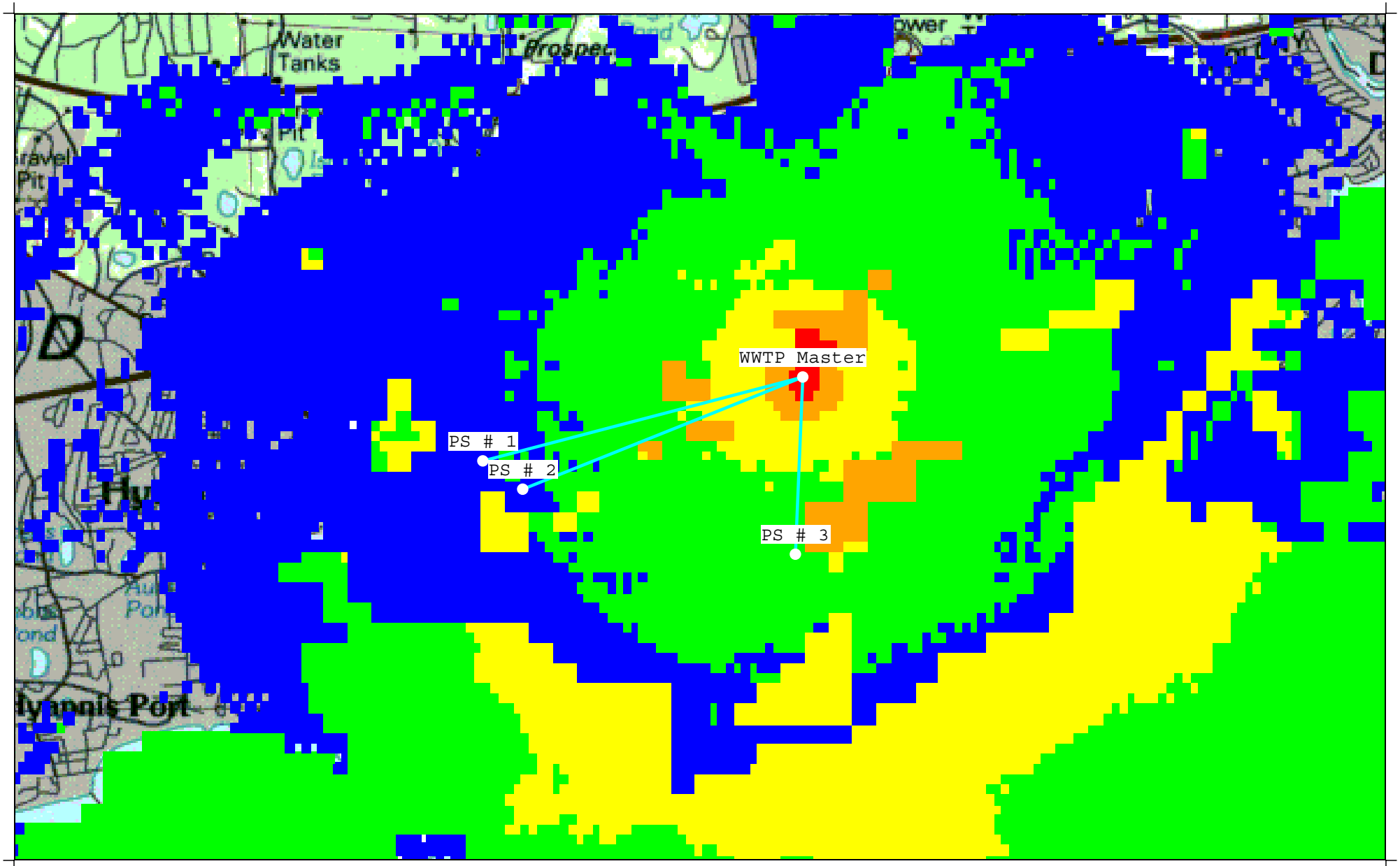
Kilometers
1.0 0 1.0 2.0

Miles
0.6 0 0.6 1.2

Yarmouth Wastewater Department Radio Propagation Study
220 MHz licensed

Map scale: 1:48,000
Rasterized at: 1:100,000

Yarmouth Wastewater 902-928 MHz propagation map. TX from WWTP at 40 feet AGL, RX at remote stations at 15 feet AGL



Signal strength at the pump stations is expected to be poor based on calculations

this configuration is not recommended for the Yarmouth system

Prop levels:

- -60.00 dBmW
- -70.00 dBmW
- -80.00 dBmW
- -90.00 dBmW
- -100.00 dBmW

Kilometers: 1.0 0 1.0 2.0

Miles: 0.6 0 0.6 1.2

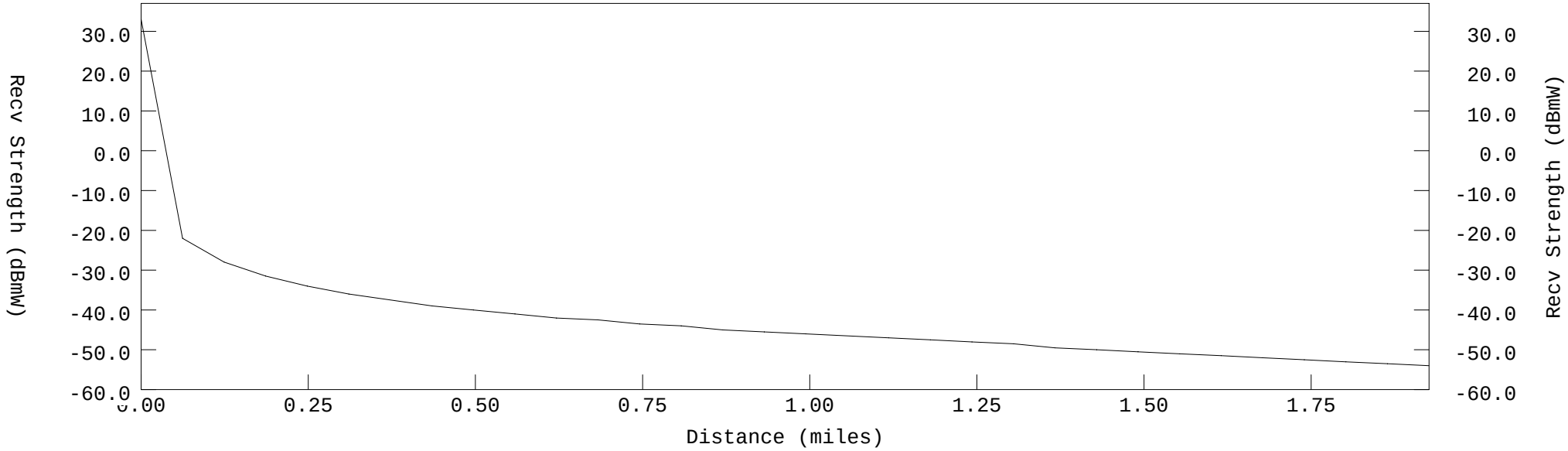
Yarmouth Wastewater Department Radio Propagation Study
902-928 MHz unlicensed spread spectrum

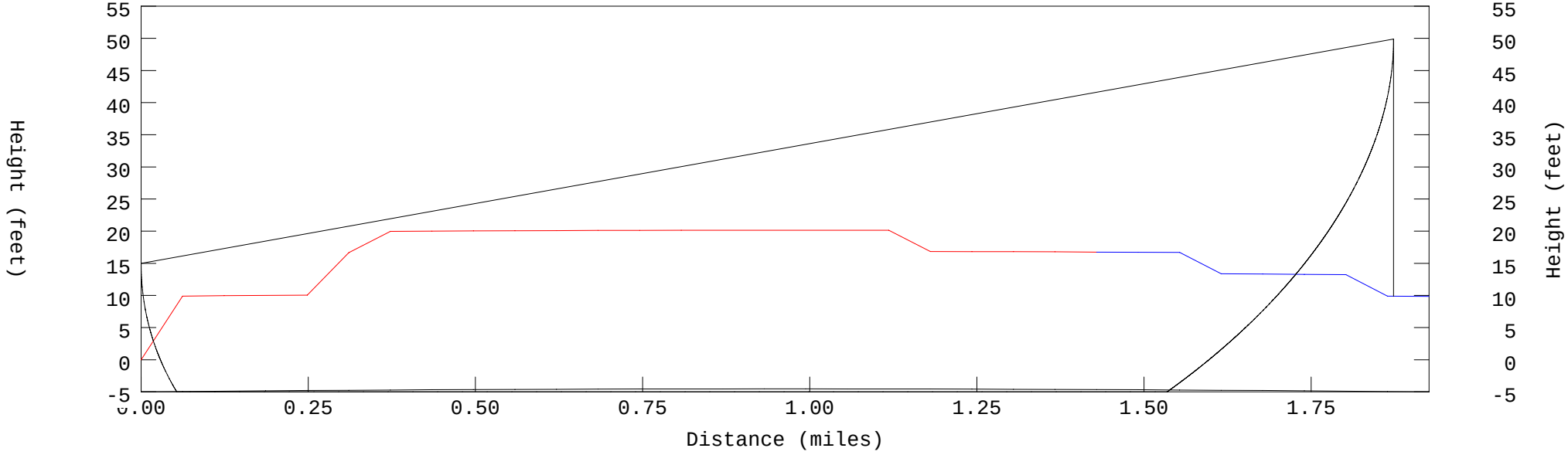
Map scale: 1:48,000
Rasterized at: 1:100,000

June 01, 2011

Study: PS # 1 to WWTP
TX Site: PS # 1
RX Site: WWTP Master
TX --> RX: 1.87 mi, 81.1 degrees, 87.0 dB loss

TX Latitude: N41-39-29.00
TX Longitude: W70-15-35.00
RX Latitude: N41-39-44.00
RX Longitude: W70-13-26.00

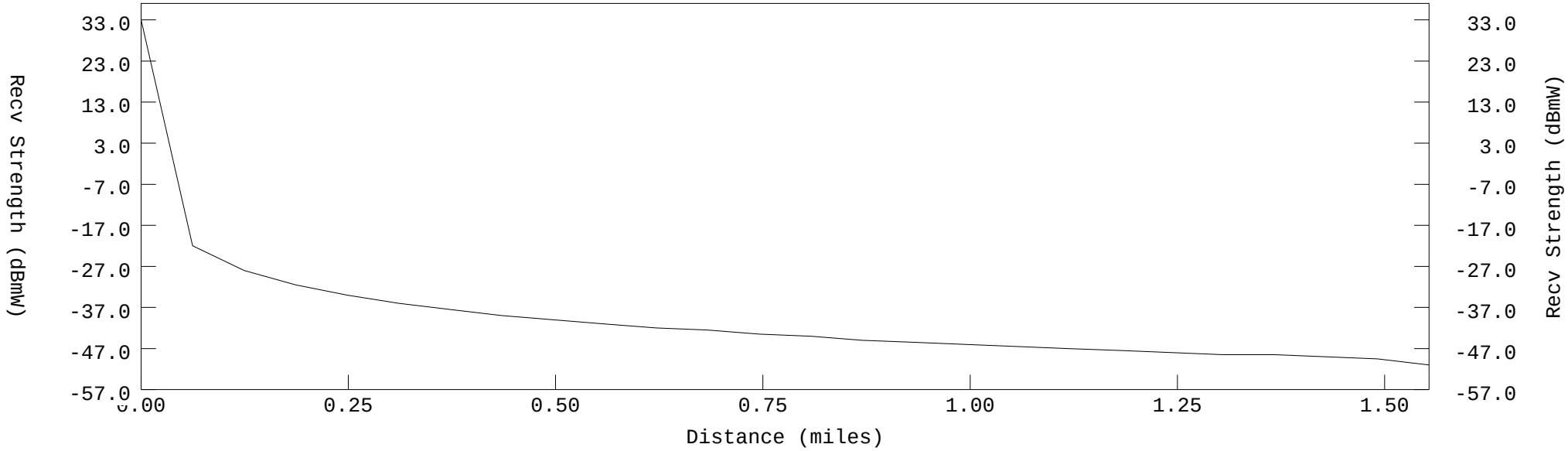


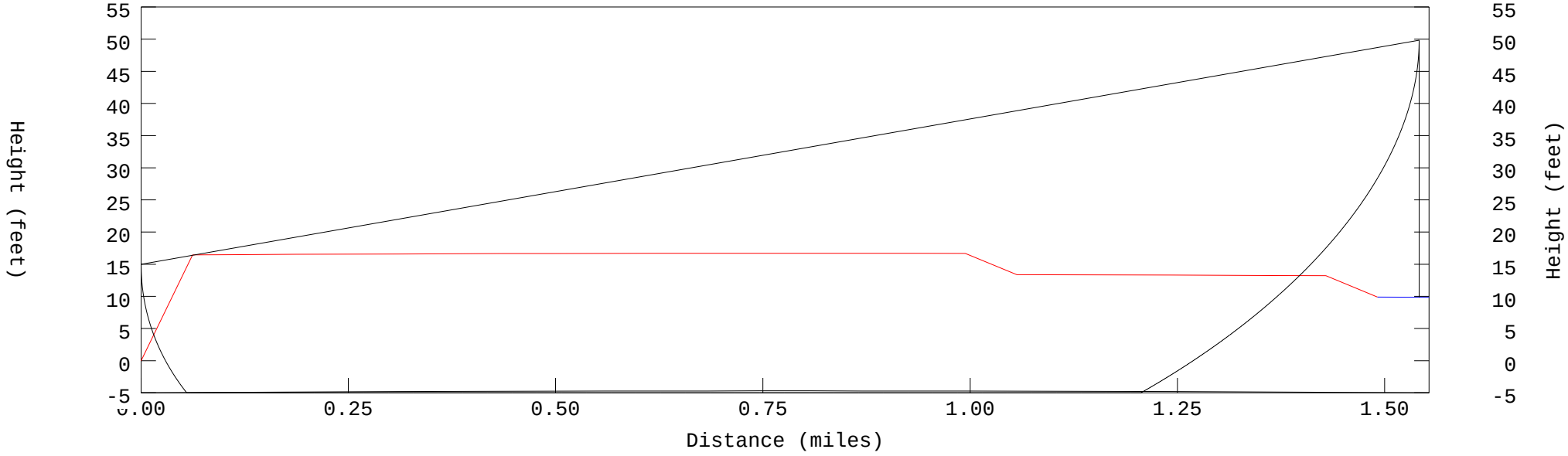


June 01, 2011

Study: PS # 2 to WWTP
TX Site: PS # 2
RX Site: WWTP Master
TX --> RX: 1.54 mi, 65.7 degrees, 84.0 dB loss

TX Latitude: N41-39-11.00
TX Longitude: W70-15-04.00
RX Latitude: N41-39-44.00
RX Longitude: W70-13-26.00

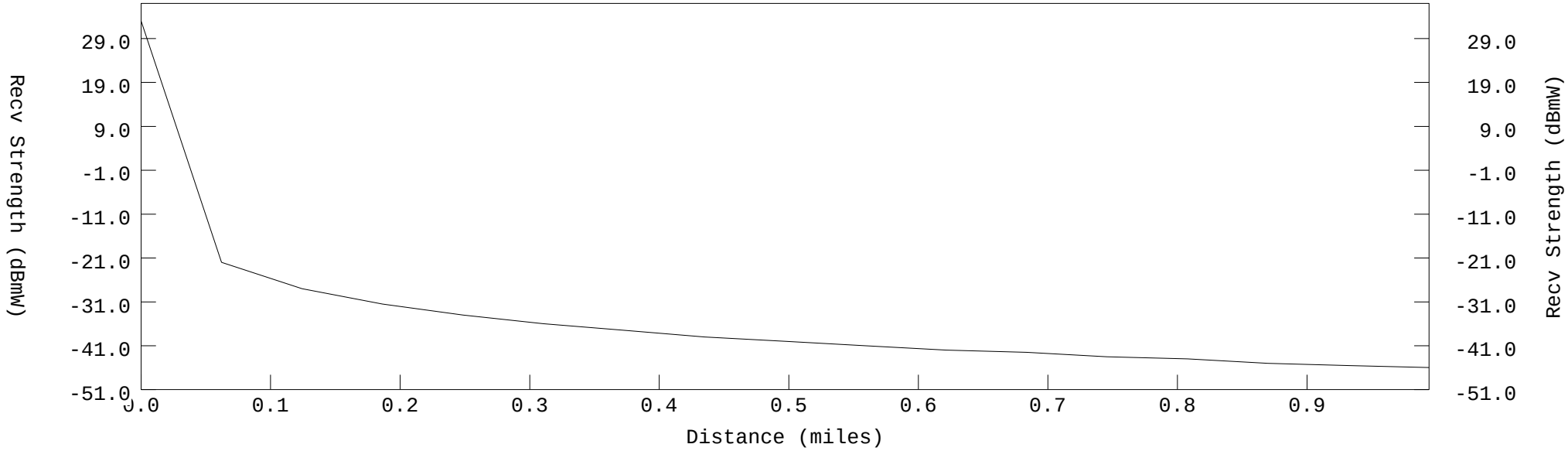


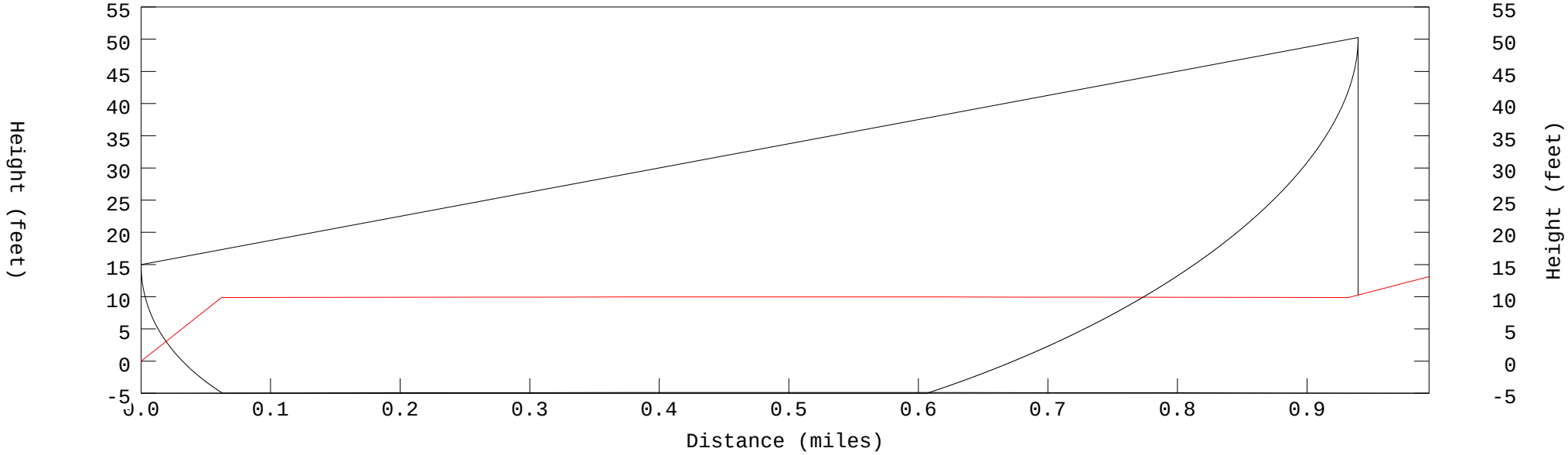


June 01, 2011

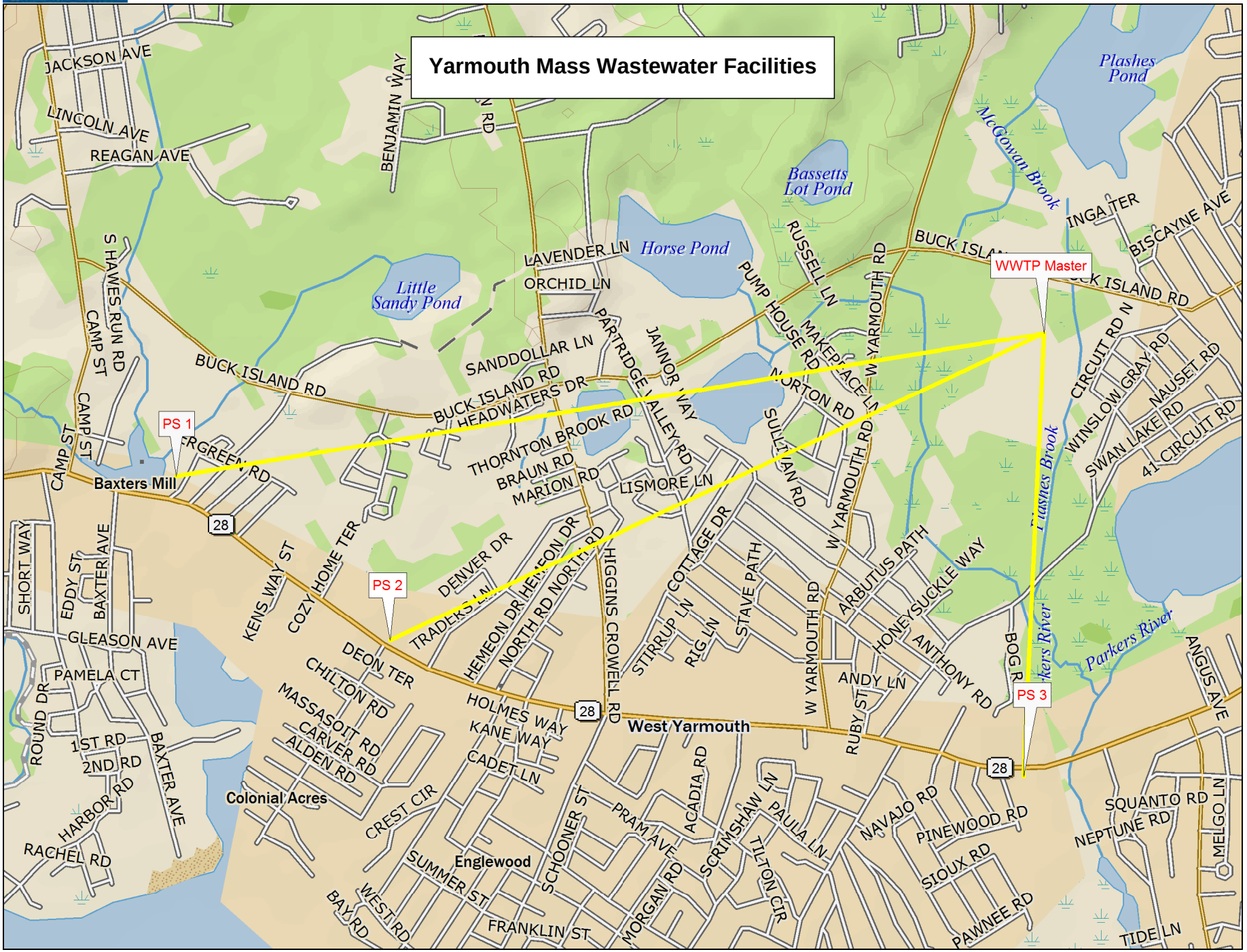
Study: PS # 3 to WWTP
TX Site: PS # 3
RX Site: WWTP Master
TX --> RX: 0.94 mi, 2.6 degrees, 79.0 dB loss

TX Latitude: N41-38-55.00
TX Longitude: W70-13-29.00
RX Latitude: N41-39-44.00
RX Longitude: W70-13-26.00





Yarmouth Mass Wastewater Facilities



Data use subject to license.

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www.delorme.com

TN

MN (15.1°W)

Scale 1 : 17,600

0 400 800 1200 1600 2000 ft

0 160 320 480 640 800 m

1 cm = 176.0 m

Data Zoom 13-0

Viper Neighbor Management

Neighbor Discovery

○ Manual-Scan ○ Auto-Scan ◉ Disabled

Apply Cancel

If you "Apply" changes to any parameters marked ! you will need to do a "Save Config" and a "Reset Unit".

Local Status

Disabled	**Neighboring Vipers found**	1	**Discovery Duration**	00:00:00

Discovered Viper Neighbors

Information on Neighboring Viper				Route to Neighboring Viper			
RF MAC Address	RF IP Address	Ethernet IP Address	RSSI dBm	Hop Count	Next Hop	Entry Type	Connectivity Status
80:17:8F	10.128.23.143/8	192.168.206.1/24	-83.48	1	80:17:8F	Static	Reachable

Received signal strength from WWTP to Pump Station 1 on Yagi antenna at 10' AGL

Control Operations

Clear List | Force Scan | Test Connectivity | Add Static Entry | Delete Entry

Refresh

Viper Neighbor Management

Neighbor Discovery

○ Manual-Scan ○ Auto-Scan ◉ Disabled

Apply Cancel

If you "Apply" changes to any parameters marked ! you will need to do a "Save Config" and a "Reset Unit".

Local Status

Disabled	**Neighboring Vipers found**	1	**Discovery Duration**	00:00:00

Discovered Viper Neighbors

Information on Neighboring Viper				Route to Neighboring Viper			
RF MAC Address	RF IP Address	Ethernet IP Address	RSSI dBm	Hop Count	Next Hop	Entry Type	Connectivity Status
80:17:8F	10.128.23.143/8	192.168.206.1/24	-78.52	1	80:17:8F	Static	Reachable

Received signal strength at Pump Station 2 from WWTP on Yagi antenna at 10' AGL

Control Operations

Clear List | Force Scan | Test Connectivity | Add Static Entry | Delete Entry

Refresh

Viper Neighbor Management

Neighbor Discovery

○ Manual-Scan ○ Auto-Scan ◉ Disabled

Apply Cancel

If you "Apply" changes to any parameters marked ! you will need to do a "Save Config" and a "Reset Unit".

Local Status

Disabled **Neighboring Vipers found** 1 **Discovery Duration** 00:00:00

Discovered Viper Neighbors

Information on Neighboring Viper				Route to Neighboring Viper			
RF MAC Address	RF IP Address	Ethernet IP Address	RSSI dBm	Hop Count	Next Hop	Entry Type	Connectivity Status
80:17:8F	10.128.23.143/8	192.168.206.1/24	-73.63	1	80:17:8F	Static	Reachable

Received signal strength at Pump Station 3 from WWTP on Yagi antenna at 10' AGL

Control Operations

Clear List Force Scan Test Connectivity Add Static Entry Delete Entry

Refresh

85 Lafayette Road, PO Box 5192
Salisbury, MA. 01952-5192
(978) 465-7932 (office) (978) 462-8980 (fax) (508) 726-3482 (cell)
www.tcscommunications.com
dean.marengi@tcscommunications.com

June 2, 2011

Camp Dresser & McKee Inc
Attn: Chris Costello
Yarmouth Wastewater Dept.
SCADA radio system
BUDGETARY PRICING

QTY	P/N	PRICE EACH	DESCRIPTION	TOTAL
4	140-5028-502	$ 1,700.00	CalAmp Viper 220 SC, Licensed IP router, 216-240 MHz frequency range	$ 6,800.00
1	BS220XL3-C	$ 294.00	Comtelco 3db gain fiberglass omnidirectional antenna 215-225 MHz	$ 294.00
1	BSMNT2	$ 36.75	Comtelco mounting kit for BS220XL3-C	$ 36.75
3	Y3323A-B	$ 199.50	Comtelco 6db gain Yagi antennas, 210-225 MHz	$ 598.50
100	LMR-600	$ 3.05	Times Microwave 1/2" low loss coaxial cable	$ 305.00
200	LMR-400	$ 1.49	Times Microwave coaxial cable	$ 298.00
2	EZ-600-NMH-D	$ 28.00	Times Microwave type N male connectors for LMR-600	$ 56.00
10	EZ-400-NMH-D	$ 22.00	Times Microwave type N male connectors for LMR-400	$ 220.00
4	EZ-400-TM-RA	$ 35.95	Times Microwave TNC male right angle connectors for LMR-400	$ 143.80
4	IS50NXC1	$ 81.95	Polyphaser lightning arrestor, type N female connectors	$ 327.80
			Subtotal / Materials (see note 1)	$ 9,079.85
4	Labor	$ 800.00	Radio integration services, 4 locations (see note 2)	$ 3,200.00
1	FCC licensing	$ 1,950.00	FCC licensing, frequency coordination, monitoring and submittal for 217-220 MHz license	$ 1,950.00
			Radio system budget total	**$ 14,229.85**

Notes

1- Price for radio equipment only. This price does not include associated costs for supplying control panels, power supplies, interface cables, antenna masts, conduits, etc. typically provided by the control panel supplier and installed by electrical contractor

2- Radio integration services includes the radio system supplier responsibilities for configuration of the radio system, coaxial cable terminations, antenna tuning / alignment, and assistance to electrical and SCADA integration contractors

COMTELCO

Technical Specification **BS220XL3**

200-225 MHz 3dBd Gain BASE STATION ANTENNA

Reliable Performance: *Rated at 250 watts and 3dB gain, you can expect years of continuous service.*

Rugged Construction: *The radiating elements are supported internally and constructed of copper alloy. They are welded and/or soldered to prevent any intermodulation. They are then encased in a fiberglass radome for total environmental protection.*

Weatherproof: *The fiberglass radome is ultraviolet inhibited. The heavy wall aluminum mounting sleeve is epoxy coated for superior weather protection.*

Lightweight: *These antennas are lightweight at less than 8 lbs. but are designed to easily withstand winds of over 100 MPH.*

Simple installation: *Using the optional BSMNT2 mounting kit, installation takes only minutes.*

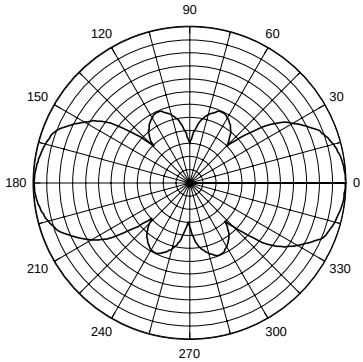
ELECTRICAL SPECIFICATIONS:

Part No.	***Frequency***
BS220XL3-A	*200-210MHz*
BS220XL3-B	*210-220MHz*
BS220XL3-C	*215-225MHz*

CUSTOM FREQUENCIES AVAILABLE

GAIN:	*3 dBd*
VSWR:	*<2.0:1*
BANDWIDTH:	*10 MHz*
POWER RATING:	*250 watts*
IMPEDANCE:	*50 ohms*
VERT BEAMWIDTH:	*45 degrees*

Vertical Pattern



MECHANICAL SPECIFICATIONS:

RADIATOR:	*Internal copper alloy elements*
RADOME:	*White UV inhibited fiberglass*
MOUNTING SLEEVE:	*1.35" dia. heavy wall epoxy coated*
SLEEVE LENGTH:	*10”*
TERMINATION:	*Female N standard, pigtail optional*
LENGTH:	*96"*
WEIGHT:	*8 lbs.*
FLAT PLATE AREA:	*.44 ft^2*
WIND RATING:	*100 MPH*
WIND LOAD:	*29.7 lbs.*

COMTELCO

Technical Specification

Y3313
Y3323

144-174MHz, 210-225MHz 6dBd Gain 3 ELEMENT YAGI ANTENNA

High Performance: *These 3 element yagi antennas provide 6dBd gain.*

Rugged and weatherproof: *The construction of these heavy duty yagis feature a 1" aluminum U channel boom and 3/8" solid elements fully welded and polyester powder coated.*

Functional & Durable: *These yagi antennas are easily installed by one person. They can be field tuned for lowest VSWR without cutting any elements. They are designed to withstand 125 MPH winds.*

Mounting: *These antennas are supplied with the YDM2 double V-bolt mounting kit.*

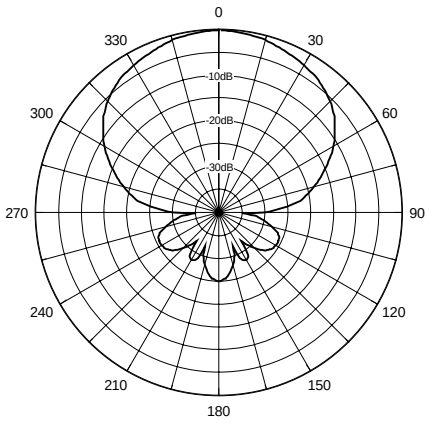
Termination Options:
Type A: *N connector*
Type C: *SO239 (standard)*

UPS Shippable: *These antennas are shipped assembled and may incur UPS premium charge.*

ELECTRICAL SPECIFICATIONS:

	Y3313	***Y3323***
FREQUENCY:	*A 144-150MHz* *B 150-156MHz* *C 156-162MHz* *D 162-166MHz* *E 168-174MHz*	*A 200-215MHz* *B 210-225MHz* *C 220-250MHz*
VSWR:	*<2:1*	*<2:1*
GAIN:	*6dBd*	*6dBd*
RATING:	*300 watts*	*300 watts*
BANDWIDTH:	*8MHz*	*8MHz*
F to B	*18dB*	*18dB*
IMPEDANCE:	*50 ohms*	*50 ohms*

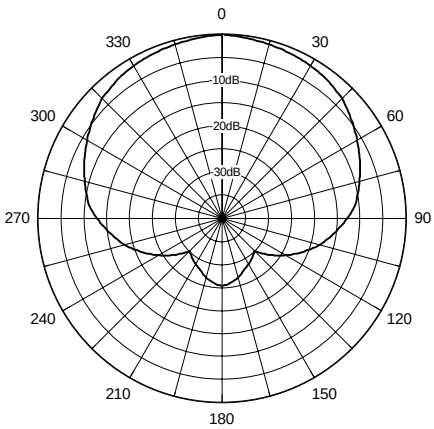
Vertical Pattern



MECHANICAL SPECIFICATIONS:

MATERIAL:	*1" aluminum U channel boom* *3/8" solid elements*	
FINISH:	*Polyester coat*	
MOUNTING:	*2 3/8" mast max.*	
HARDWARE:	*Stainless steel*	
LENGTH:	*44"*	*34"*
WIDTH:	*38"*	*27"*
WEIGHT:	*7 lbs.*	*5 lbs.*
FLAT PLATE AREA:	*.50 ft^2*	*.38 ft^2*
WIND RATING:	*125 MPH*	*125 MPH*
WIND LOAD:	*30 lbs.*	*22.5 lbs.*
SHIPPING:	*UPS*	*UPS*

Horizontal Pattern



Viper SC™

IP Router for Licensed Spectrum

136-174 MHz | 215-240 MHz | 406-512 MHz | 928-960 MHz

You no longer have to choose between wireless IP and secure, long range communications; Viper SC delivers both! Using a Software Defined Radio, Viper SC is programmable for 50, 25, 12.5, or 6.25 kHz channels. This robust communications link for VHF, UHF & MAS licensed networks features an internal web browser with a familiar interface for IT and network administrators to set up and view device information, configure network parameters and deploy unit upgrades from any location.

Each Viper SC features store and forward and route redundancy for extended range and easy network expansion. With advanced diagnostic capabilities, over the air firmware upgrades, channel migration and RoHS compliance, you can bet your investment today is protected well into the future.

MultiSpeed operation allows each remote Viper SC to communicate to a Viper SC Base Station at the fastest speed supported by a given signal strength. MultiSpeed operation results in an adaptive network which is optimized for performance and reliability.

Air Superiority Advantage!

- **128 kbps @ 50 kHz**
- **MultiSpeed operation** utilizes variable modulation to result in better overall system performance
- Easily configured in **bridge** or **router** mode
- Single device **store and forward** for easy network expansion
- Advanced security and encryption designed to meet **FIPS 140-2** requirements
- **Route redundancy** allows switching from the primary to a secondary path when encountering system interference and link degradation
- 1-10 Watts continuous duty; software selectable
- 10-30 VDC wide range power supply

High Speed

Long Range

Ruggedized

Safe/Secure

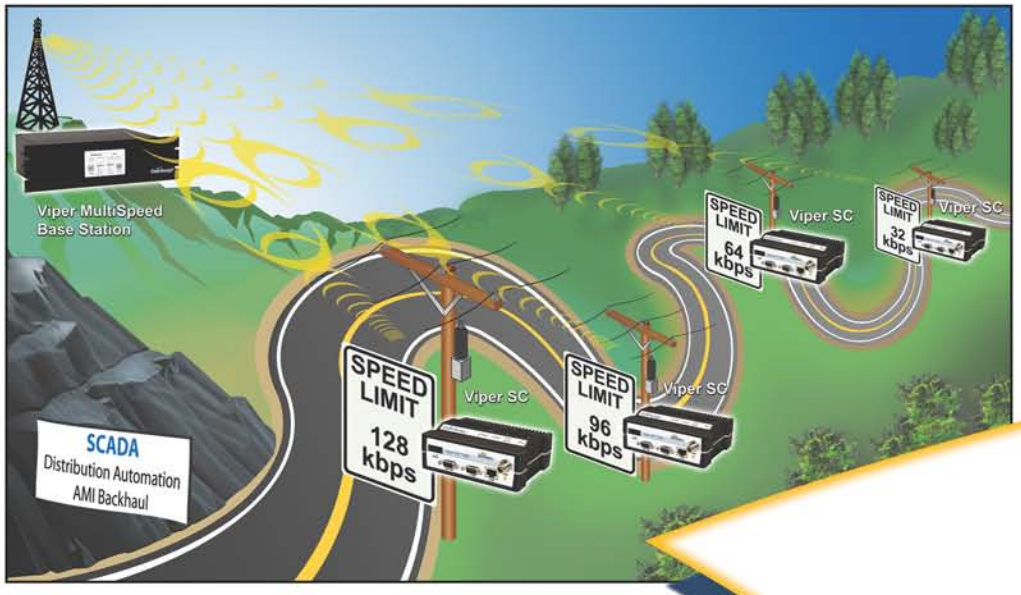
Diversity

Connectivity

CalAmp®

Viper SC Specifications

GENERAL		VHF | 200 | UHF	MAS | 900
Frequency Range		Variable	
Channel Bandwidth		6.25 kHz, 12.5 kHz, 25 kHz, 50 kHz	12.5 kHz, 25 kHz, 50 kHz
Modes of Operation		Simplex, Half-Duplex	
Modulation		2FSK, 4FSK, 8FSK, 16FSK	
RECEIVER			
Bit Error Rate (BER) @ 1x10-6 (in dBm)	6.25 kHz:	-115@4 kbps; -106@8 kbps; -100@12 kbps	
	12.5 kHz:	-116@8 kbps; -109@16 kbps; -102@24 kbps; -95@32 kbps	-112@8 kbps; -106@16 kbps; -99@24 kbps; -90@32 kbps
	25 kHz:	-114@16 kbps; -106@32 kbps; -100@48 kbps; -92@64 kbps	-111@16 kbps; -104@32 kbps; -97@48 kbps; -89@64 kbps
	50 kHz:	-111@32 kbps; -104@64 kbps; -97@96 kbps; -88@128 kbps	-108@32 kbps; -101@64 kbps; -94@96 kbps; -85@128 kbps
Adjacent Channel Rejection		45 dB@6.25 kHz; 60 dB@12.5 kHz; 70 dB@25 kHz; 75 dB@50 kHz	60 dB@12.5 kHz; 70 dB@25 kHz; 75 dB@50 kHz
TRANSMITTER			
Frequency Stability		1.0 ppm	
Carrier Output Power		1-10 Watts	1-8 Watts
Duty Cycle		100% (Power Foldback for High Temps)	
Output Impedance		50 Ω	
ELECTRICAL			
Tx Current		1.2-3.6A@10V; 0.6-1.8A@20V; 0.4-1.2A@30V	
Rx Current		450mA@10V; 240mA@20V; 170mA@30V	
Primary Power		10-30 VDC	
MECHANICAL			
Nominal Dimensions		5.50" W x 2.125" H x 4.25" D (13.97 x 5.40 x 10.8 cm)	
Shipping Weight		2.4 lbs (1.1 kg)	
ENVIRONMENTAL			
Operating Temperature		-30° to +60° C	
Operating Humidity		5% to 95% Non-condensing	
INTERFACES			
Serial COM 1, COM 2		RS-232, DB-9	
Ethernet		10 BaseT Auto-MDIX RJ-45	
Antenna		TNC Female (Tx/Rx), SMA Female (Rx)-Dual port models only	
APPROVALS & CERTIFICATIONS			
FCC		NP4-5018-500	NP4-5098-500
IC (DOC)		773B-5018500	773B-5098500
UL		Class I, Div 2 when powered with a listed Class 2 source	



MultiSpeed Illustration

CalAmp
299 Johnson Ave, Ste 110
Waseca, MN 56093

Tel 800.992.7774 | Tel 507.833.8819
Fax 507.833.6748

www.calamp.com

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PN: 000-0000-059 Rev 1

The Viper SC is a commercial off-the-shelf Information Technology component manufactured in the United States.

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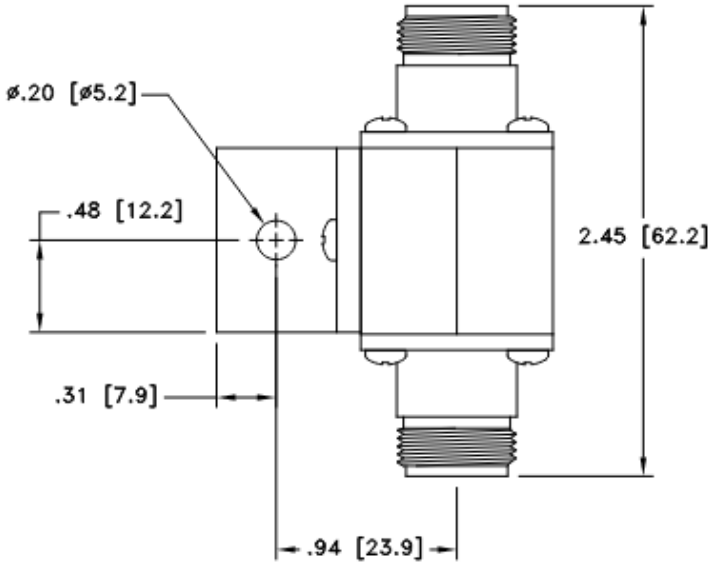
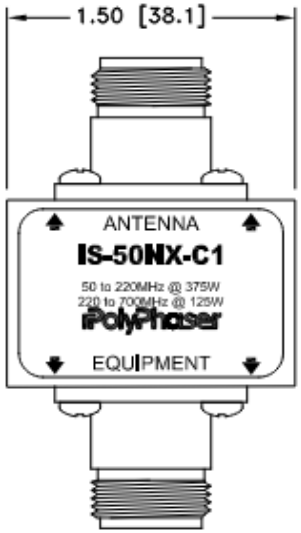
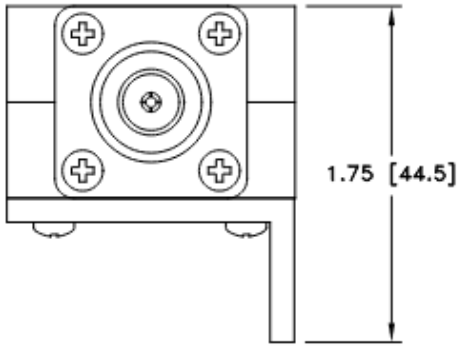
REVISIONS				
REV LTR	DATE	ENG	MKTG	Q.A.
A	07/13/99 SH	M.M	T.M	R.M
B	01/15/01 SH	KCB	PH	RM
C	12/09/02 SH	LC	SD	LJ







MAXIMUM CHARACTERISTICS

SURGE:
50kA IEC 1000-4-5 8/20 µs WAVEFORM 500 JOULES
TURN-ON:
600Vdc ±20%
TURN-ON TIME:
2.5ns FOR 2kV/ns
FREQUENCY RANGE:
50MHz TO 700MHz
VSWR:
≤1.2:1 50 TO 60MHz
≤1.1:1 60 TO 700MHz
INSERTION LOSS:
≤0.1dB OVER FREQUENCY RANGE
MAX POWER:
VHF 375W, UHF 125W
THROUGHPUT ENERGY:
≤600µJ
TEMPERATURE:
-45°C + 85°C STORAGE/OPERATING +50°C

CUSTOMER APPROVAL: _____ DATE: _____

ALL DIMENSIONS SHOWN ABOVE ARE FOR REFERENCE ONLY.

DRAFTER: M.WALSER	DATE: 06/30/94	PolyPhaser				
MECH ENGINEER: - - - -	DATE: - - -	P.O. BOX 9000 MINDEN, NV 89423 TEL: 775-782-2511 FAX: 775-782-4476				
ELEC ENGINEER: J. JONES	DATE: 06/30/94	DWG NO/PART NO/DESCRIPTION: IS-50NX-C1 CUSTOMER PRINT				
MARKETING: - - - -	DATE: - - -					
QUALITY DEPT: J. FILBIN	DATE: 06/30/94	CAGE CODE: 61114	FILE NAME: -C1	SCALE: 1/1	SHEET: 1 OF 1	

TIMES MICROWAVE SYSTEMS

LMR®-400
Flexible Low Loss Communications Coax

Ideal for...

- Drop-in replacement for RG-8/9913 Air-Dielectric type Cable
- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. In addition, the LMR-FR series is MSHA-P rated for mining operations.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose indoor/outdoor applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other indoor/outdoor applications where color compatibility is desired.

• **Flexibility** and bendability are hallmarks of the LMR-400 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-400. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability**: LMR-400 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors**: A wide variety of connectors are available for LMR-400 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies**: All LMR-400 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				Stock
Part Number	Application	Jacket	Color	Code
LMR-400	Outdoor	PE	Black	54001
LMR-400-DB	Outdoor/Watertight	PE	Black	54091
LMR-400-FR	Indoor -Riser CMR	FRPE	Black	54030
LMR-400-FR-PVC	Indoor -Riser CMR	FRPVC	Black	54073
LMR-400-PVC	Indoor/Outdoor	PVC	Black	54218
LMR-400-PVC-W	Indoor/Outdoor	PVC	White	54204

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.108	(2.74)
Dielectric	Foam PE	0.285	(7.24)
Outer Conductor	Aluminum Tape	0.291	(7.39)
Overall Braid	Tinned Copper	0.320	(8.13)
Jacket	(see table above)	0.405	(10.29)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.00	(25.4)
Bend Radius: repeated	in. (mm)	4.0	(101.6)
Bending Moment	ft-lb (N-m)	0.5	(0.68)
Weight	lb/ft (kg/m)	0.068	(0.10)
Tensile Strength	lb (kg)	160	(72.6)
Flat Plate Crush	lb/in. (kg/mm)	40	(0.71)

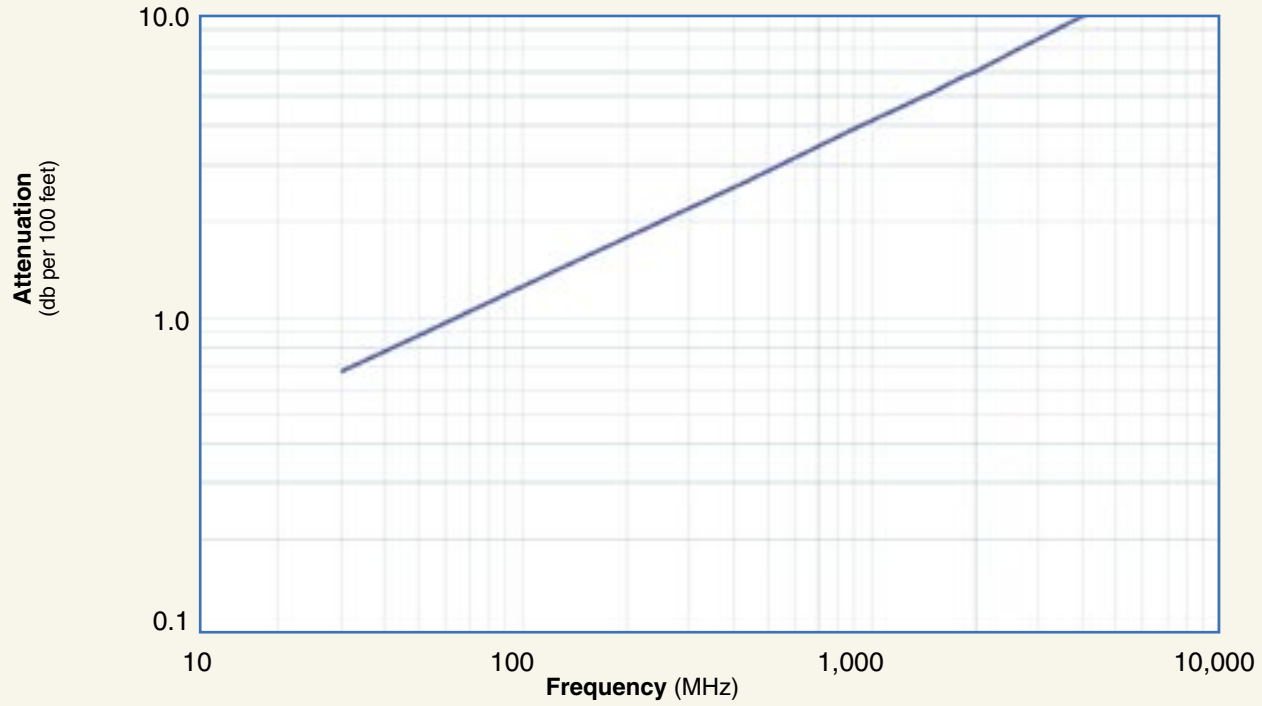
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Cutoff Frequency	GHz	16.2	
Velocity of Propagation	%	85	
Dielectric Constant	NA	1.38	
Time Delay	nS/ft (nS/m)	1.20	(3.92)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.9	(78.4)
Inductance	uH/ft (uH/m)	0.060	(0.20)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	1.39	(4.6)
Outer Conductor	ohms/1000ft (/km)	1.65	(5.4)
Voltage Withstand	Volts DC	2500	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	16	

Attenuation vs. Frequency (typical)



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.7	0.9	1.5	1.9	2.7	3.9	5.1	5.7	6.0	6.8	10.8
Attenuation dB/100 m	2.2	2.9	5.0	6.1	8.9	12.8	16.8	18.6	19.6	22.2	35.5
Avg. Power kW	3.33	2.57	1.47	1.20	0.83	0.58	0.44	0.40	0.37	0.33	0.21

Calculate Attenuation =
$(0.122290) \bullet \sqrt{FMHz} + (0.000260) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:
VSWR=1.0 ; Ambient = +25°C (77°F)

Power:
VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-400
Flexible Low Loss Communications Coax

SC-400-NM
TC-400-NM

TC-400-NMC

EZ-400-NMH-D

TC-400-NMH-D

EZ-400-NMK

TC-400-NMH-RA-D

TC-400-NMC-RA (A)

EZ-400-NMH-RA

TC-400-NM-RP

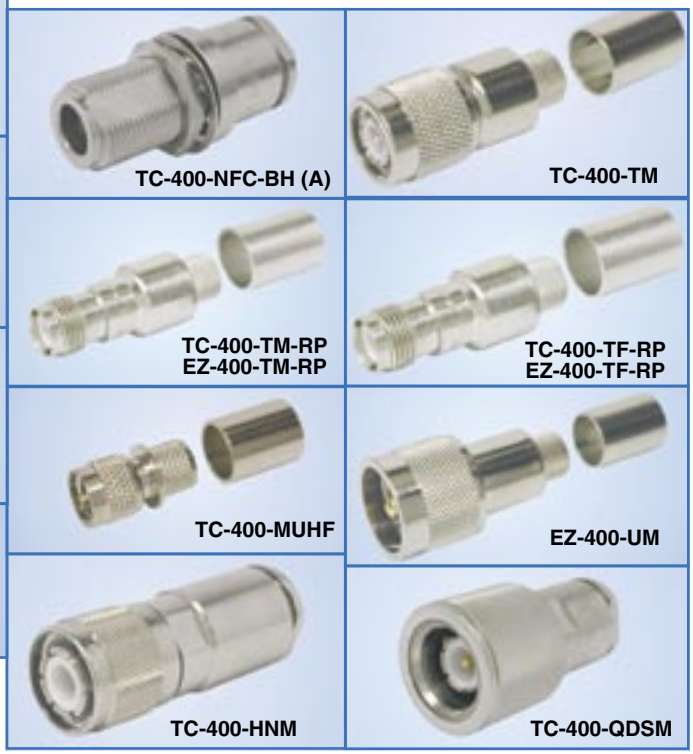
EZ-400-NMC-2

TC-400-NFC

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in	Length (mm)	Width in	Width (mm)	Weight lb	Weight (g)
7-16 DIN Female	Straight Jack	TC-400-716-FC	3190-376	<1.25:1(2.5)	NA	Solder	Clamp	S/S	1.6	(41)	1.13	(28.7)	0.281	(127.5)
7-16 DIN Male	Straight Plug	TC-400-716-MC	3190-279	<1.25:1(2.5)	Hex	Solder	Clamp	S/S	1.4	(36)	1.40	(35.6)	0.268	(121.6)
7-16 DIN Male	Right Angle	TC-400-716MC-RA	3190-1671	<1.25:1(<3)	Hex	Solder	Clamp	A/S	2.4	(61.5)	1.88	(47.8)	0.35	(159)
BNC Male	Straight Plug	TC-400-BM	3190-318	<1.25:1(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.56	(14.2)	0.063	(28.6)
HN Male	Straight Plug	TC-400-HNM	3190-923	<1.25:(<1)	Knurl	Solder	Clamp	S/G	2.3	(59.2)	0.88	(22.4)	0.25	(113.4)
QDS Male	Straight Plug	TC-400-QDSM	3190-620	<1.25:(<3)	Knurl	Solder	Clamp	A/G	1.8	(46.6)	1.00	(25.4)	0.25	(113.4)
Mini-UHF	Straight Plug	TC-400-MUHF	3190-520	<1.25:1(2.5)	Knurl	Solder	Crimp	N/G	1.1	(28)	0.50	(12.7)	0.020	(9.1)
N Female	Straight Jack	TC-400-NFC	3190-299	<1.25:1 (2.5)	NA	Solder	Clamp	N/S	1.6	(41)	0.75	(19.1)	0.119	(54.0)
	Straight Plug	EZ-400-NFC-2	3190-1907	<1.25:1(2.5)	NA	Spring Finger	Clamp	N/G	1.5	(38)	0.89	(22.6)	0.121	(54.9)
	Straight Jack	EZ-400-NF	3190-956	<1.25:1(2.5)	NA	Spring Finger	Crimp	N/G	1.8	(45)	0.66	(16.8)	0.105	(47.6)
	Bulkhead Jack	EZ-400-NF-BH	3190-518#	<1.25:1(2.5)	NA	Spring Finger	Crimp	N/G	1.8	(46)	0.88	(22.4)	0.102	(46.3)
	Bulkhead Jack	TC-400-NFC-BH (A)	3190-872	<1.25:1(2.5)	NA	Solder	Clamp	A/G	1.8	(46)	0.88	(22.4)	0.145	(65.8)
N Male	Straight Plug	SC-400-NM	3190-1454	<1.25:1(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
	Straight Plug	TC-400-NM	3190-188	<1.25:1(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
	Straight Plug	TC-400-NMC	3190-277	<1.25:1(2.5)	Knurl	Solder	Clamp	N/G	1.5	(38)	0.70	(17.8)	0.121	(54.9)
	Straight Plug	EZ-400-NMC-2	3190-1906	<1.25:1(2.5)	Hex/Knurl	Spring Finger	Clamp	N/G	1.5	(38)	0.75	(19.1)	0.121	(54.9)
	Straight Plug	EZ-400-NMH-D	3190-400#	<1.25:1(10)	Hex/Knurl	Spring Finger	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.103	(46.8)
	Straight Plug	TC-400-NMH-D	3190-552	<1.25:1(10)	Hex/Knurl	Solder	Crimp	A/G	1.5	(38)	0.89	(22.6)	0.113	(51.3)
	Straight Plug	EZ-400-NMK	3190-661	<1.25:1(10)	Knurl	Spring Finger	Crimp	S/G	1.5	(38)	0.75	(22.6)	0.113	(51.3)
	Right Angle	TC-400-NMH-RA-D	3190-2293#	<1.35:1(6)	Hex/Knurl	Solder	Crimp	A/G	1.8	(46)	1.25	(31.8)	0.130	(59.0)
	Right Angle	TC-400-NMC-RA (A)	3190-870	<1.35:1(2.5)	Hex	Solder	Clamp	A/G	1.8	(46)	1.25	(31.8)	0.150	(68.0)
	Right Angle	EZ-400-NMH-RA	3190-761	<1.35:1(2.5)	Hex	Spring Finger	Crimp	S/G	1.8	(46)	1.25	(31.8)	0.130	(59.0)
	Reverse Polarity	TC-400-NM-RP	3190-960	<1.25:1(2.5)	Knurl	Solder	Crimp	N/G	1.5	(38)	0.75	(19.1)	0.090	(40.8)
SMA Male	Straight Plug	TC-400-SM	3190-439	<1.25:1(8)	Hex	Solder	Crimp	N/G	1.2	(29)	0.50	(12.7)	0.032	(14.5)
TNC Female	Reverse Polarity	TC-400-TF-RP	3190-1063	<1.25:1(2.5)	NA	Solder	Crimp	N/G	1.8	(46)	0.55	(14.0)	0.074	(33.6)
	Reverse Polarity	EZ-400-TF-RP	3190-795	<1.25:1(2.5)	-NA	Spring Finger	Crimp	A/G	1.8	(46)	0.55	(14.0)	0.074	(33.6)
TNC Male	Straight Plug	TC-400-TM	3190-260	<1.25:1(2.5)	Knurl	Solder	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.074	(33.6)
	Straight Plug	EZ-400-TM	3190-650	<1.25:1(2.5)	Knurl	Spring Finger	Crimp	N/S	1.7	(43)	0.59	(15.0)	0.074	(33.6)
	Right Angle	TC-400-TM-RA	3190-442#	<1.35:1(2.5)	Knurl	Solder	Crimp	N/G	1.7	(43)	0.59	(15.0)	0.085	(38.6)
	Reverse Polarity	TC-400-TM-RP	3190-1062	<1.25:1(2.5)	Knurl	Solder	Crimp	N/G	1.7	(43)	0.59	(15.0)	0.074	(33.6)
	Reverse Polarity	EZ-400-TM-RP	3190-794	<1.25:1(2.5)	Knurl	Spring Finger	Crimp	A/G	1.7	(43)	0.59	(15.0)	0.074	(33.6)
UHF Male	Straight Plug	EZ-400-UM	3190-997	<1.25:1(2.5)	Knurl	Spring Finger	Crimp	N/G	1.9	(48)	0.80	(20.3)	0.090	(40.8)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair #Available in bulk pack



Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S400TT	GK-S400TT	Standard Grounding Kit (each)
Hoisting Grip	HG-400T	HG-400T	Laced Type (each)

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1719	3190-202	.429" Hex Dies
Crimp Tool	CT-400/300	3190-666	Crimp tool for LMR 400 connectors
Crimp Rings	CR-400	3190-830	Crimp rings for TC/EZ-400 connectors (package of 10)
Strip Tool	ST-400C-2	3190-1972	Prep tool for EZ-400-NMC-2 two piece clamp style connector
Strip Tool	CST-400	3192-004	Combination prep tool for LMR-400 crimp and clamp style connectors
Mid-Span Strip Tool	GST-400	3190-2174	For ground strap attachment
Replacement Blades	RB-456	3190-421	Replacement blades for Strip Tool
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Tool Kit	TK-400EZ	3190-1601	Tool kit for LMR-400 Crimp Connectors (includes CCT-01, CST-400, CT-400/300, DBT-U, Tool Pouch)

TIMES MICROWAVE SYSTEMS

LMR®-600
Flexible Low Loss Communications Coax

Ideal for...

- Jumper Assemblies in Wireless Communications Systems
- Short Antenna Feeder runs
- Any application (e.g. WLL, GPS, LMR, WLAN, WISP, WiMax, SCADA, Mobile Antennas) requiring an easily routed, low loss RF cable

• **LMR®** standard is a UV Resistant Polyethylene jacketed cable designed for 20-year service outdoor use. The bending and handling characteristics are significantly better than air-dielectric and corrugated hard-line cables.

• **LMR®- DB** is identical to standard LMR plus has the advantage of being watertight. The addition of waterproofing compound in and around the foil/braid insures continuous reliable service should the jacket be inadvertently damaged during installation or in the future.

• **LMR®- FR** is a non-halogen (non-toxic), low smoke, fire retardant cable designed for in-building runs that can be routed anywhere except air handling plenums. LMR-FR has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. In addition, the LMR-FR series is MSHA-P rated for mining applications.

• **LMR®- FR-PVC** is a general-purpose indoor cable and has a UL/NEC & CSA rating of 'CMR' and 'FT4' respectively. It is less expensive than LMR-FR, however it emits toxic fumes (HCL) and greater smoke density when burned.

• **LMR®- PVC** is designed for low loss general-purpose indoor/outdoor applications and is somewhat more flexible than the standard polyethylene jacketed LMR.

• **LMR®- PVC-W** is a white-jacketed version of LMR-PVC for marine and other indoor/outdoor applications where color compatibility is desired.

• **Flexibility** and bendability are hallmarks of the LMR-600 cable design. The flexible outer conductor enables the tightest bend radius available for any cable of similar size and performance.

• **Low Loss** is another hallmark feature of LMR-600. Size for size LMR has the lowest loss of any flexible cable and comparable loss to semirigid hard-line cables.

• **RF Shielding** is 50 dB greater than typical single shielded coax (40 dB). The multi-ply bonded foil outer conductor is rated conservatively at > 90 dB (i.e. >180 dB between two adjacent cables).

• **Weatherability**: LMR-600 cables designed for outdoor exposure incorporate the best materials for UV resistance and have life expectancy in excess of 20 years.

• **Connectors**: A wide variety of connectors are available for LMR-600 cable, including all common interface types, reverse polarity, and a choice of solder or non-solder center pins. Most LMR connectors employ crimp outer attachment using standard hex crimp sizes.

• **Cable Assemblies**: All LMR-600 cable types are available as pre-terminated cable assemblies. Refer to the section on FlexTech for further details.

Part Description				
Part Number	Application	Jacket	Color	Stock Code
LMR-600	Outdoor	PE	Black	54003
LMR-600-DB	Outdoor/Watertight	PE	Black	54093
LMR-600-FR	Indoor -Riser CMR	FRPE	Black	54032
LMR-600-FR-PVC	Indoor -Riser CMR	FRPVC	Black	54074
LMR-600-PVC	Indoor/Outdoor	PVC	Black	54219
LMR-600-PVC-W	Indoor/Outdoor	PVC	White	54206

Construction Specifications			
Description	Material	In.	(mm)
Inner Conductor	Solid BCCAl	0.176	(4.47)
Dielectric	Foam PE	0.455	(11.56)
Outer Conductor	Aluminum Tape	0.461	(11.71)
Overall Braid	Tinned Copper	0.490	(12.45)
Jacket	(see table above)	0.590	(14.99)

Mechanical Specifications

Performance Property	Units	US	(metric)
Bend Radius: installation	in. (mm)	1.50	(38.1)
Bend Radius: repeated	in. (mm)	6.0	(152.4)
Bending Moment	ft-lb (N-m)	2.75	(3.73)
Weight	lb/ft (kg/m)	0.131	(0.20)
Tensile Strength	lb (kg)	350	(158.9)
Flat Plate Crush	lb/in. (kg/mm)	60	(1.07)

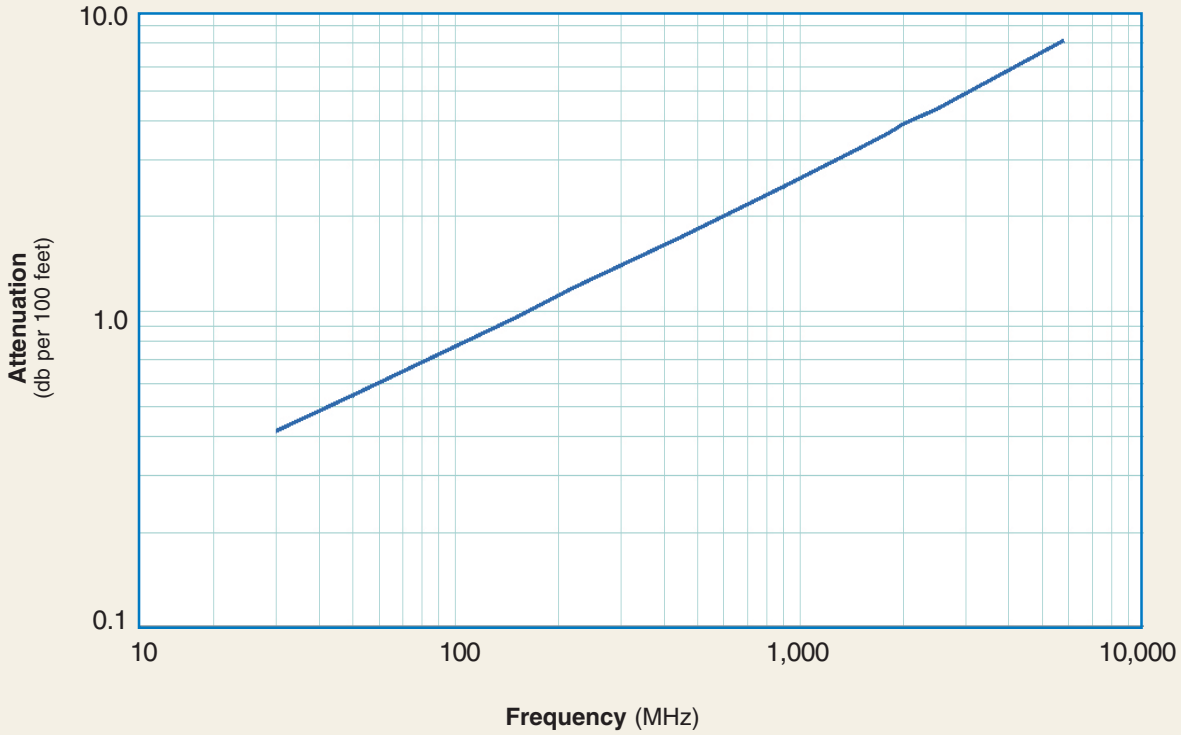
Environmental Specifications

Performance Property	°F	°C
Installation Temperature Range	-40/+185	-40/+85
Storage Temperature Range	-94/+185	-70/+85
Operating Temperature Range	-40/+185	-40/+85

Electrical Specifications

Performance Property	Units	US	(metric)
Cutoff Frequency	GHz	10.3	
Velocity of Propagation	%	87	
Dielectric Constant	NA	1.32	
Time Delay	nS/ft (nS/m)	1.17	(3.83)
Impedance	ohms	50	
Capacitance	pF/ft (pF/m)	23.4	(76.6)
Inductance	uH/ft (uH/m)	0.058	(0.19)
Shielding Effectiveness	dB	>90	
DC Resistance			
Inner Conductor	ohms/1000ft (/km)	0.53	(1.7)
Outer Conductor	ohms/1000ft (/km)	1.2	(3.9)
Voltage Withstand	Volts DC	4000	
Jacket Spark	Volts RMS	8000	
Peak Power	kW	40	

Attenuation vs. Frequency **(typical)**



Frequency (MHz)	30	50	150	220	450	900	1500	1800	2000	2500	5800
Attenuation dB/100 ft	0.4	0.5	1.0	1.2	1.7	2.5	3.3	3.7	3.9	4.4	7.3
Attenuation dB/100 m	1.4	1.8	3.2	3.9	5.6	8.2	10.9	12.1	12.8	14.5	23.8
Avg. Power kW	5.51	4.24	2.41	1.97	1.35	0.93	0.70	0.63	0.59	0.52	0.32

Calculate Attenuation =

$(0.075550) \bullet \sqrt{FMHz} + (0.000260) \bullet FMHz$ (interactive calculator available at http://www.timesmicrowave.com/cable_calculators)

Attenuation:

VSWR=1.0; Ambient = +25°C (77°F)

Power:

VSWR=1.0; Ambient = +40°C; Inner Conductor = 100°C (212°F); Sea Level; dry air; atmospheric pressure; no solar loading

TIMES MICROWAVE SYSTEMS

LMR®-600
Flexible Low Loss Communications Coax

Connectors

Interface	Description	Part Number	Stock Code	VSWR** Freq. (GHz)	Coupling Nut	Inner Contact Attach	Outer Contact Attach	Finish* Body /Pin	Length in (mm)	Width in (mm)	Weight lb (g)
7/8 EIA	Flange	EZ-600-78EIA	3190-1373	<1.25:1 (2.5)	NA	Spring Finger	Clamp	S/S	2.3 (58)	2.60 (66.0)	0.873 (396.0)
7-16 DIN Female	Straight Jack	TC-600-716FC	3190-375	<1.25:1 (2.5)	NA	Solder	Clamp	S/S	1.1 (28)	1.00 (25.4)	0.249 (112.9)
7-16 DIN Male	Straight Plug	EZ-600-716MH	3190-503	<1.25:1 (2.5)	Hex	Spring Finger	Crimp	S/S	2.0 (51)	1.30 (33.0)	0.254 (115.2)
	Straight Plug	TC-600-716MC	3190-502	<1.25:1 (2.5)	Hex	Solder	Clamp	S/S	2.0 (51)	1.30 (33.0)	0.347 (157.4)
	Right Angle	TC-600-716M-RA	3190-395	<1.35:1 (2.5)	Hex	Solder	Crimp	S/S	1.4 (36)	1.40 (35.6)	0.354 (160.8)
HN Male	Straight Plug	TC-600-HNM	3190-1429	<1.25:1 (<1)	Knurl	Solder	Clamp	S/g	2.3 (59.2)	0.88 (22.4)	0.25 (113)
LC Male	Straight Plug	TC-600-LCM	3190-1406	<1.25:1 (<1)	Hex	Solder	Clamp	N/S	3.1 (78.0)	1.62 (41.1)	1.20 (544)
N Female	Straight Jack	EZ-600-NF	3190-955	<1.25:1 (2.5)	NA	Spring Finger	Crimp	S/G	2.3 (59)	0.87 (22.1)	0.150 (68.0)
	Bulkhead Jack	EZ-600-NF-BH	3190-616	<1.25:1 (2.5)	NA	Spring Finger	Crimp	S/G	2.4 (61)	0.88 (22.4)	0.195 (88.5)
	Bulkhead Jack	TC-600-NF-BH	3190-589#	<1.25:1 (2.5)	NA	Solder	Crimp	S/G	2.4 (61)	0.88 (22.4)	0.195 (88.5)
	Bulkhead Jack	TC-600-NFC-BH	3190-466	<1.25:1 (2.5)	NA	Solder	Clamp	S/G	2.2 (56)	0.94 (23.9)	0.214 (97.1)
N Male	Straight Plug	EZ-600-NMH-D	3190-1268	<1.25:1 (8)	Hex/Knurl	Spring Finger	Crimp	A/G	2.1 (53)	0.92 (23.4)	0.164 (74.4)
	Straight Plug	EZ-600-NMK	3190-669	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	2.1 (53)	0.92 (23.4)	0.164 (74.4)
	Straight Plug	TC-600-NMH-D	3190-208#	<1.25:1 (2.5)	Hex/Knurl	Solder	Crimp	A/G	2.1 (53)	0.92 (23.4)	0.166 (75.3)
	Straight Plug	EZ-600-NMC-2	3190-1387	<1.25:1 (6)	Hex/Knurl	Spring Finger	Clamp	S/G	2.1 (53)	0.92 (23.4)	0.202 (91.6)
	Straight Plug	TC-600-NMC	3190-357#	<1.25:1 (2.5)	Hex	Solder	Clamp	S/G	2.1 (53)	0.92 (23.4)	0.208 (93.4)
	Right Angle	TC-600-NMC-RA	3190-233	<1.35:1 (2.5)	Hex	Solder	Clamp	S/G	2.1 (53)	0.92 (23.4)	0.280 (117.9)
	Right Angle	EZ-600-NMH-RA	3190-762	<1.35:1 (2.5)	Hex	Spring Finger	Crimp	S/G	2.1 (53)	0.92 (23.4)	0.185 (83.9)
	Right Angle	TC-600-NMH-RA	3190-785#	<1.35:1 (6)	Hex	Solder	Crimp	S/G	2.1 (53)	0.92 (23.4)	0.185 (83.9)
QDS Male	Straight Plug	TC-600-QDSM	3190-846	<1.25:1 (<1)	Knurl	Solder	Clamp	A/G	2.2 (55.6)	1.00 (25.4)	0.25 (113)
	Right Angle	TC-600-QDSM-RA	3190-847	<1.25:1 (<1)	Knurl	Solder	Clamp	A/G	2.4 (61.5)	1.88 (47.8)	0.35 (159)
TNC Male	Straight Plug	EZ-600-TM	3190-418#	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	1.7 (43)	0.59 (15.0)	0.112 (50.8)
	Reverse Polarity	EZ-600-TM-RP	3190-796	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	A/G	2.2 (56)	0.87 (22.0)	0.112 (50.8)
TNC Female	Reverse Polarity	EZ-600-TF-RP	3190-797	<1.25:1 (2.5)	NA	Spring Finger	Crimp	A/G	2.3 (58)	0.87 (22.0)	0.100 (45.4)
UHF Male	Straight Plug	EZ-600-UM	3190-615	<1.25:1 (2.5)	Knurl	Spring Finger	Crimp	S/G	1.7 (43)	0.88 (22.4)	0.164 (74.4)
	Straight Plug	TC-600-UMC	3190-213	<1.25:1 (2.5)	Knurl	Solder	Clamp	S/G	1.7 (43)	0.88 (22.4)	0.198 (89.8)

* Finish metals: N=Nickel, S=Silver, G=Gold, SS=Stainless Steel, A=Alballoy **VSWR spec based on 3 foot cable with a connector pair #Available in bulk pack

EZ-600-78EIA

EZ-600-NMK

TC-600-HNM

TC-600-QDSM

TC-600-LCM

TC-600-QDSM-RA

HX-4

ST-600C ST-600EZ

WR-600

GST-600A

CR-600

DBT-U

CCT-01

TK-600EZ

Y1720

RB-456

Install Tools

Type	Part Number	Stock Code	Description
Crimp Tool	HX-4	3190-200	Crimp Handle
Crimp Dies	Y1720	3190-203	.610" Hex Dies
Crimp Rings	CR-600	3190-831	Crimp Rings for TC/EZ-600 connectors (pkg of 10)
Strip Tool	ST-600C	3190-230	For Clamp Style Connectors
Strip Tool	ST-600EZ	3190-310	For Crimp Style Connectors
Replacement Blades	RB-456	3190-421	Replacement Blades for Strip Tools
Deburr Tool	DBT-U	3192-001	Removes center conductor rough edges
Midspan Strip Tool	GST-600A	3190-1051	For ground strap attachment
Wrench	WR600	3190-1435	15/16" Box Wrench (2 required for EZ-600-NMC-2)
Cutting Tool	CCT-01	3190-1544	Cable end flush cut tool
Replacement Blade	RB-01	3190-1609	Replacement blade for cutting tool
Tool Kit	TK-600EZ	3190-1602	Tool kit for LMR-600 Crimp Connectors (includes CCT-01, ST-600EZ, HX-4, Y1720, DBT-U, Tool Pouch)

SH-U600T

HG-600T

Hanger Support Hardware

CS-A600T, CS-60120T, CS-60170T

CB-600T

SC-600T

GK-S600TT

Hardware Accessories

Type	Part Number	Stock Code	Description
Ground Kit	GK-S600TT	GK-S600TT	Standard Grounding Kit (each)
Hoisting Grip	HG-600T	HG-600T	Split/Laced Type (each)
Cold Shrink	CS-A600T	CS-A600T	Cable to Antenna Junction (each)
Cold Shrink	CS-60120T	CS-60120T	LMR-600 to -1200 Junction (each)
Cold Shrink	CS-60170T	CS-60170T	LMR-600 to -1700 Junction (each)
Hanger Blocks	CB-600T	CB-600T	Dual Cable Support Block (kit of 10)
Standard Entry Port Cushion	SC-600T-3	SC-600T-3	Three cables (each)
Snap-In Hangers	SH-U600T	SH-U600T	Snap-In Hangers (Kit of 10)
Hanger Block Supporting Hardware			Complete Range of Supporting Hardware & Adapters Available

Information required for FCC Radio license application

Official name of the entity

(*Example: Town of Yarmouth, Department of Public Works, Wastewater Division)*

Town of Yarmouth Federal Tax ID #:

Entity call sign of any existing FCC licenses (if available):

Entity official contact person name and title (who we will identify & signature on the license):

FCC ULS (universal licensing system) database password (if any/known, if not we will create):

Contact person's office phone number, fax number, cell phone number

---

Contact person's mailing address and physical address:

Contact person's email address:

TCS
tcscommunications.com
800-TCS-XMIT
850

TCS
800-TCS-XMIT

850
M60·599

BAXTER GRIST MILL
PARKING
1420

TCS-XMIT

M26·547
COMMERCIAL

316
Bass
OUTLET

Massachusetts
M26·547
COMMERCIAL

CRANBERRY
BOG
Please
Keep Off!
VIOLATORS WILL BE PROSECUTED

FOR LEASE
3,000 sq ft.
508-395-7518
TCS
tcscommunications.com
800-TCS-XMIT

SEACOAST VILLAGE
775 5555
Town Taxi

LOVE THAT DOG

ZOOQUARIUM
M26·547

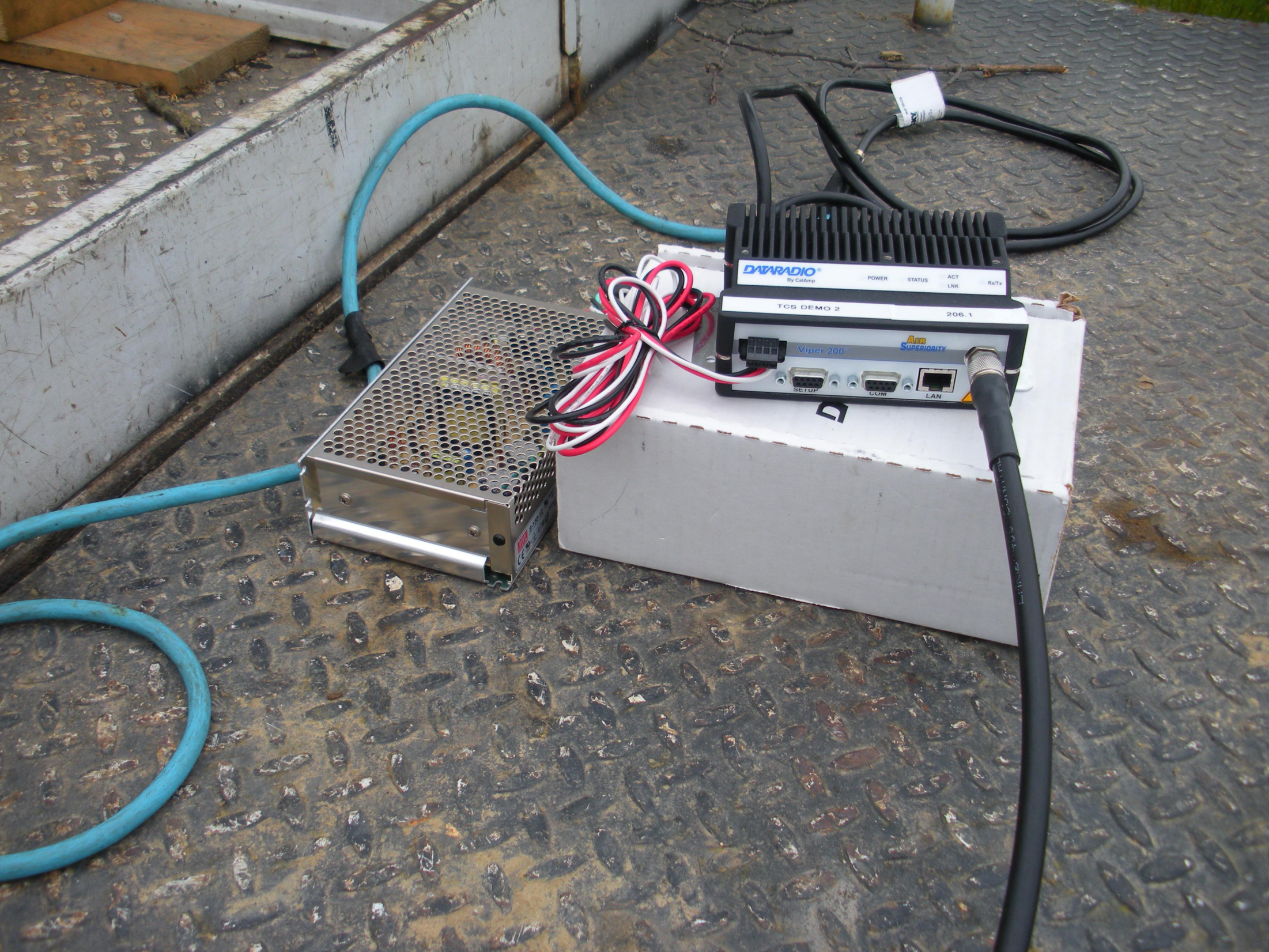
TCS
800-TCS-XMIT

CHEVROLET

Altec
Merrill Electric
M11
Merrill Electric
978•388•1522
USDOT 1206794

Atec
Morrill Electric
M11
Morrill Electric
978-388-1622
USDOT 1206734

DATARADIO®
By CalAmp
POWER
STATUS
ACT
LNK
Rx/Tx
TCS DEMO 2
206.1
Viper 200™
AIR SUPERIORITY
LAN


DATARADIO
By CalAmp
POWER
STATUS
ACT
LNK
Rx/Tx
TCS DEMO 2
206.1
Viper 200
AIR SUPERIORITY
SETUP
COM
LAN

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APPENDIX 406650-A

RADIO COMMUNICATION PATH STUDY

This radio communication path study is included for reference only. The determination of the exact length of transmission line and quantity of materials shall be the responsibility of the Contractor.

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SECTION 406663 - ANTENNAS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes antennas for radio telemetry.

B. A radio path study was performed by TCS Communications Corp. The equipment specified herein is based on the results of the radio path study and the recommendations of TCS Communications. A copy of the radio path study is included as an appendix to Section 406650 “Radio Telemetry Equipment.”

C. Provide identical antennas as much as possible throughout the system to reduce spare parts inventory.

D. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provision.”
2. Section 406121.20 “Process Control System Testing” for field testing requirements.
3. Section 406650 “Radio Telemetry Equipment.”
4. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”
5. Division 26 for electrical installation requirements.
6. Refer to the E-sheets in the Drawing package.

E. Obtain required Construction permits for equipment installation.

F. Meet all applicable federal (FCC, etc.), state, and local codes and regulations.

1.3 DEFINITIONS

A. Citizen Band Radio Service (CBRS): Frequency band of 3550-3700 MHz (3.5 GHz band) reserved for private two-way, short-distance communication.

B. Voltage Standing Wave Ratio (VSWR): The measure of reflected power on a transmission line, expressed as a ratio of reflected voltage (V_{max}) to ideal voltage (V_{min}). An ideal system will have 100% energy transmitted, resulting in a VSWR of 1.0, or 1:1.

C. Yagi-Uda antenna (YAGI): A directional antenna consisting of parallel arrays of similar elements, typically half-wave dipoles.

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1.4 ACTION SUBMITTALS

A. Provide shop drawings and product data, in accordance with Section 013300 “Submittal Procedures,” showing materials of construction and details of installation for:

1. Data sheets and catalog literature for hardware (antennas and accessories)
2. Physical dimension drawings
3. Antenna utility pole details and structural calculations
4. Installation and interconnection/wiring diagrams depicting the proposed installation of the equipment, in conformance to the requirements specified on the Plans. Detail these drawings to the extent that they may be modified after installation to serve as the "AS-BUILT" drawings.

    a. A complete telemetry system block diagram(s) showing in schematic form, the interconnections between major hardware components. Reference all interconnecting cabling requirements for digital components of the system including any data communication links.
    b. Equipment specification sheets that fully describe the device, the intended function, how it operates and its physical environmental and performance characteristics. As a minimum the specification sheets include the following:

        1) Dimension, rigid clearances.
        2) Mounting or installation details.
        3) Connection.
        4) Electrical power requirements.
        5) Materials of construction.
        6) Environmental characteristics.
        7) Performance characteristics.

    c. Submit all planning information, site preparation instructions, grounding and bonding procedures, cabling diagrams, plug identifications, safety precautions or guards, and equipment layouts to enable the Supplier to proceed with the detailed site preparation for the equipment.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each test performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Not required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form a complete working system.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

PART 2 - PRODUCTS

2.1 YAGI DIRECTIONAL ANTENNAS

A. Refer to Appendix A – Radio Path Study in Section 406650 “Radio Telemetry Equipment” for all antenna and related equipment part numbers.

B. Manufacturers

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mobile Mark 7.0dB, 205-225 MHz Yagi Antenna or equal as specified in Appendix A – Radio Path Study, or comparable product by one of the following:

a. Or equal.

C. Yagi directional antennas shall come equipped with coordinated lengths of transmission line as shown on the Drawings.

D. Type:

1. 200-225 MHz yagi directional antenna.
2. Seamless boom with 3 parallel detector elements.

E. Required Accessories:

1. Provide lightning protectors between transmission cable and coaxial jumper cable.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Polyphaser surge arrestor or equal as specified in Appendix A – Radio Path Study, or comparable product by the following:

1) Or equal.

2. Provide mounting brackets and hardware suitable for the installation location shown on the drawings and as recommended by the antenna manufacturer.
3. Additional equipment and accessories listed in Appendix A – Radio Path Study.
4. Provide any additional connectors, mounting hardware, and ancillary equipment required to install the antennas and all related components in compliance with the manufacturer's recommendations and as shown on the Drawings.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 "Quality Requirements" for requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utility poles, conduits, and roofs for suitable conditions where antennas are installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install antenna equipment and anciallary equipment as shown on the Drawings and in accordance with manufacturer's instructions and approved shop drawings.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. During factory testing and field testing, the PCSS, AESS, and RTSS shall demonstrate communications to the Engineer. Burden of proof of communications is the transfer of 1 analog and 1 discrete register in both directions.
2. Test and inspect components, assemblies, and equipment installations, including connections.
3. All tests and inspections required by the manufacturer to certify installation.
4. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work

C. Antennas are considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service with PCSS, AESS, RTSS and any other affected subcontractors.

1. Complete installation and startup check according to manufacturer's written instructions.
2. The start-up services include calibration and positioning of directional antennas, oversight of installations of the antennas, and start-up of the LFR communication system in order to provide reliable communications from the pumping station to the radio master

control panel at the water department. Coordinate with the PCSS, AESS, RTSS, and any other affected subcontractors to test and verify the LFR system sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit LFR system commissioning report in order to document the startup procedure of the antennas and LFR system.

3.7 ADJUSTING

A. Position directional antennas for maximum received signal strength.

B. Adjust transmitter power if needed to comply with FCC rules and regulations before acceptance testing.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406663

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SECTION 406717 – INDUSTRIAL ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes industrial enclosures.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-t5 requirements.
3. Section 406650 “Radio Telemetry Equipment” for specs on licensed frequency radio surge arrestor that will be housed in the TVSS enclosure.
4. Section 406733 “Panel Wiring.”
5. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors” for specs on intrinsically safe barriers that will be housed in the Intrinsically Safe Barrier (ISB) panel.
6. Section 462433 “Open-Channel Grinders.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”
2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
3. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions”.

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1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

D. Maintain copies of panel drawings on site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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PART 2 - PRODUCTS

2.1 INDUSTRIAL ENCLOSURES

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. nVent: Hoffman.
b. Rittal.
c. Saginaw.
d. Or equal

B. Structure and Enclosure

1. Panels in indoor, dry, non-corrosive environments:

a. NEMA 12, painted steel or aluminum construction, as required by the schedule in PART 3.

2. Panels in outdoor, wet, or chemically corrosive environments:

a. NEMA 4X, stainless-steel or FRP construction, as required by the schedule in PART 3.

3. Panels located in hazardous locations:

a. Rated for the type of hazard (e.g., NEMA 7 for Class 1, Division 1).

4. Construction:

a. Freestanding and floor-mounted vertical panels:

1) Panels of 12-gauge sheet steel
2) Front panels or panels containing instruments: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

b. Wall and Unistrut mounted panels:

1) Panels no less than 14-gauge steel,

c. Consoles:

1) Panels of 12-gauge sheet steel
2) Front panels: provide 10-gauge stretcher-leveled sheet steel, reinforced to prevent warping or distortion.

5. Provide angle stiffeners on the back of the panel face to prevent panel deflection under instrument loading or operation, as follows:

a. Structural framework internal to the panel allows for instrument support and panel bracing.
b. Interior structure framework to permit panel lifting without racking or distortion.
c. Removable lifting rings designed to facilitate simple, safe rigging, and lifting of the control panels during installation.

6. Full height and fully gasketed access door with full-length, continuous, piano type stainless steel hinges with stainless steel pins.

a. Provide doors with three-point stainless steel latch and heavy-duty stainless-steel locking handle.
b. Provide front access doors of sufficient width to permit instrument or control device mounting without interference from flush mounted instruments.
c. Clamp-type door latches are not permitted.

7. Avoid kinks and sharp bends in wiring.

a. Route wiring for easy access to other components for maintenance and inspection purposes.

8. Panel suitable for top and bottom conduit entry as required by the Electrical Drawings

a. For top mounted conduit entry, provide panel top with nominal one-foot square removable access plates, which may be drilled to accommodate conduit and cable penetrations.
b. Provide all conduit and cable penetrations with ground bushings, hubs, gasketed locknuts, and other accessories as required to maintain the NEMA rating of the panel and electrical rating of the conduit system.

C. General Requirements

1. UL labeled control panels and cabinets.

a. UL listing includes enclosure, specific equipment supplied with enclosure, and equipment installation and wiring within and on the enclosure. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment necessary to achieve compliance with UL 508A requirement. The Drawings do not detail all UL 508A requirements.

2. Panel door handles with lock, or a hasp and staple for padlocking: key the locks for all control panels provided under this Contract alike.
3. Arrange devices for rear of panel mounting within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.

a. Locate heat generating devices, such as power supplies, at or near the top of the panel.

4. Mount all components in a manner that permits servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component.

a. Mount interior panel components on removable plates (sub-panels) and not directly on the enclosure.
b. Unless shock mounting is required by the manufacturer to protect equipment from vibration, provide rigid and stable mounting.
c. Mount and orient components in accordance with manufacturer's recommendations.
d. Identify internal components with suitable plastic or metal engraved nametags mounted adjacent to (not on) each component identifying the component in accordance with the drawings and specifications.

5. Mount all panel components on a single rear-of-panel sub-panel unless the density of devices exceeds the panel mounting space permitted by the minimum panel dimensions specified. Side panel mounted components are not permitted without review and approval by Engineer.
6. Type 316 stainless-steel hardware and fasteners:

a. Provide drilled and tapped mounting screws; self-tapping screws are not permitted.

7. Install suitable gaskets and faceplates, required to maintain NEMA rating of the panel.

D. Mounting Elevations

1. Refer to ISA Recommended Practice RP60.3 for guidance on layout and arrangement of panels and panel mount components. Account for housekeeping pad dimensions.
2. Locate centerline of indicators and controllers no lower than 48 inches or higher than 66 inches above the floor on a panel face.
3. Locate centerline of lights, selector switches, and pushbuttons no lower than 32 inches or higher than 70 inches above the floor on a panel face.
4. Locate tops of annunciators no higher than 86 inches above the floor on a panel face.
5. Install panel components in accordance with manufacturer's guidelines.

E. Minimum Enclosure Size

1. For each enclosure provided, the enclosure shall be capable of housing all components of the control system specified herein and in other Sections plus 20% spare space for future expansion. The enclosure shall be an industry standard size that is readily available.

2.2 TEMPERATURE CONTROL

A. Provide force air ventilation or air conditioning units as required to prevent temperature buildup inside of panel.

B. Heat Load Calculations:

1. Submit heat load calculations for all control panels located in areas where either venting is not possible due to NEMA rating of panel or control panel is located in an area or building without air conditioning.
2. Utilize manufacturer available thermal calculators to determine heating/cooling requirements (i.e., Saginaw SCE thermal calculator, nVent Hoffman cooling selection tool, or equivalent).

3. Ensure the internal temperature of the panel is regulated between 45 to 104 degrees F under all conditions.
4. Account for the following conditions in the heat load calculations:

    a. Loading and dissipation effects on all surfaces of the enclosure. Account for surfaces not available for heat transfer (e.g., against a wall).
    b. Internal heat load of components (load and duty cycle).
    c. For outside temperature limits, refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

C. Sun Shields:

1. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

    a. Fabricate sun shields from a material suited for the area classification rating of its environment.
    b. Design, fabricate, install, and support the unit to fully cover and shade the top, sides, and back of the enclosure, and to partially shade the front panel of the enclosure from direct exposure to sunlight from sunrise to sunset.
    c. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure, to preserve rigidity.
    d. Design and mount sun shields with a minimum 3-inch air gap around the enclosure for air circulation and heat dissipation.
    e. Drilling holes or welding studs directly to the enclosure for sun shield mounting is not permitted.
    f. Slope the top section of the sun shield a minimum angle of 5 degrees from horizontal.

        1) Wall mounted enclosures: slope the top section downward away from the wall and towards the front of the enclosure.
        2) Free standing, floor mounted, and frame mounted enclosures: slope the top section downward towards the back side of the enclosure.

    g. Incorporate a narrow and more steeply sloped drip shield segment on the front edge of the top section to shed water away from the front of the enclosure and prevent dripping or running directly onto the front panel of the enclosure.
    h. Fabricate sun shields with continuous seam welds that are ground smooth.
    i. Smooth round or chamfer exposed corners, edges, and projections to prevent injury.

D. Louvers

1. If louvers are used, provide louver plate and filter kit.
2. Provide louver plates of stamped sheet metal construction.
3. Provide washable and replaceable filters.
4. Install louvers on the rear, top, or bottom of the panel, as required by the panel installation location.
5. For wall mounted enclosures with their backs directly adjacent to a wall, install louvers on the sides.

E. Forced Air Ventilation:

1. Provide forced air ventilation fans to create positive internal pressure within the panel.
2. Provide washable and replaceable filters.
3. Fan motors operate on 120-volt, 60-Hz power.

F. Air Conditioning:

1. For panels with internal heat that cannot be adequately dissipated with natural convention and heat sinks, or forced air ventilation, provide an air conditioner sized to deliver sufficient cooling.
2. NEMA rating equivalent to the NEMA rating of the panel. Maintain NEMA rating of panel when installed.
3. Provide air conditioner with conformal coating on exposed surfaces.
4. Mount air conditioners on panel side. If provided, cut sun shields to accommodate air conditioner.

G. Heating:

1. Provide an integral heater, fan, and adjustable thermostat for outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture, to reduce condensation and maintain the minimum internal panel temperature.

    a. Mount unit near enclosure bottom with discharge away from heat-sensitive equipment.
    b. Provide Hoffman DAH series, Stego PTC series, or equal.

2.3 ACCESSORIES

A. Nameplates

1. Identify the panel and individual devices as required, unless otherwise indicated:

    a. Include up to three lines:

        1) First line containing the device tag number as shown on the Drawings.
        2) Second line containing a functional description (e.g., Submersible Pump No. 1).
        3) Third line containing a functional control description (e.g., Start).

2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings:

    a. Furnish nameplates as 3/32-inch thick, black against white background unless otherwise noted, Lamicoid with engraved inscriptions. Bevel and smooth edges of nameplate.
    b. Nameplates with chipped or rough edges are not acceptable.

3. Mount or fasten cabinet mounted nameplates with epoxy adhesive or stainless steel screws.
4. Provide a panel nameplate with a minimum of 1-inch high letters for every panel.

5. Provide legend plates or 1-inch by 3-inch engraved nameplates with 1/4-inch lettering for identification of door mounted control devices, pilot lights, and meters.
6. Use single Lamicoid nameplates with multiple legends for grouping of devices such as selector switches and pilot lights that relate to one function.

B. Print Storage Pockets

1. Provide print storage pockets of steel construction, welded onto the door of the enclosure.
2. Size storage pockets to accommodate all prints required to service the equipment, and to accommodate 8.5-inch by 11-inch documents without folding.

C. Corrosion Control

1. Protect panels from internal corrosion by use of corrosion-inhibiting vapor capsules. Size and quantity as necessary per manufacturer recommendations.
2. Manufacturer:

a. Zerust VC.
b. Hoffman Model AHCI.
c. Or equal.

2.4 GENERAL FINISH REQUIREMENTS

A. Descale, degrease, fill, grind, and finish sections.

B. Finish steel-fabricated enclosures with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which are applied by either hot air spray or conventional cold spray methods.

1. Brushed anodized aluminum, stainless steel, and FRP panels do not require a paint finish.

C. Grind smooth, sand blast, and then clean with solvent. Fill surface voids and grind smooth.

D. Immediately after cleaning, apply one coat of a rust-inhibiting primer inside and outside, followed by an exterior intermediate and topcoat of a two-component type epoxy enamel.

1. Apply final sanding to the intermediate exterior coat before top coating.

E. Apply a minimum of two coats of manufacturer’s standard, flat light-colored lacquer, on the panel interior after priming.

F. Unless otherwise noted, finish exterior colors as ANSI 61 gray with textured finish.

G. Finish products after assembly.

2.5 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for requirements for testing, inspection, and analysis.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine buildings, walls, floors, roofs, and rooms for suitable conditions where industrial enclosures will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of each industrial enclosure.

B. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible
2. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
3. Install plenum cable in environmental air spaces, including plenum ceilings.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly and lubricate as recommended by manufacturer.

3.4 INDUSTRIAL ENCLOSURE SCHEDULE

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Table 1. Industrial Enclosure Schedule

Panel Designation	Minimum Size	Maximum Size	Enclosure Rating	Construction	General Requirements
PS1CP Enclosure	See Paragraph 2.1(E)	60-inch high by 36-inch wide by 18-inch deep	NEMA Type 12	Painted Steel	Free standing single door, front access only. Provide shelf inside the cabinet for radio
Intrinsic Safety Panel (ISP)	See Paragraph 2.1(E)	24-inch high by 24-inch wide by 18-inch deep	NEMA Type 12	Painted Steel	Wall-mounted, single door, front-access only.
PS2CP Enclosure	See Paragraph 2.1(E)	60-inch high by 36-inch wide by 18-inch deep	NEMA Type 12	Painted Steel	Free standing single door, front access only. Provide shelf inside the cabinet for radio
Intrinsic Safety Panel (ISP)	See Paragraph 2.1(E)	24-inch high by 24-inch wide by 18-inch deep	NEMA Type 12	Painted Steel	Wall-mounted, single door, front-access only.

END OF SECTION 406717

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SECTION 406733 - PANEL WIRING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for internal wiring of control panels and consoles.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing.”
3. Section 406263 “Operator Interface Terminals.”
4. Section 406343 “Programmable Logic Controllers.”
5. Section 406613 “Switches and Routers.”
6. Section 406650 “Radio Telemetry Equipment.”
7. Section 406717 “Industrial Enclosures.”
8. Section 406763 “Control Panel Mounted UPS.”
9. Section 407819 “Switches and Push Buttons.”
10. Section 407853 “Relays.”
11. Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
12. Section 407859 “Power Supplies”
13. Section 462433 “Open-Channel Grinders”

1.3 DEFINITIONS

A. American Wire Gage (AWG): Measurement of the cross-sectional area of a conductor.

B. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

C. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

D. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

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1.4 ACTION SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required

1.8 QUALITY ASSURANCE

A. Perform work in accordance with UL 508.

B. Provide components compatible with functions required to form complete working system.

C. Provide UL 508 label on complete assembly.

D. Maintain 2 copies of panel drawings on site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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PART 2 - PRODUCTS

2.1 CONTROL PANEL - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Provide stranded, type MTW interconnecting wiring:

a. Use 600-volt insulation rated for not less than 90 degrees Celsius.
b. Segregate wiring for systems operating at voltages in excess of 120 VAC from other panel wiring

1) Locate either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier.

c. Develop panel layout such that technicians have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. For power distribution wiring on the line side of fuses or breakers:

a. Use 12 AWG minimum.
b. For control wiring on the secondary side of fuses:

1) Use 16 AWG minimum.
2) Utilize 18 AWG shielded, twisted pair cable insulated for not less than 600 volts for electronic analog circuits.

3. Cover power distribution blocks with protective guards to meet “finger-safe” requirements of IP20.
4. Route power and low voltage DC wiring systems in separate wireways.

a. Cross different system wires at right angles.
b. Separate different system wires routed parallel to each other by at least 6-inches.
c. Terminate different wiring systems on separate terminal blocks.
d. Do not fill wiring troughs to more than 60 percent visible fill.

5. Terminations:

a. Terminate wiring onto single tier terminal blocks:

1) Uniquely and sequentially number each terminal block.
2) Direct wiring between field equipment and panel components is not acceptable.
3) Multi-level terminal blocks or strips are not acceptable.

b. Arrange terminal blocks in vertical rows and separated into groups (power, AC control, DC signal).

1) Provide each group of terminal blocks with a minimum of 25 percent spares.

c. Use compression type, fused, unfused, or switched terminal blocks.

1) Use two terminals per point for discrete inputs and outputs (DI and DO) with adjacent terminal assignments.
2) Wire all active and spare PLC and controller points to terminal blocks.

d. Use three terminals per point for analog inputs and outputs (AI and AO) per shielded pair connection with adjacent terminal assignments for each point.

1) The third terminal is for shielded ground connection for cable pairs.

a) Ground the shielded signal cable at the PLC cabinet.
b) Wire all active and spare PLC and controller points to terminal blocks.

e. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
f. Use only one side of a terminal block row for internal wiring.

1) Field wiring side of the terminal not to be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.

g. Isolate circuit power from the SCADA cabinet to field devices (switches, dry contacts etc.) that are used as discrete inputs to the PLC input cards with an isolating switch terminal block with flip cover that is supplied with a dummy fuse.

1) Use Allen Bradley Model 1492-H7 or equal.
2) One isolating switch terminal block per loop numbered piece of equipment and one per spare I/O point is acceptable.

h. Isolate all PLC discrete outputs to the field with an isolating fuse switch terminal block with a flip cover and a neon blown fuse indicator.

1) Use Allen Bradley 1492-H4 or equal.

6. Clearly identify wiring to hand switches and other devices, which are live circuits independent of the panel's normal circuit breaker protection as such.
7. Clearly tag and color code wiring.

a. Tag numbers and color coding to correspond to panel wiring diagrams and loop drawings prepared by the PCSS.
b. Power wiring, control wiring, grounding, and DC wiring to utilize different color insulation for each wiring system used.
c. Color coding scheme to be in accordance with UL 508a.

8. Provide surge protectors on all incoming power supply lines at each panel per requirements of Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
9. Each field instrument furnished under Division 40 and shown on the Drawings as deriving input power from the control panel(s) to have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.

a. Power instruments requiring 120VAC power as shown on the drawings.

10. Wiring trough for supporting internal wiring:

    a. Plastic type with snap-on covers.
    b. Side walls to be open top type to permit wire changing without disconnecting.
    c. Trough to be supported to the subpanel by stainless steel screws.
    d. Do not bond trough to the panel with glue or adhesives.

11. Provide each panel with a single tube, LED light fixture, 20 Watt in size (minimum)

    a. Mounted internally to the ceiling of the panel.
    b. Light fixture to be switched and be complete with the lamp.

12. Each panel to have a specification grade duplex convenience receptacle with ground fault interrupter:

    a. Mount internally within a stamped steel device box with appropriate cover.
    b. Convenience receptacle is not powered from a UPS
    c. Protect by a dedicated fuse or circuit breaker.

13. Each panel to be provided with an isolated copper grounding bus for all signal and shield ground connections.

    a. Shield grounding to be in accordance with the instrumentation manufacturer's recommendations.

14. Provide each panel with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
15. Each panel to have control, signal, and communication line surge suppression in accordance with Section 407856 “Isolators, Intrinsic Safety Barriers, and Surge Suppressors.”
16. Microprocessor-based electronic devices in the panel that are powered by 120VAC to be powered by the UPS.
17. Provide each panel with a circuit breaker to interrupt incoming power.
18. Additional electrical components including transformers, motor starters, switches, circuit breakers, etc. to be in compliance with the requirements of Division 26.

B. Relays not provided under Division 26 and required for properly completing the control function specified in Division 40, Division 26 or shown on the Drawings to be provided under this Section.

C. Orientation of devices including PLC and I/O when installed to be per the manufacturer's recommendations.

1. No vertical orientation of PLC racks is allowed unless specifically indicated by the manufacturer as an acceptable mounting alternative and also approved by the Engineer.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.2 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.3 JUNCTION BOXES - INTERNAL CONSTRUCTION

A. Internal Electrical Wiring:

1. Terminations:

a. Each field instrument specified under Division 40 that is wired to a junction box shall have its wiring terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Splicing is not acceptable.

1) Multi-level terminal blocks or strips are not acceptable.
2) Terminal blocks shall be installed on Din Rail, and the Din Rail shall be mounted to a back panel.

b. Arrange terminal blocks in vertical rows.
c. Use compression type, fused, unfused, or switched terminal blocks.
d. Use sleeve-type wire and tube markers with heat impressed letters and numbers.
e. Use only one side of a terminal block for instrument wiring. The other side of the terminal block shall only be used for field wiring to the final termination point. Wiring shall not be within 4-inches of the bottom, top, or sides of the junction box.
f. Isolate instrument power from the junction box out to field devices (instruments, switches, dry contacts etc.) with an isolating switch terminal block with flip cover that is supplied with a dummy fuse. Use an Allen Bradley Model 1492-H7 or equal. One isolating switch terminal block per loop numbered piece of equipment is acceptable.

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2. Wiring shall be clearly tagged and color coded. Tag numbers and color coding shall correspond to panel wiring diagrams and loop drawings prepared by the PCSS or vendor system manufacturer. Color coding scheme shall be in accordance with UL 508a.

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SECTION 406763 - CONTROL PANEL MOUNTED UPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes control panel mounted uninterruptible power supplies (UPS).

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406717 “Industrial Enclosures.”
4. Section 406733 “Panel Wiring” for wiring requirements.
5. Refer to the Control System Architecture on the “I” Drawings for control panels requiring a control panel mounted uninterruptible power supply.

1.3 DEFINITIONS

A. Uninterruptible Power Supply (UPS): A device capable of providing emergency battery power when the main power source fails.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

C. Grinder control system manufacturer supplying the grinder system control panel shall submit UPS sizing calculations showing the UPS meets the battery runtime requirements of this specification.

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1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Product Test Reports: For each uninterruptable power supply, for tests performed by manufacturer and witnessed by a qualified testing agency, or performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. UPS Batteries: Quantity equal to quantity installed, such that all batteries can be replaced to form one complete UPS unit.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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PART 2 - PRODUCTS

2.1 SINGLE PHASE UPS - INTERNAL TO CONTROL PANELS

A. Manufacturers

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Sola Hevi Duty SDU UPS.
b. Phoenix Contact Quint4
c. Or equal

B. System Description:

1. Provide an industrially rated continuous-duty, on-line, solid state, line interactive, single-phase uninterruptible power system.
2. UPS to provide power conditioning and power backup for PLC, communications hardware, 24VDC power supplies, and other critical electronic loads as indicated on Drawings.
3. UPS system consists of the following major components:

a. Rectifier and battery charger.
b. Inverter.
c. Batteries.
d. Other features as described in this Section and as indicated on Drawings.

C. General Requirements:

1. Provide battery protection via an internal circuit breaker disconnect.
2. Current limiting circuitry to protect inverter output under any load condition.
3. AC output neutral be electrically isolated from UPS chassis.

a. UPS chassis to have an equipment ground terminal.
b. Provide provisions for installation of a bonding connector.

4. Suitable for installation in a UL508A listed panel.
5. Tower style or DIN rail mountable.
6. UL recognized components for industrial applications in accordance with UL508 without derating.

D. Performance Requirements:

1. Ratings:

a. Output power: As shown in the schedule in PART 3.
b. Battery runtime: 14 minutes at full-load, 34 minutes at half-load.

2. Environment:

    a. Ambient temperature: 0 to 40 degrees C.
    b. Elevation: Up to 500-ft above mean sea level.
    c. Relative humidity: 1 to 95 percent non-condensing.

3. System Input - Primary source:

    a. Nominal Input Voltage: As shown in the schedule in PART 3.
    b. Frequency: 45 to 65 Hz.
    c. Input Power Factor: 0.95 lag minimum, 50 to 100 percent load.
    d. Input Surge Withstandability: Per IEEE 587/ANSI C62.41. Category A and B, (6 kV).

4. System Output:

    a. Nominal Output Voltage: As shown in the schedule in PART 3.
    b. Frequency: 60 Hertz plus or minus 3 Hertz.
    c. 100 percent load with 3:1 Crest Ratio
    d. Frequency Slew Rate: 1 Hz/second. (Adjustable at startup)

5. AC to AC Efficiency (100 percent load @ rated PF): 88 percent online, 86 percent on battery.
6. Acoustical Noise: Noise generated by UPS under normal operation not exceed 65 dBA (60 dBA typical) at one meter from any surface, measured at 25 degrees C (77 degrees F) and full load.
7. EMI Suppression: UPS to meet FCC Rules and Regulation 47, Part 15, Subpart J, for Class A devices.

E. Modes of Operation:

1. UPS to operate as a line interactive on-line, fully automatic system in the following modes:

    a. Normal:

        1) Critical load continuously supplied with filtered and regulated AC power by inverter. Rectifier/battery chargers derive power from preferred AC source and supply DC power to inverter while simultaneously floats charge the batteries.

    b. Emergency:

        1) Upon failure of preferred AC power source, critical load continues to be supplied by inverter. Inverter power supplied without switching from storage battery. No interruption to critical load upon failure or restoration of preferred ac sources. If AC source cannot be restored before battery discharges to its low voltage dropout value, UPS automatically shuts itself down in an orderly manner.

c. Recharge:

1) Upon restoration of AC source, rectifier/battery charger to power inverter and simultaneously recharge batteries. This to be an automatic function causing no interruption to critical load.

F. Rectifier/Charger:

1. Solid-state equipment and controls necessary to convert incoming AC power to regulated DC power for input to inverter and for battery charging.
2. Solid-state SCR/IGBT power transistor type with constant voltage/current limiting control circuitry.

G. Inverter:

1. Include all solid-state equipment and controls to convert DC power from rectifier/charger or battery to a regulated AC power for powering critical load.

a. Use Insulated Gate Bipolar Transistors (IGBTs) in a phase-controlled, pulse width modulated (PWM) design capable of providing the specified AC output.

2. Capable of supplying current and voltage for overloads exceeding 100 percent.

a. Provide 150 percent of full load for 30 seconds and 125 percent of full load for 2 minutes.
b. Status indicator and audible alarm indicate overload operation.

3. Maintain output voltage to within plus or minus 5 percent.
4. Output voltage total harmonic distortion (THD) not greater than 5 percent at full load.

H. Batteries:

1. High Temperature sealed, maintenance-free, high-rate discharge, lead-acid cells suitable for use indoors with no off gassing, or water addition requirements.

a. Require no special ventilation.
b. One or more battery banks with number of cells required to meet requirements of rest of these specifications.

2. Battery Design Life: 2 to 4 years

I. Controls and Monitoring:

1. Microprocessor-controlled circuitry:

a. Provide fully automatic operation of UPS through use of a microprocessor-based controller.
b. Operating and protection parameters firmware-controlled.
c. Logic includes system test capability to facilitate maintenance and troubleshooting.
d. Startup, battery charging, and transfers to be automatic.

2. Front Indicators: As a minimum, the following indicators to be provided on UPS control panel:

    a. On-line (UPS is using utility power to power the load).

        1) In bypass mode.
        2) On battery.
        3) Overload.
        4) Replace battery / battery disconnected.
        5) Fault.
        6) Bar graph for utility voltage.
        7) Bar graph for battery.

    b. Front Panel UPS Controls:

        1) Power On/Off.
        2) Self-test.
        3) Alarm silence.
        4) Cold start.
        5) Load off.

    c. Remote alarm and status indication: Isolated SPDT dry contacts provided to indicate UPS status for remote monitoring. Contacts rated for 250VAC @ 5A or 30VDC @ 5A

        1) Individual contacts provide for separate annunciation of the following alarm and status conditions:

            a) On Battery
            b) Common Alarm
            c) Static Bypass

J. External Maintenance Bypass:

1. Each UPS shall be provided with a "two-position" external bypass switch system to permit UPS to be removed for repair or maintenance without causing power disruption to connected power loads. External bypass switch shall be snap-action type with switching speed approximately 10ms or less independent of operator action. External bypass switch positions shall be labeled UPS and UTILITY.
2. For UPS units up to and including 3KVA, furnish an Electroswitch series 103 snap action switch or equivalent, along with custom plugs, receptacles, and appropriate wiring to achieve the specified functionality. For UPS units above 3 KVA, furnish standard manufacturer’s maintenance bypass switch unless a dry contact for remote monitoring is specified herein to monitor the switch and it is not offered by the manufacturer. Otherwise, provide an Electroswitch series 103 switch or equivalent along with custom plugs, receptacles, and appropriate wiring to achieve the specified functionality.
3. Provide a dry contact to indicate when bypass switch is in “Maintenance” position. Contact shall be rated for 250VAC @ 5A or 30VDC @ 5A

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PART 3 - EXECUTION

3.1 UNINTERRUPTIBLE POWER SUPPLY SCHEDULE

A. Provide the following uninterruptible power supplies. Exact sizing of the UPS is the responsibility of the PCSS.

Table 1. Uninterruptible Power Supply Schedule

UPS Designation	Minimum VA	Input Voltage	Output Voltage	Location, Type, and Notes
UPS-PS1CP	750 VA	120 VAC	120 VAC	PS1CP Enclosure. Tower style UPS or DIN rail mounted.
UPS-PS2CP	750 VA	120 VAC	120 VAC	PS2CP Enclosure. Tower style UPS or DIN rail mounted.

3.2 EXAMINATION

A. Examine control panels for suitable conditions where UPS will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with manufacturer’s instructions for installation of each uninterruptable power supply.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

E. Installation location of UPS within control panel shall not block or impede access to terminal blocks, control panel wiring, or any other control panel component.

3.4 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.5 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work

C. Uninterruptible power supplies will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.7 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check’s according to manufacturer's written instructions.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 406763

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SECTION 406863 - CONFIGURATION OF HMI SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. No programming software is being provided under this contract. AESS and vendor system manufacturer shall own all required hardware, software, associated licenses, and peripheral devices required to execute the services specified herein and in other Sections.

C. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control of all equipment to be in conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment. Include the following services:

1. Provide configuration of Operator Interface Terminals, and drivers provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.
2. Provide communications, data exchange, and the functionality described within these Contract Documents, between all connected devices (such as PLCs and VFDs) and the OIT software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and display.

D. Coordinate all work with Owner to minimize impacts on daily operation. Note delays caused for any reason and formally submit to the Engineer and the Owner in the form of a letter.

E. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and AESS requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406126 “Process Control System Training” for training requirements.

4. Section 406196 “Process Control Descriptions” for control strategies, including monitoring and control requirements, loop numbering, ISA abbreviations, control function definitions, and general configuration criteria.
5. Section 406263 “Operator Interface Terminals” for OIT information.
6. Section 406343 “Programable Logic Controllers” for PLC information.
7. Section 406866 “Configuration of Controller Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

G. VFD: Variable Frequency Drive

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.

B. Schedule and conduct a standards and conventions workshop. The purpose of this workshop is to review the standards, conventions, and methodologies that will be used to program and develop the programs (i.e., OIT and PLC databases, OIT graphics, and PLC programming, etc.) and will solicit Engineer and Owner's input. Submit an agenda with examples for items to be discussed at client workshop.

C. Schedule and conduct a draft graphics review meeting. The purpose of this meeting is to present draft graphics for the Owner's and Engineer's review and feedback prior to creating the full set of graphics for review. For repetitive graphics such as graphics for multiple process trains, include an example of the first graphic only for discussion. Include discussion of process and overview displays, examples of pop-ups, trends, and system navigation tools. Expect major comments and incorporate any changes resulting from those comments.

D. Schedule and conduct a factory-testing coordination meeting, two weeks prior to factory testing. The purpose of this meeting is to discuss the specifics of proposed tests and provide a forum for coordinating required factory testing.

E. Schedule and conduct a field-testing coordination meeting, two weeks prior to field testing. The purpose of this meeting is to discuss specifics of proposed tests and provide a forum for coordinating required field-testing.

1.5 ACTION SUBMITTALS

A. Provide all required submittals in accordance with Section 013300 “Submittal Procedures.” Provide the submittals listed below at a minimum:

1. System Standards and Conventions.
2. Operator Interface.

B. System Standards and Conventions Submittal:

1. Following the standards and conventions workshop, submit standards and conventions to be used on this project. Define the submittal, at a minimum:

   a. Graphic display standards, including color conventions, equipment symbols, display format, equipment control pop-up displays, trend displays, and display navigation. Include samples of each proposed type of graphic display (i.e., overview, detail, diagnostic, tabular, etc.).
   b. System naming conventions, such as graphic displays naming, database naming, tag names, and computer naming.
   c. System configuration, including network addressing and PLC/RTU addressing.
   d. Alarm configuration standards, including priorities and logging.
   e. Security configuration standards, including user groups and privileges.
   f. PLC/RTU standard programming modules, including analog input scaling, flow totalization, equipment runtime, motor start/stop, valve open/close, and any other standard logic planned to be used.

2. To facilitate the Owner's future operation and maintenance, use the submitted standards and conventions as basis for programming and configuration of the system. Do not begin the system programming and configuration prior to the System Standards and Conventions Submittal.

C. Operator Interface

1. Following the approval of the standards and conventions submittal, submit a draft of all proposed graphic displays, examples of each type of pop-up (faceplate) displays, and examples of trends. For those graphics, which will be duplicated more than once for similar type of equipment, submit graphics for the first equipment only.
2. Following the draft graphics review meeting and prior to the factory test, submit a ready-for testing version of all graphic displays. These graphics should be completely finished other than the incorporation of comments and changes resulting from testing.
3. Submitted graphic displays and trends are to be no less than 8.5 inches by 11 inches and in full color.

1.6 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. The system specified performs the following generalized functions:

1. Allows the operator to control equipment such as pumps and grinders as shown on the Drawings and as defined in Section 406196 “Process Control Descriptions.”
2. Perform real-time process control, including proportional integral derivative control action, sequencing, and process calculations.
3. Collect, calculate, and store accurate, reliable operating information for present and future uses.
4. Assist remote site operating personnel by noting and communicating normal operating conditions and equipment failures.
5. Accumulate and store equipment running times for use in preventative maintenance.
6. Provide color graphic displays and reports for use by the system operating and supervisory personnel.
7. Provide trending for analog values.
8. Provide control system diagnostics.
9. Perform process control functions including PID, calculations, sequencing, timing, in the process controller. The HMI software performs the real-time database, report generation, graphic screens, program development, set point modification, data archiving, etc.
10. Allow the operator to manually control (by keyboard entry and mouse type pointing device) the status of pumps, valves, e.g., on/off, open/close, setpoint value,) when viewing the appropriate graphic screen on the HMI.

3.2 GRAPHIC DISPLAYS - GENERAL

A. Ensure displays contain and continuously update the displayed process variables with process values showing in engineering units, date, and time of day. Incorporate on displays:

1. Process variables on their associated display(s) with correct engineering units.
2. Process variables with their associated data quality flags.

B. Incorporate on displays references to both instrumentation tag numbers and plant equipment numbers. Provide toggle button to toggle display of instrumentation tag numbers and plant equipment numbers.

C. Operator commands related to controlling field devices or system attributes require multiple keystrokes or mouse actions to protect against inadvertent operations. Confirmation to the operator for the selected point to be controlled is provided, at which time a cancellation of the control can be affected.

D. Process graphic displays are depicted from the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these Contract Documents. The graphic displays include process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

E. Include on main graphical screens a title bar, main graphic area, navigational buttons, and alarm summary bar.

1. Title bar displayed on the top of each screen (below the alarm summary bar) and include display name, description, and time/date.
2. Main graphical area contains primary screen data in graphical format.
3. Navigational buttons include a minimum of main menu, trends, main alarm summary, and security log in.
4. Alarm summary bar displayed on the top of each screen displays the last three valid alarms on the bottom of each screen.

F. Provide animation to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors to change when opened and closed.

G. Adjust from the OIT timers, setpoints, alarm actuation levels, unless specifically noted.

H. Ensure the system show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri-state must be represented in three conditions.

I. Ensure conditions in the field designated as alarm conditions report to the OIT, actuate an alarm, and provide a visual blinking image on the associated graphic page. Display alarms and events on the screen and archive.

J. Identify interlocks that affect equipment operation both by alarm and by OIT indication.

K. Check analog inputs for out of range (via high and low limit checks) and alarmed.

L. Label process flow streams and color-code using the project color schedule in Division 09. Identify structures and equipment by name and appropriate equipment and loop tags.

M. Color coding for equipment status and alarms is as follows:

1. Red for on or open.
2. Green for off or closed.
3. Active, unacknowledged alarms are indicated by flashing amber.
4. Active, acknowledged alarms are indicated solid amber.

N. Automatically record alarm and events should any of the following sequences or events occur:

1. Date/Time entry.
2. Limit changes.
3. Commanded or un-commanded change of any point.
4. Alarm conditions.
5. PLC activation or deactivation.
6. Operator login or logout activity.

O. There may be additional general programming requirements listed in Part 1 of the Section 406196 “Process Control Descriptions” that impact the HMI configuration.

3.3 SPECIFIC GRAPHIC SCREENS

A. At a minimum, provide the following types of graphic screen indicated below.

1. Pumping Station Overview screen including a site plan representation, indicating the geographic location of each process and building/structure.
2. Main menu screen linking all screens and process areas/buildings; complete and logical listing names and number of all screens.
3. Pump Station Process screen graphically screening key process variables and equipment. Features:

    a. No operator entries are available from these screens.
    b. Individual process flow screen for pumping station that includes all process components, including tanks, pumps, grinders, major pieces of equipment, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves.
    c. These diagrams are generally depicted from the P&ID's with at least 1 screen per P&ID on average.

4. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, grinders, major pieces of equipment, valves, gates, mixers, and drives. Navigational buttons consist of the P&ID's flow arrows to other individual unit processes. The unit process screens provide the ability for the operator to go to individual equipment popup screens. These diagrams are generally depicted from the P&ID's with at least 2 screens per P&ID on average.
5. Provide popup screens for each piece of equipment to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.
6. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies and UPS units.
7. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.
8. Maintenance screens display the raw value for each analog and digital I/O point in the system. They allow the operators/maintenance personnel to enter an override value for an

analog point that is then used by the system instead of the value read from the input card / communications link.

9. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.
10. Main alarm summary screen includes the following information for each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button acknowledges all new unacknowledged alarms. Display alarms in the alarm summary screen and in the alarm banner as follows:

    a. Unacknowledged and active alarm: Displayed on screen, blinking
    b. Acknowledged and active alarm: Displayed on screen, not blinking.
    c. Unacknowledged and inactive alarm: Displayed on screen, blinking. Text/background of the alarm displayed in a different color than active alarms.
    d. Acknowledged and inactive alarm: Not displayed in banner.

11. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.
12. Loop Tuning screen showing ‘P’, ‘I’, and ‘D’ gains for each PID control loop. The loop tuning screen provides the ability for the engineer to modify ‘P’, ‘I’, and ‘D’ gains. This functionality is only available when logged into OIT in “engineer mode” (refer to Article 3.4 below).

3.4 SECURITY

A. Configure and implement the system with security to prevent unauthorized access. The system allows authorized changes to system operation through defined user accounts and password verification.

B. Coordinate with Owner user account information, including login name and password for each account.

C. Assign security levels of "display only," "operator mode," "supervisor mode," and "engineer mode" through assignable passwords. On system startup, automatically enter the "display only" security level. In the "display only" mode, information is available to be displayed on the screen, but no changes may be made. In the "operator mode," changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode," all operator functions can be modified, and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system are available for modification.

3.5 ALARM/EQUIPMENT STATUS REPORTING

A. Display on the alarm log all alarms as they occur. Include on the alarm message the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal are displayed. Include on all reports the plant equipment number of the associated device.

B. Log the equipment status whenever a change in status occurs (i.e., start, stop). Include on the equipment status log the time, equipment name, tag number, and the particular change in status.

3.6 TESTING

A. Refer to Section 406121.20 “Process Control System Testing.”

B. Supplement to Field Testing requirements.

1. Loop Tuning – Tune all PID control loops (single or cascade) following device installation but prior to commencement of the Functional Demonstration Test.

    a. Achieve optimal loop tuning either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method.
    b. Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control PID. Adjust each control loop that includes anti-reset windup features to provide optimum response following startup from an integral action saturation condition.
    c. Tune all PID control loops to eliminate excessive oscillating final control elements. Adjust loop parameters to achieve a decay ratio of 1/4 or better. In addition, achieve loop steady state at least as fast as the loop response time associated with critical damping.
    d. Verify loop performance and stability by step changes to setpoint in the field.

3.7 TRAINING

A. Refer to Section 406126 “Process Control System Training” for general training requirements

B. Furnish training as shown in the table below.

Description	Minimum Course Duration (hours)	Maximum Number of Trainees per Course	Number of Times Course to be Given	Intended Audience
Onsite Training				
Control System Overview Seminar	2	12	1	All
Operator Control System Training (Pre start-up)	2	12	1	Maintenance, Operations
Operator Control System Training (Post start-up)	2	12	1	Maintenance, Operations

A. Definitions of Audience Roles:

1. Administrator: Personnel responsible for maintaining the HMI / SCADA system.
2. Maintenance: Personnel responsible for maintaining the field controller hardware and instrumentation system.
3. Operations: Personnel responsible for daily plant operations.

4. Management: Non-daily operations personnel.
5. All: Used to indicate training should be intended for all defined audience roles.

B. Control System Overview Seminar:

1. Provide Control System Overview seminar for the Owner's personnel at the Owner's facility. The objective of this seminar is to provide personnel with an overview understanding of the Control System. Target the seminar material to the Owner's management, engineering, and other non-operations personnel. The seminar includes, but not limited to, the following:

    a. An overview of the Control system explaining how the hardware and software supplied under this Contract is used for the operation and control of the facilities.
    b. A block diagram presentation of the Control system showing how and what information flow within the system and what each functional unit does.
    c. An explanation of the operator interfaces including a demonstration of how to use an operator's workstation to monitor, control, navigate, display trends, and all other operational features of the system. Address outside of this course a discussion of process control of individual processes.
    d. A walkthrough of the installed system explaining each of the items covered in the functional units' discussion. Discuss the features and functions of operator controls and interfaces.

C. Operator Training (pre and post start-up):

1. Cover during operator training plant operation with the control system and use of the OIT display screens, including at a minimum all the following items:

    a. Basics of OIT control and navigation.
    b. Alarming and Interlocks.
    c. Auto functionality of automated processes and OIT control.
    d. Failure modes of equipment and operator responses.

2. Hold a minimum of one operator-training sessions (Pre-Startup) for operators one week before system startup. Hold additional one or two operator-training sessions (Post-Startup) for operators one week after system startup.
3. Hold operator training at the convenience of the Owner. Hold this training during the day, late at night, or very early in the morning to accommodate the Owner's shift schedule.
4. Operator training is introductory in nature during pre-startup training and more in-depth and detailed during post-startup training.
5. At a minimum, provide the following teaching aids for distribution during Operator training sessions:

    a. Preliminary O&M Manuals (pre-startup); Final O&M Manuals (post-startup).
    b. P&IDs.
    c. Daily syllabus.

6. Fifty percent of the Operator training is "hands on" utilizing the installed Control System to the fullest extent possible. Confirm the operability of the Control System before commencing training. Training performed using a non-functioning Control System is not permitted.

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SECTION 406866 - CONFIGURATION OF CONTROLLER SOFTWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. If referred to anywhere else in the project manual, AE or AESS services include, but are not limited to, those services specified in this Section.

B. No programming software is being provided under this contract. AESS and vendor system manufacturer shall own all required hardware, software, associated licenses, and peripheral devices required to execute the services specified herein and in other Sections.

C. Provide all programming, configuration, and related services required to achieve a fully integrated and operational system. Control all equipment in full conformity with the Contract Drawings, process control descriptions, specifications, engineering data, instructions, and recommendations of the equipment manufacturer. Coordinate the control system for proper operation with related equipment and materials furnished by other suppliers under other Sections of these specifications and with related existing equipment.

1. Provide configuration of the PLC provided for all equipment shown on the drawings, except for controls equipment shown being provided as part of a vendor package system.
2. Provide communications, data exchange, and the functionality described within these Contract Documents, between all connected devices (such as PLCs and VFDs) and the OIT software packages, including devices supplied by others, as depicted on the system architecture drawings in order to provide a comprehensive working system of data collection, storage and display.

D. Coordinate all work with Owner to minimize impacts on daily operation. Note delays caused for any reason and formally submit to the Engineer and the Owner in the form of a letter.

E. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and AESS requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406126 “Process Control System Training” for training requirements.
4. Section 406196 “Process Control Descriptions” for control strategies, including monitoring and control requirements, loop numbering, ISA abbreviations, control function definitions, and general configuration criteria.

5. Section 406263 “Operator Interface Terminals” for OIT information.
6. Section 406343 “Programable Logic Controllers” for PLC information.
7. Section 406863 “Configuration of HMI Software.”

1.3 DEFINITIONS

A. Applications Engineering System Supplier (AESS): The entity who provides all programming, configuration, and related services for the control system equipment provided by the PCSS.

B. Human Machine Interface (HMI): A software-based user interface with supervisory level control and of machine level equipment.

C. Input/Output (I/O): Analog or digital field instrument signals to be received and interpreted by a PLC.

D. Operator Interface Terminal (OIT): A hardware component of the HMI used for device level control and monitoring.

E. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

F. Programmable Logic Controller (PLC): A ruggedized programmable computer used for industrial automation.

G. VFD: Variable-frequency drive.

1.4 PREINSTALLATION MEETINGS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.” The meetings below are in addition to the meetings specified in that section.

B. Refer to Section 406863 “Configuration of HMI Software” for requirements of the standards and conventions workshop and factory and field-testing coordination meetings.

1.5 ACTION SUBMITTALS

A. Controller Program Submittal

1. For each controller, submit the following using the controller manufacturer's built in printing functions. Electronic submission of Adobe Portable Document Format ("pdf") files in lieu of paper submittals is acceptable. Review will be for general program organization, level of documentation, and overall programming standards (basic pump and valve control, for example). The review will not attempt to confirm the logic works correctly for every loop.

    a. PLC programs showing ladder logic, function block, high level language or another controller language used. Include individual rung, network, and/or command descriptions with abundant comments to clearly identify function and

intent of each code segment. Clearly present each logic segment, describe the function of each timer, label and define the purpose of each subroutine call, etc. Ensure that program documentation is sufficiently clear to allow determination of compliance with the process control requirements included in the control descriptions and with the Drawings. The submittal demonstrates that all logic provided under this project follows the same structure and format and reflects a common programming approach.

b. Submit a memory usage report for the controller. Indicate total memory capacity and unused memory capacity.

c. Submit cross reference index of I/O allocation and controller memory address. Include every physical I/O point as well calculated or virtual I/O required for the implementation of the process scheme.

2. Control System Communication Submittal:

a. Submit a "memory map" or other means showing which signals are exchanged between PLCs. Also submit an OIT tag database showing all signals exchanged between the PLCs and OIT. Define any specific communication block memory addresses.

b. Submit a "memory map" or other means showing which signals are exchanged between PLCs and VFDs. Submit a VFD tag database showing the location of all signals within the data array and define any specific communication block memory addresses. All signals shown on the ‘I’ drawings and exchanged between the PLCs and VFDs over Ethernet shall be included in the “memory map.” Factory-programmed signals that are available for monitoring over the network, but not shown on the ‘I’ drawings, shall be included in the “memory map.”

B. Submit all electronic files associated with the controller such that the Owner and Engineer can open a complete copy of the controller program using the controllers native programming package.

1.6 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS (NOT USED)

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PART 3 - EXECUTION

3.1 CONTROLLER PROGRAMS

A. Develop all application programs using the manufacturer's latest version firmware.

B. Adhere to any standards and conventions developed during the standards and conventions workshop specified in Section 406863 "Configuration of HMI Software."

C. Develop all application programs in a structured manner and follow an intuitive arrangement so that an instrumentation technician with basic programming knowledge will be able to understand. Utilize standard program templates or subroutines for repetitive logic such as equipment control, flow total calculations, equipment runtime calculations.

D. Make changes to the application programs and software configuration, based on comments during the submittals, workshops specified in Section 406863 "Configuration of HMI Software", the factory tests, the field tests, and during the commissioning process to meet the design intent, at no additional cost to the Owner.

END OF SECTION 406866

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SECTION 407000 - INSTRUMENTATION FOR PROCESS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the general requirements to furnishing, installing, and servicing PCSS provided instruments.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for testing requirements
3. Section 406126 “Process Control System Training” for training requirements.
4. Section 406196 “Process Control Descriptions” for instrument application information.
5. Section 407113 “Magnetic Flow Meters.”
6. Section 4072XX “Sections for level measurement.”
7. Section 4073XX “Sections for pressure, strain, and force measurement.”
8. Section 407463 “Temperature Transmitters.”
9. Section 4076XX “Sections for gas analytical measurement.”
10. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors” for instruments requiring intrinsically safe barriers.

1.3 DEFINITIONS

A. Process Control System Supplier (PCSS): The entity responsible for providing all materials, equipment, labor, and services required to achieve a fully integrated and operational control system.

B. Section 4071XX “Sections for flow measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Submit complete documentation for all field instruments in one comprehensive submittal. Use ISA-TR20.00.01-2007 data sheet format as a cover sheet for each instrument prior to data sheets. Submit a complete Bill of Materials (BOM) or Index that lists all instrumentation equipment, sorted by Loop Number.

B. Submit separate data sheets for each instrument type:

1. Plant Equipment Number and ISA tag number per the Drawings.
2. Product (item) name used herein and on the Drawings.
3. Manufacturer's complete model number.
4. Location of the device.
5. Input - output characteristics.
6. Range, size, and graduations in engineering units.

C. Submit the following information for each instrument type:

1. Include construction details, material descriptions, dimensions of individual components and profiles.
2. Sizing calculations where applicable.
3. Indicate which instruments will be provided with certified calibration data (i.e., all flow metering devices) as part of O&M manual.
4. Include rated capacities, operating characteristics, electrical characteristics and furnished specialties and accessories.
5. Two-wire, three-wire, or four-wire device type as applicable.
6. Indicate which instruments will be provided with manufacturer’s maintenance services if specified.

D. Submit catalog cuts for all instruments. Submit descriptive literature for each hardware component, which fully describes the units being provided.

E. Submit index and data sheets in electronic format. Submit electronic copies in Microsoft Excel or Word format on DVD disk or USB thumb drive.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to individual instrument specifications for spare parts requirements.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for PCSS requirements regarding submission of maintenance materials.

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1.8 QUALITY ASSURANCE

A. Refer to individual instrument specifications for quality assurance requirements as well as which specific instruments require manufacturer's start-up and training services.

B. Provide components compatible with functions required to form complete working system.

C. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for overall quality assurance requirements for PCSS scope of work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 "Product Requirements" for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

1.11 WARRANTY

A. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions."

PART 2 - PRODUCTS

2.1 INSTRUMENT TAGS

A. Permanent stainless steel or other non-corrosive material tag firmly attached and indelibly marked with the instrument tag number, as indicated in the Drawings. Tag equipment before shipping to the site.

B. Provide 1/8-in by 3/8-in, Type 316 stainless-steel button head machine screws.

C. All supplied instrument transmitters and instrument transmitter elements require a stainless-steel identification tag. Attach tag via stainless steel chain or stainless-steel wire (24-gauge min) to a non-removable part of the device. Stamp the ISA alphanumeric instrument number as indicated on the P&ID, loop, or detail drawings into the tag. Minimum tag size is 1" H x 3" W with 3/16" high alphanumeric characters.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. See installation requirements in individual specification sections.

B. Mount instrumentation on instrumentation racks or stands, unless otherwise indicated. Provide shutoff and drain valves on all instrumentation connections.

3.2 FIELD INSTRUMENT SCHEDULE

A. The field instrument schedule Section 407000 APPENDIX A itemizes field instruments being provided by the PCSS (Division 40) or manufacturers of vendor provided equipment.

B. Each column of the field instrument schedule is defined as follows:

1. DRAWING NO.: The P&ID or drawing where the I/O point appears on.
2. ISA TAG NAME AND LOOP NO.: The identifier assigned to the field instrument.
3. LOOP SUFFIX: Used to distinguish instruments that share an ISA tag and loop number.
4. TYPE: The type of instrument to be provided. For example, if the instrument is a pressure, this will specify whether it is a differential pressure transmitter, gauge pressure transmitter, etc. Specific criteria will also be included in this column, such as if a diaphragm seal is required.
5. RANGE: Required measurement span of the instrument.
6. UNITS: Engineering units being measured
7. LOCATION AND DESCRIPTION: The process being measured.
8. PROVIDED BY: The entity responsible for providing the instrument.
9. SPEC: The specification section number where the instrument details can be found.
10. INSTALLATION DETAIL: Detail on the drawings showing specific installation requirements.

END OF SECTION 407000

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SECTION 407000 APPENDIX-A: PS1 FIELD INSTRUMENT SCHEDULE

Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location: Description	Div	Spec	Installation Detail*
I-4	LE/LT-0101	1	Radar Level Element & Transmitter	0 – 10	FT	Wet Well: Level Sensor & Transmitter	40	407223	I-8 – Detail B
I-4	LI/LSLL-0101	1	Radar Level Indicator & Switch	1.67	FT	Control Building: Level Indicator & Low-Low Switch	40	407813	I-8
I-4	LE/LT-0101	2	Radar Level Element & Transmitter	0 – 10	FT	Wet Well: Level Sensor & Transmitter	40	407223	I-8 – Detail B
I-4	LI/LSLL-0101	2	Radar Level Indicator	1.67	FT	Control Building: Level Indicator	40	407813	I-8
I-4	PG-0110	1	Pressure Gauge	0 – 100	PSI	Valve and Meter Vault: Pump No. 1 Discharge Pressure Indicator	40	407313	I-8 – Detail C
I-4	PG-0110	2	Pressure Gauge	0 – 100	PSI	Valve and Meter Vault: Pump No. 2 Discharge Pressure Indicator	40	407313	I-8 – Detail C
I-4	LSH-0120	1	Ultrasonic Gap Switch	2	IN	Valve and Meter Vault: Flood Detection Switch	40	407213	I-8 – Detail D
I-4	FE-0122	1	Magnetic Flow Element	0 – 2000	GPM	Valve and Meter Vault: Discharge Flow Sensor	40	407113	I-8 – Detail A
I-4	FIT-0122	1	Magnetic Flow Indicating Transmitter	0 – 2000	GPM	Valve and Meter Vault: Discharge Flow Indicating Transmitter	40	407113	I-8 – Detail A
I-4	FI-0122	1	Flow Indicator	0 – 2000	GPM	Control Building: Discharge Flow Indicator	40	407813	I-8
I-4	PIT-0123	1	Pressure Indicating Transmitter	0 – 100	PSI	Valve and Meter Vault: Discharge Pressure Indicating Transmitter	40	407313	I-8 – Detail E
I-4	PI-0123	1	Pressure Indicator	0 – 100	PSI	Control Building: Discharge Pressure Indicator	40	407813	I-8
I-6	AE-0184	1	H_2S Gas Sensing Element	0 – 50	PPM	Wet Well: H_2S Gas Analyzer	40	407633	I-8 – Detail F
I-6	ASH-0184	1	H_2S Gas Switch	5	PPM	Wet Well: H2S High Alarm Switch	40	407633	I-8 – Detail F
I-6	AIT-0184	1	H_2S Gas Indicating Transmitter	0 – 50	PPM	Control Building: H_2S Indicating Transmitter	40	407633	I-8 – Detail F

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Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location: Description	Div	Spec	Installation Detail*
I-6	AE-0185	1	Combustible Gas Sensing Element	0 – 100	% LEL	Wet Well: % LELGas Analyzer	40	407623	I-8 – Detail F
I-6	ASH-0185	1	Combustible Gas Alarm Switch	5%	% LEL	Wet Well: %LEL High Alarm Switch	40	407623	I-8 – Detail F
I-6	AIT-0185	1	Combustible Gas Indicating Transmitter	0 – 100	% LEL	Control Building: % LEL Indicating Transmitter	40	407623	I-8 – Detail F
I-6	TIT-0191	1	Temperature Indicating Transmitter	0 – 120	° F	Control Building Temperature Indicating Transmitter	40	407463	I-8 – Detail G

1. (*): I drawing unless otherwise stated

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SECTION 407000 APPENDIX-B: PS2 FIELD INSTRUMENT SCHEDULE

Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location: Description	Div	Spec	Installation Detail*
I-5	LE/LT-0201	1	Radar Level Element & Transmitter	0 – 12	FT	Wet Well: Level Sensor & Transmitter	40	407223	I-8 – Detail B
I-5	LI/LSLL-0201	1	Radar Level Indicator & Switch	1.5	FT	Control Building: Level Indicator	40	407813	I-8
I-5	LE/LT-0201	2	Radar Level Element & Transmitter	0 – 12	FT	Wet Well: Level Sensor & Transmitter	40	407223	I-8 – Detail B
I-5	LI/LSLL-0201	2	Radar Level Indicator	1.5	FT	Control Building: Level Indicator	40	407813	I-8
I-5	PG-0210	1	Pressure Gauge	0 – 100	PSI	Valve Vault: Pump No. 1 Discharge Pressure Indicator	40	407313	I-8 – Detail C
I-5	PG-0210	2	Pressure Gauge	0 – 100	PSI	Valve Vault: Pump No. 2 Discharge Pressure Indicator	40	407313	I-8 – Detail C
I-5	PG-0210	3	Pressure Gauge	0 – 100	PSI	Valve Vault: Pump No. 3 Discharge Pressure Indicator	40	407313	I-8 – Detail C
I-5	LSH-0220	1	Ultrasonic Gap Level Switch	2	IN	Valve Vault: Flood Detection Switch	40	407213	I-8 – Detail D
I-5	LSH-0230	1	Ultrasonic Gap Level Switch	2	IN	Meter Vault: Flood Detection Switch	40	407213	I-8 – Detail D
I-5	FE-0232	1	Magnetic Flow Element	0 – 3100	GPM	Meter Vault: Discharge Flow Sensor	40	407113	I-8 – Detail A
I-5	FIT-0232	1	Magnetic Flow Indicating Transmitter	0 – 3100	GPM	Meter Vault: Discharge Flow Indicating Transmitter	40	407113	I-8 – Detail A
I-5	FI-0232	1	Flow Indicator	0 – 3100	GPM	Control Building: Discharge Flow Indicator	40	407813	I-8
I-5	PIT-0233	1	Pressure Indicating Transmitter	0 – 100	PSI	Meter Vault: Discharge Pressure Indicating Transmitter	40	407313	I-8 – Detail E
I-5	PI-0233	1	Pressure Indicator	0 – 100	PSI	Control Building: Discharge Pressure Indicator	40	407813	I-8
I-7	AE-0284	1	H_2S Gas Sensing Element	0 – 50	PPM	Wet Well: H_2S Gas Analyzer	40	407633	I-8 – Detail F

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Drawing No.	ISA tag name and loop No.	Loop Suffix	Type	Range	Units	Location: Description	Div	Spec	Installation Detail*
I-6	ASH-0284	1	H_2S Gas Switch	5	PPM	Wet Well: H2S High Alarm Switch	40	407633	I-8 – Detail F
I-7	AIT-0284	1	H_2S Gas Indicating Transmitter	0 – 50	PPM	Control Building: H_2S Indicating Transmitter	40	407633	I-8 – Detail F
I-7	AE-0285	1	Combustible Gas Sensing Element	0 – 100	% LEL	Wet Well: % LELGas Analyzer	40	407623	I-8 – Detail F
I-6	ASH-0285	1	Combustible Gas Alarm Switch	5%	% LEL	Wet Well: %LEL High Alarm Switch	40	407623	I-8 – Detail F
I-7	AIT-0285	1	Combustible Gas Indicating Transmitter	0 – 100	% LEL	Control Building: % LEL Indicating Transmitter	40	407623	I-8 – Detail F
I-7	TIT-0291	1	Temperature Indicating Transmitter	0 – 120	° F	Control Building Temperature Indicating Transmitter	40	407463	I-8 – Detail G

1. (*): I drawing unless otherwise stated

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SECTION 407113 - MAGNETIC FLOW METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes magnetic flow meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form a complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Furnish sensors, field preamplifiers, signal conditioners, offset and span adjustments, amplifiers, transducers, transmitters, control devices, interconnecting cables, and unit conversions and algorithms as required for application.

2.2 MAGNETIC FLOW METERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. ABB Instrumentation
b. Endress+Hauser
c. Krohne

d. Rosemount
e. Siemens
f. Or equal

B. General:

1. Low-frequency, electromagnetic induction-type flow meter, producing a linear signal directly proportional to flow rate, consisting of flow tube, signal cable, and transmitter.

C. Type:

1. Between-flange mounting.
2. Comply with AWWA M33.

D. Performance and Design Criteria:

1. Process Fluid: Wastewater.
2. Flow Rate Range: As shown on instrument schedule in Section 407000 “Instrumentation for Process Systems.”
3. Accuracy: Plus or minus 0.5 percent of actual flow rate over a 30:1 range, within velocity limits of 0.1 to 10 ft/sec.
4. Size: As shown on Drawings.
5. Flow Tubes:

a. Body Material: Carbon Steel

6. Liner: Polyurethane
7. Flanges: ANSI 150lb or DIN PN 16
8. Flange Material: Stainless-steel.
9. Environment: Meters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet.

E. Electrodes:

1. Type 316L stainless steel.
2. Bullet-nose, self-cleaning.

F. Accessories:

1. Rated for hazardous area, Class I, Division 2.
2. Provide manufacturer cable between transmitter and receiver.
3. Furnish stainless-steel grounding rings, wires, and gaskets as recommended by the manufacturer. All materials must be suitable for the process and surrounding pipe.

2.3 TRANSMITTERS

A. Manufacturer: Same manufacturer as meter.

B. Transmitter Output:

1. 4- to 20-mA DC analog signal.

C. Display:

1. Touch-screen programming, functioning through enclosure window without opening enclosure.
2. Size: Four lines by 16 characters.
3. Type: Backlit digital display.
4. User-selectable engineering units.
5. Readout of diagnostic error messages.

D. Control Power:

1. 120VAC, single phase, 60 Hz.
2. Provide local transformers as required.

E. Mounting:

1. Mounting: Integral to the meter as shown on Drawings.

F. Transmitter Communication Interface: HART

G. Communication Firmware and Software: As required by the Manufacturer.

H. Required Accessories:

1. A fully configurable and locally viewable totalizer integral to the transmitter.
2. Current signal output simulation.
3. Empty pipe detection.
4. Self-diagnostics.
5. Signal Cable: Provided by flow meter manufacturer.
6. Automatic zero adjust.

I. Environment: Transmitters below grade to be suitable for submergence for up to 48 hours to a depth of 30 feet.

2.4 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

B. Provide shop inspection and testing of meters according to AWWA M6.

C. Certificate of Compliance:

1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pipe and process area for suitable conditions where magnetic flow meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer’s installation instructions and recommendations for magnetic flow meters.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.

2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Magnetic flow meters will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

F. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not required.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 “Process Control System Training” for specific instrument training requirements.

END OF SECTION 407113

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SECTION 407213 - ULTRASONIC LEVEL METERS (CONTINUOUS AND POINT TYPE)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes ultrasonic level meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.

1.3 DEFINITIONS

A. Double Pole Double Throw (DPDT): A switch with 2 inputs and 4 outputs. Each input has 2 corresponding outputs to control.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Ultrasonic Level Meters Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 units.]

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 ULTRASONIC GAP LEVEL SWITCH

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Ametek Drexelbrook VeriGAP.
b. Magnetrol Echotel 961/962
c. Or equal.

B. Type:

1. Point Level Ultrasonic Gap Probe
2. Detects the presence of liquid between a pair of encapsulated piezoelectric crystals.

C. Function/Performance:

1. Sensitivity: response time of 2 seconds
2. Repeatability: 0.0625 inch.

D. Physical:

1. Housing: Heavy duty cast aluminum. NEMA 4X construction.
2. Where hazardous areas are indicated, provide explosion-proof housing, approved for Class 1, Division 1, Groups C and D. Locate the housing/electronics outside tank, channel, or containment area.
3. Probe: Type 316 stainless-steel.
4. Mounting: 2” 150lb flange or NPT fitting.
5. Output: DPDT contacts rated 7A at 120VAC.

E. Power Requirements:

1. 120VAC powered instrument

F. Required Accessories:

1. Provide mounting bracket and mounting hardware as required for installation.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where ultrasonic level meters are installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer's installation instructions and recommendations for ultrasonic gap level switches.

B. Comply with NECA 1.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 "Process Control and Enterprise Management Systems General Provisions" for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 "Process Control System Testing."

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Ultrasonic gap level switch is considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 "Process Control and Enterprise Management General Provisions."

E. Prepare evaluation reports in accordance with Section 406121.20 "Process Control System Testing."

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Coordinate with the PCSS and AESS to test and verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 "Process Control System Training" for specific instrument training requirements.

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SECTION 407223 - RADAR LEVEL METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes radar level meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Radar level meters: Full-size units] equal to 15 percent of quantity installed for each size indicated, but no fewer than1 complete unit packaged and ready for immediate installation.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 NON- CONTACT RADAR-LEVEL MEASUREMENT DEVICE

A. Manufacturers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide VEGA Americas, Inc. VEGAPULS C21 radar sensor with VEGAMET 861 transmitter with external display or comparable product by one of the following:

a. Or equal.

B. Type:

1. Non-contact, microwave type level meter.
2. W-Band 80 GHz radar frequency for continuous level measurement of liquid, slurry and sludge processes in storage vessels that may be turbulent, have heavy vapors and foaming conditions in nominal pressure and temperature.
3. Antenna: Horn.

C. Function/Performance:

1. Measuring Range: As shown in the instrument schedule in Section 407000 "Instrumentation for Process Systems."
2. Accuracy: Plus or minus 0.32 inches.
3. Operating Temperature: -40 to 176 degrees F.
4. Output: Isolated 4-20 mA output.
5. Relay Output: Minimum of 4 programmable operating relays of which at least one can be configured as a failsafe relay.
6. Display: Digital indicator displaying level or volume in engineering units or percent, as indicated on the Drawings or in the Instrument Device Schedule.
7. Diagnostics: On-screen instructions and display of self-diagnostics.

D. Physical:

1. Antenna: PVDF, Type 316 stainless-steel, Hastelloy C or other material depending upon its compatibility to the process in which it is measuring.
2. Provide integral antenna with transmitter.
3. Provide antenna with adjustable, stainless-steel mounting bracket matching radar sensor size and mounting requirements.
4. NEMA 4X (IP66) housing. Where the instrument is installed in a hazardous area, provide explosion-proof housing, approved for Class I, Division 1, Groups C and D installation and certified for installation of the antenna in a Class I, Division 1, Groups C and D (Zone 0) environment.
5. Power Requirements: 120VAC or 24 VDC loop powered with intrinsically safe barriers
6. Remote Display: Digital indicator displaying level or volume in engineering units or percent, as indicated on the Drawings or in the instrument schedule. Display unit used to remotely program the transmitter.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 "Quality Requirements" for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where radar level meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer’s installation instructions and recommendations for radar level meters.

B. Comply with NECA 1.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Radar level meters will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

F. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check’s according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 “Process Control System Training” for specific instrument training requirements.

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SECTION 407313 - PRESSURE AND DIFFERENTIAL PRESSURE GAUGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes pressure and differential pressure gauges.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.
3. Section 407363 “Diaphragm Seals.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Pressure and Differential Pressure Gauges: Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 unit.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PRESSURE GAUGES

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Ametek US Gauge.
b. Ashcroft.
c. Weksler.
d. Or equal

B. Type:

1. Bourdon tube actuated dial face pressure gauge.

C. Function/Performance:

1. Accuracy: Plus or minus 1.0 percent of full-scale range.
2. Provide for zero-reading adjustment.
3. Adjusting Screws: Accessible from rear of case without need for disassembly.
4. Comply with ASME B40.100.

D. Physical:

1. Dial:

a. Nominal Diameter: 4-1/2 inches.
b. Face: White, laminated plastic dials with black graduations.
c. Scale: Extend over arc not less than 200 and not more than 270 degrees.
d. Ranges and Graduation Units: As indicated on instrument schedule.

2. Cases:

a. Liquid filled.
b. Material: Phenolic or Type 316 stainless-steel.
c. Provide removable rear plate.
d. For gauge pressure, vented case for temperature/atmospheric compensation
e. Windows:

1) Material: Clear acrylic or shatterproof glass.
2) Thickness: 1/8 inch.
3) Provide gasket.

3. Bourdon Tubes:

a. Material: Stainless steel, to brass socket.
b. Provide welded, stress-relieved joints.

4. Connection:

a. Location: Bottom.
b. Socket:

1) 1/2-inch NPT male thread.
2) Material: Brass forging.
3) Extend minimum 1-1/4 inches below gage cases.
4) Provide wrench flats.

c. Mounting: Stem or surface.

E. Required Accessories:

1. Pressure Snubber:

a. Material: Type 316 stainless steel.
b. Provide isolation valve.

2. Shutoff Cocks: Furnished by gauge manufacturer.
3. Provide diaphragm seals as shown on the drawings.
4. Special scales: Engineer reserves the right to require special scales and/or calibration if the manufacturer's standard is not suitable for the application.
5. Liquid fill gauges at the factory.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pipe and process area for suitable conditions where pressure gauges will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer’s installation instructions and recommendations for each pressure gauge.

3.3 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. All tests and inspections required by the manufacturer to certify installation .

B. Pressure gauges will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Works with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.6 MAINTENANCE SERVICE

A. Not Required.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 407313

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SECTION 407326 - GAUGE-PRESSURE TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes gauge-pressure transmitters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.
3. Section 407363 “Diaphragm Seals.”
4. Section 407856 “Isolators, Intrinsically Safe Barriers, and Surge Suppressors.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Gauge Pressure Transmitters: Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 units.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 GAUGE PRESSURE TRANSMITTERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. ABB 266HRH.
b. Foxboro IGP20.
c. Rosemount 3051CG.
d. Siemens Sitrans P DS III.
e. Smar LD301M.
f. Or equal.

B. Type:

1. Microprocessor based, intelligent type.

C. Function/Performance:

1. Measuring Range: As shown in the instrument schedule in Section 407000 "Instrumentation for Process Systems."
2. Accuracy: 0.075 percent of span.
3. Operating Temperature: -4 to 176 degrees F.
4. Temperature Effect: Combined temperature effects less than 0.2 percent of maximum span per 82 degrees F temperature change.
5. Output Signal: 4 to 20 mA DC linear with pressure, with HART protocol.
6. Output: Zero adjustable over the range of the instrument calibrated span is greater than the minimum calibrated span.
7. Stability: 0.05 percent of upper range limit for 1 year.
8. Response Time: Less than 1 ms.
9. Display: Digital indicator displaying pressure in the engineering units indicated on the instrument schedule in Section 407000 "Instrumentation for Process Systems."
10. Diagnostics:

    a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
    b. Simulation capability for inputs and loop outputs.
    c. Test terminals available to ease connection for test equipment without opening the loop.
    d. Registers to record minimum and maximum pressure and temperatures transmitter has been exposed to be available.

11. Over Range Protection: Provide positive over range protection to 150 percent of the maximum pressure of the system being monitored.

D. Physical:

1. Power Supply: 24 VDC loop power.
2. Enclosure:

    a. NEMA 4X (IP66), explosion proof
    b. Approved for Class I, Division 1, Groups C and D.
    c. Instruments for hazardous locations have Factory Mutual (FM), Canadian Standards Association (CSA), and CENELEC approvals and certifications as specified herein and as indicated on the Drawings or in the instrument device schedule.

3. Process Wetted Parts (except for ozone/oxygen service):

   a. Isolating diaphragm and other wetted metal parts: Type 316L stainless-steel.
   b. Gaskets and O-rings: Teflon.

4. Sensor Fill Fluid (except for ozone/oxygen service): Silicone.

E. Required Accessories:

1. Shutoff Cocks: Furnished by gauge manufacturer.
2. Provide diaphragm seals as shown on the drawings.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pipe and process area for suitable conditions where gauge pressure transmitter will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of each gauge-pressure transmitter.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Gauge-pressure transmitters will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

F. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required

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3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 “Process Control System Training” for specific instrument training requirements.

END OF SECTION 407326

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SECTION 407363 - DIAPHRAGM SEALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes diaphragm seals.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.
3. Section 4073XX “Sections for pressure, strain, and force measurement.”

1.3 DEFINITIONS

A. Section 4073XX “Sections for pressure, strain, and force measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diaphragm Seals: Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 units.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

B. Ensure that materials of construction of wetted parts are compatible with process liquid.

C. Materials in Contact with Potable Water: Certified to NSF 61 and NSF 372.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 DIAPHRAGM SEALS – ANNULAR FLANGE MOUNTED

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide the following:

a. Ashcroft
b. Red Valve
c. Wika
d. Siemens
e. Or equal

B. Type:

1. Line mounted, between two flanges.

C. Function/Performance:

1. Pressure Limit: Correspond to flange ratings.
2. Inside diameter conforms to the dimensions of the pipe where the seal is installed.
3. ANSI or DIN Flange Class: Equivalent to the flange class of the piping where the seal is installed. Bolting dimensions conform to ANSI or DIN drilling specifications as required by the installation.

D. Physical:

1. Body material and Flange: Type 316 stainless-steel and compatible with process connection.
2. Process connection: 1/4-inch NPT.
3. Wetted Parts and Bolt Materials: Corrosion resistant to process fluid.
4. Sensing Liquid: Silicone Oil.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis.

B. Diaphragm Seals:

1. Factory-assemble, fill, and calibrate entire assembly, including gauge and transmitter, prior to shipment.
2. Field filling is not acceptable.

C. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pipe and process area for suitable conditions where diaphragm seal will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Diaphragm seals will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

3.3 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.4 MAINTENANCE SERVICE

A. Not Required.

3.5 DEMONSTRATION

A. Not Required.

END OF SECTION 407363

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SECTION 407463 - TEMPERATURE TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes temperature transmitters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions.”
2. Section 407000 “Instrumentation for Process Systems.”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.4 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.5 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Temperature Transmitters: Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 unit.

1.7 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.9 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.10 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 TEMPERATURE TRANSMITTER

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. Devar d-RTTI.
    b. Or equal

B. Type:

1. Remotely mounted, intelligent transmitter compatible with sensor provided.

C. Function/Performance:

1. Digital Accuracy: Plus or minus 0.36 degrees F
2. Stability: Plus or minus 0.1 percent or 0.18 degrees F whichever is greater, for 24 months.
3. Operating Temperature: 0 to 120 degrees F.
4. Output: 4-20 mA DC signal, linear with temperature.
5. Output capable of being set as difference or average of two measured temperatures.

6. Output configurable with custom curves, including Callendar-Van Dusen correction.
7. Display: Digital indicator displaying temperature in engineering units.
8. Diagnostics:

    a. Self-diagnostics with transmitter failure driving output to above or below out of range limits.
    b. LED indication of transmitter faults.

9. Capable of simulation of inputs and loop outputs.
10. Include test terminals to allow for connection of test equipment without opening the 4-20mA DC loop.

D. Physical:

1. Plastic Housing with Splash Resistant Cover.
2. 24 VDC loop powered.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements”: Requirements for testing, inspection, and analysis.

B. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where temperature transmitter will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer’s installation instruction and recommendations for temperature transmitters.

B. Comply with NECA 1.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Temperature transmitter is considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

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3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 “Process Control System Training” for specific instrument training requirements.

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SECTION 407623 - COMBUSTIBLE GAS ANALYZERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes combustible gas analyzers.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.

1.3 DEFINITIONS

A. Lower Explosive Limit (LEL): The minimum concentration of a combustible gas or vapor to support combustion.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

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1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Combustible Gas Analyzers: Full-size units equal to 15 percent of quantity installed, but no fewer than 1 unit.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 COMBUSTIBLE GAS/LEL DETECTOR

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Dräger Polytron 8310 IR Series.
b. Industrial Scientific iTrans.
c. MSA Ultima XIR Series.
d. Or equal

B. Type:

1. Continuous infrared sensor.

C. Function/Performance:

1. Response Time: T90 in less than 30 seconds.
2. Operating Temperature: -58 to 194 degrees F.
3. Sensor Life: 3 years typical.
4. Intrinsically safe.

D. Physical:

1. Suitable for remote wall or ceiling mounting, or directly fitted to transmitter as indicated on the Drawings. Mount the sensor approximately 1-3ft. below the ceiling in accordance with manufacturer's recommendation.
2. Enclosures in Non-Hazardous Areas: NEMA 4X (IP65).
3. Enclosures in Hazardous Areas: Explosion proof, approved for Class 1, Division 1, Groups C and D areas.

E. Required Accessories:

1. Manufacturer's cable for connection of sensor to transmitter. Length of cable as required by installation indicated on Drawings.
2. Mounting brackets for mounting as indicated on the Drawings.
3. Manufacturer's junction box
4. Analyzers mounted below 6 feet of floor level or mounted in areas where liquid splashing is likely to occur shall be fitted with a manufacturer supplied splash guard to protect the sensor from accidental wetting.

F. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the start-up and training services.

2.2 TRANSMITTER

A. Type:

1. Electronic, microprocessor based single channel transmitter compatible with sensor provided.

B. Function/Performance:

1. Accuracy: Plus or minus 3 percent up to 50 percent LEL, plus or minus 5 percent for greater than 50 percent LEL.
2. Range: As shown on instrument schedule in Section 407000 "Instrumentation for Process Systems."
3. Environmental conditions: -4 to 140 degrees F.
4. Relative humidity: 10 to 95 percent.
5. Output: One 4-20 mA output proportional to calibrated range.
6. Contacts: Two (2) programmable relay contacts for warning, alarm, and/or fault.
7. Display: Digital display indicating the gas level, alarm or fault messages, and diagnostic information.

C. Physical:

1. Explosion proof enclosure approved for Class 1, Division 1, Groups B, C, and D.
2. Suitable for surface mounting at elevation shown on drawings.
3. Power Requirements: 7 to 30 VDC.

D. Required Accessories:

1. Calibrator, fittings, hoses, and other devices require for calibration of detectors.
2. One year's supply of calibration and test gas for detectors indicated in the instrument device schedule or on the Drawings.
3. If the vendor offers a "Sensor Exchange" program as a standard offering, a year of this Sensor Exchange program is acceptable. This program delivers a freshly calibrated sensor at manufacturer recommended calibration intervals for replacement of the existing sensor. Upload all information to the transmitter for the new sensor with no further maintenance required for the new sensor to function properly.

E. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the Field Quality Control, Startup Service, and Demonstration paragraphs.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where combustible gas analyzer will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer’s installation instructions and recommendations for combustible gas/LEL detectors.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Combustible gas analyzers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

F. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete all installation and startup checks in accordance with manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the

instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system's operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 "Process Control System Training" for specific instrument training requirements.

END OF SECTION 407623

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SECTION 407633 - HYDROGEN SULFIDE ANALYZERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hydrogen sulfide analyzers.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 407000 “Instrumentation for Process Systems” for general instrumentation requirements and additional related requirements.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Hydrogen Sulfide Analyzers: Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 unit.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 HYDROGEN SULFIDE DETECTOR

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Dräger PointGard II.
b. Industrial Scientific iTrans.
c. MSA Ultima Series.
d. Or equal

B. Type:

1. Continuous diffusion type

C. Functional/Performance:

1. H_2S Gas Range: As shown on instrument schedule in Section 407000 “Instrumentation for Process Systems.”
2. Response Time: T90 in less than 10 seconds.
3. Useful life greater than 2 years under normal operating conditions.

D. Physical:

1. Suitable for remote wall or ceiling mounting, or directly fitted to transmitter as indicated on the Drawings. Mount the sensor approximately 1-3ft above the floor in accordance with manufacturer’s recommendation.
2. Enclosures in Non-Hazardous Areas: NEMA 4X (IP65).
3. Enclosures in Hazardous Areas: Explosion proof, approved for Class 1, Division 1, Groups C and D areas.
4. Mount the sensor to prevent moisture accumulation.

E. Accessories Required:

1. Manufacturer's cable for connection of sensor to transmitter. Length of cable as required by installation indicated on Drawings.
2. Mounting brackets for mounting as indicated on the Drawings.
3. Manufacturer’s junction box
4. Detectors that are mounted at or below 6 ft of floor level, or mounted in areas where liquid splashing is likely to occur, shall be fitted with splash guards supplied by the manufacturer, to protect the sensor from accidental wetting.

F. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the start-up and training services paragraph below.

2.2 TRANSMITTER:

A. Type:

1. Electronic, microprocessor-based transmitter compatible with sensor provided.
2. Single or dual channel as indicated on the Drawings or in the Instrument Device Schedule.

B. Function/Performance:

1. Linearity: Plus or minus 2 percent of full scale.
2. Repeatability: Plus or minus 1 percent of full scale.
3. Range: As shown on instrument schedule in Section 407000 “Instrumentation for Process Systems.”
4. Environmental conditions: -4 to 122 degrees F.
5. Relative humidity: 0 to 95 percent.
6. Output: One 4-20 mA output proportional to calibrated range.
7. Contacts: Two (2) relay contacts for alarm and one fault relay contact.

8. Digital display indicating the gas level, alarm or fault messages, and diagnostic information.

C. Physical:

1. NEMA 4X (IP65) enclosure approved for Class 1, Division 1, Groups C and D.
2. Suitable for surface mounting at elevation shown on drawings.
3. Power Requirements: 7 to 30 VDC.

D. Required Accessories:

1. Calibrator, fittings, hoses, and other devices require for calibration of detectors.
2. One year's supply of calibration and test gas for detectors indicated in the instrument device schedule or on the Drawings.
3. If the vendor offers a "Sensor Exchange" program as a standard offering, a year of this Sensor Exchange program is acceptable. This program delivers a freshly calibrated sensor at manufacturer recommended calibration intervals for replacement of the existing sensor. Upload all information to the transmitter for the new sensor with no further maintenance required for the new sensor to function properly.

E. Manufacturer Start-up and Training services:

1. Provide manufacturer's start-up and training services as specified in the Field Quality Control, Startup Service, and Demonstration paragraphs.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where hydrogen sulfide analyzer will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with all manufacturer’s installation instructions and recommendations for hydrogen sulfide gas detectors.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections

B. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

C. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

D. Hydrogen sulfide analyzers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

F. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

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3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. The start-up services include calibration, oversight of installations of the sensor, and start-up of the sensor/transmitter in order to provide reliable measurement at the instrument. Work with the PCSS and AESS to verify the transmitter sends correct information to the control system (i.e., that the scaling and units are the same at the instrument and on the control system’s operator interface/PLC). Submit an instrument calibration report in order to document the calibration procedure of the instruments.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Section 406126 “Process Control System Training” for specific instrument training requirements.

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SECTION 407813 - INDICATORS AND METERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes indicators and meters.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406717 “Industrial Enclosures.”
3. Section 407000 “Instrumentation for Process Systems.”
4. Section 407223 “Radar Level Meter.”
5. Section 707313 “Pressure and Differential Pressure Gauges.”
6. Section 407113 “Magnetic Flow Meters.”

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 407000 “Instrumentation for Process Systems.”
2. Refer to Section 407223 “Radar Level Meter.”
3. Refer to Section 407313 “Pressure and Differential Pressure Gauges.”
4. Refer to Section 407113 “Magnetic Flow Meters.”

B. Shop Drawings:

1. Refer to Section 407000 “Instrumentation for Process Systems.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Indicators and Meters: Full-size units equal to 15% percent of quantity installed for each size indicated, but no fewer than 1 unit.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PANEL-MOUNTED DIGITAL INDICATORS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Precision Digital ProVu Series.
b. Red Lion Controls PAXDP Series.
c. Or equal

B. Type:

1. Digital indicator.

C. Function/Performance:

1. Accuracy: Plus or minus 0.25 percent of calibrated range.
2. Operating Temperature: -4 to 158 degrees F (-20 to 70 degrees C)..
3. Input: One (1) 4 to 20 mA.
4. Output: One (1) 4 to 20 mA.
5. Digital Outputs: Two (2) Form C programmable contacts rated for 5A at 120/240 VAC.
6. Display: 0.56-inch-high efficiency, 5-digit LED display.
7. Indicator Failure: Failure of the indicator will not cause failure of the 4-20 mA loop.

D. Physical:

1. Suitable for panel mounting.
2. Case size nominal 2.5-inch-high by 5-inch-wide by 6 inch deep.
3. NEMA 4X and explosion-proof approved for Class I, Division 1, Groups C and D areas.
4. Programmable via integrated keypad.
5. Power Requirements: 120 VAC/60 Hz.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, roofs, and process area for suitable conditions where indicators and meters will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to drawings for tagging designations

3.5 FIELD QUALITY CONTROL

A. Perform the tests and inspections in accordance with 406121.20 “Process Control System Testing.”

B. Indicators and meters will be considered defective if they do not pass tests and inspections.

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not Required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

B. While starting up the instruments, the manufacturer to provide training to the Owner's instrumentation technicians as follows:

1. How to calibrate, install, troubleshoot, read the diagnostics, and maintain the transmitter.
2. Provided training in accordance with 406126 “Process Control System Training.”

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SECTION 407816 - INDICATING LIGHTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes indicating lights.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements
3. Section 406717 “Industrial Enclosures” for nameplate requirements.
4. Section 406733 “Panel Wiring” for panel wiring requirements.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 PILOT TYPE INDICATING LIGHTS

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. Cutler-Hammer.
    b. Allen Bradley.
    c. General Electric.
    d. Square D.
    e. Crouse Hinds (NEMA 7).
    f. Or equal.

2. Type: Energy efficient, solid state, push-to-test LED Lamps.

B. Function/Performance:

1. Low voltage LED lamps suitable for the voltage supplied.
2. Integral reduced voltage transformers for 120VAC powered lights.
3. Replaceable lamps from the front of the unit.

C. Physical:

1. NEMA 4X.
2. Lens caps: 1.18-inch (30 mm) diameter.
3. Lens color:

    a. Running, on, open - Red.
    b. Stopped, off, closed - Green.
    c. Alarm, fault, overload - Amber.
    d. White - Power on.
    e. Blue - All other status indications not covered by the above.

4. Provide legend faceplates engraved to indicate the required function of each device.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine control panels, enclosures, and rooms for suitable conditions where indicating lights will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of each indicating light.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Indicating lights will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with the following:

E. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

F. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not required.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

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SECTION 407819 - SWITCHES AND PUSH BUTTONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes switches and push buttons.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406717 “Industrial Enclosures” for nameplate requirements.
4. Section 406733 “Panel Wiring” for panel wiring requirements.”
5. Section 406763 “Control Panel Mounted UPS” for maintenance bypass switch requirements.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

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1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 SELECTOR SWITCHES AND PUSHBUTTONS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen Bradley.
b. Crouse Hinds (NEMA 7).
c. Cutler-Hammer.
d. General Electric.
e. Square D.
f. Or equal.

B. Type:

1. Heavy-duty oil tight type with stackable contact blocks.

C. Function/Performance:

1. Contact arrangement and switching action as required for the control system specified.
2. For 120VAC service, provide contacts rated 10A at 120VAC. For 24VDC service, provide silver sliding contacts rated 5A at 125VDC. For electronic (millivolt/milliamp) switching, provide contacts rated 1A at 28VDC.

D. Physical:

1. NEMA 4X.
2. Size: 1.18-inch diameter.
3. Pushbuttons: Flush type operators.
4. Selector switches: Knob or wing lever operators.
5. Provide legend plates denoting switch/pushbutton position and/or function.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine control panels, enclosures, and rooms for suitable conditions where switches and pushbuttons will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of switches and pushbuttons.

B. Comply with NECA 1.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer Section 406717 “Industrial Enclosures” for nameplate requirements.

C. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Switches and push buttons will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not required.

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3.8 DEMONSTRATION

A. Not required.

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SECTION 407853 - RELAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes relays.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406717 “Industrial Enclosures.”
4. Section 406733 “Panel Wiring” for panel wiring requirements.

1.3 DEFINITIONS

A. Not used

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. None Required.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE RELAYS AND TIME DELAYS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen Bradley.
b. IDEC.
c. Omron.
d. Schneider Electric.
e. Or equal.

B. Type:

1. General purpose plug-in type.

C. Function/Performance:

1. Provide all relays with number of poles required to meet the design intent.
2. Mechanical life expectancy to be in excess of 10 million.
3. Provide solid state time delays with polarity protection (DC units) and transient protection.
4. Time delay units in ranges from .1 second to 4.5 hours.

D. Physical:

1. Mounting: DIN rail.
2. Integral indicating light to indicate if relay is energized.
3. For 120 VAC service, provide contacts rated 10A at 120VAC. For 24 VDC service, provide contacts rated 5A at 28VDC. For electronic (milliamp/millivolt) switching applicator, provide gold plated contacts rated for electronic service.
4. Dust and moisture resistant covers.

5. Required Accessories:

6. Provide DIN rail mounted relay socket for each relay, rated 10A at 300VAC.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine control panels and enclosures for suitable conditions where relays will be installed .

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of relays.

B. Comply with NECA 1.

C. Comply with manufacturer’s instructions for installation of relays.

D. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Relays will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

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3.7 MAINTENANCE SERVICE

A. Not required.

3.8 DEMONSTRATION

A. Not required.

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SECTION 407856 - ISOLATORS, INTRINSICALLY SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes isolators, intrinsically safe barriers, and surge suppressors.

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406650 “Radio Telemetry Equipment” for radio path study and LFR surge protection requirements.
4. Section 406717 “Industrial Enclosures.”
5. Section 406733 “Panel Wiring” for panel wiring requirements.
6. Section 407000 “Instrumentation for Process Systems.”
7. Section 407326 “Gauge-Pressure Transmitters” for instruments requiring intrinsically safe barriers.
8. Division 28 for magnetic reed switches.

1.3 DEFINITIONS

A. Licensed Frequency Radio (LFR): Frequency bands reserved by the FCC for sole use by the organization to which it is licensed.

B. Section 4072XX “Sections for level measurement”: The XX in the number indicates all spec sections starting with the first 4 numbers (indicating a category described in the accompanying text) are included in the reference.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each ISB and surge suppressor, for tests performed by manufacturer and witnessed by a qualified testing agency, or performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Surge Suppressors: For each type of surge suppressor supplied, provide ten percent of quantity installed, but no fewer than one unit.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

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PART 2 - PRODUCTS

2.1 INTRINSIC SAFETY BARRIERS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. Gems – 54800 (4-20mA) and 65800 (dry contacts).
    b. Pepperl+Fuchs
    c. R. Stahl - Intrinspak
    d. Siemens Water Technologies – IS1 (4-20mA) and IS6 (dry contacts).
    e. Or equal.

B. Type:

1. Solid state electronic type in which the energy level of the sensing or actuation circuit is low enough to allow safe usage in hazardous areas.

C. Function/Performance:

1. Provide a barrier for instrumentation and equipment transmitting analog or digital signals that originate in a hazardous area as indicated in the design documents.
2. Locate in non-hazardous areas.

    a. Match power supply provided.

        1) Power supplied via UPS as shown on I-4 and I-5 of instrumentation drawings.

    b. Operating Temperature: -40 to 140 degrees F.

D. Physical:

1. Mounting: DIN Rail.

2.2 SURGE PROTECTION FOR CONTROL SYSTEMS

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

    a. Citel DLA series.
    b. MJ8 series.
    c. MTL Surge Technologies (Telematic) NP Series.
    d. Phoenix Contact PlugTrab Series.
    e. Transtector FSP Series.
    f. Or equal.

B. Function/Performance:

1. Provides surge protection of electronic instrumentation from induced surges propagated along the signal and power supply lines from lightning, utility, or the plan electrical systems.
2. Protection system lower than the instrument withstand level, while not interfering with normal operation.
3. Maintenance free and self-restoring.
4. Response time: Less than 50 nanoseconds.
5. Discharge surge current: At least 8kA (at an 8x20µs impulse waveform)

C. Required Surge Protection:

1. Analog Signal (4-20mA) Circuits:

a. Provide surge protection where any part of the circuit is outside of the building envelope.
b. Protect circuits at both the transmitter and the control system end of the circuit.
c. Mount transmitter surge protectors in separate NEMA 4X enclosure or conduit mount.
d. Use of a single device to protect both 120VAC and 4-20mA wires is acceptable.
e. Provide surge protector from one of the following:

1) Phoenix Contact PT Series
2) MTL Surge Technologies (Telematic) TP48
3) Citel DLA or CAD series.
4) Or equal.

2. Control Panel Power Feed (120VAC):

a. Provide protection of 120VAC power feed into control panels, instruments, and control room equipment.
b. Provide surge protector from one of the following:

1) Citel DS40 series.
2) MCG Surge Protection 400 Series.
3) Phoenix Contact “Mains-PlugTrab.”
4) Transtector ACP-100BW Series.
5) Or equal.

3. Non-Fiber Based Data Highway or Communications Circuits:

a. Provide protection on all communication and data highway circuits that leave a building or are routed external to a building.
b. Provide circuit protection at both ends of the line.
c. Provide surge protector from one of the following:

1) Phoenix Contact PlugTrab Series.
2) Transtector FSP Series.
3) MTL Surge Technologies (Telematic) NP Series.
4) Citel DLA series.

5) MJ8 series.
6) Or equal.

4. RF Coaxial Cable:

a. Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure.
b. Protected in accordance with NEMA and UL 497E standards.
c. Basis-of-Design Product: Provide Polyphaser Coaxial RF Surge Protector as specified in Section 406650 “Appendix A – Radio Path Study” to match Owners standard antenna surge protection equipment. No equals shall be accepted

5. Inductive Loads:

a. Provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120VA or less that drive solenoid, coil, or motor loads.

2.3 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine control panels, enclosures, and rooms for suitable conditions where ISB’s and surge protection will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of ISB’s and surge protection devices.

B. Comply with NECA 1.

C. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. ISB’s and surge protection devices will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not required.

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3.8 DEMONSTRATION

A. Not required.

END OF SECTION 407856

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SECTION 407859 - POWER SUPPLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes power supplies

B. Related Requirements:

1. Section 406100 “Process Control and Enterprise Management Systems General Provisions” for submittal requirements and general installation requirements.
2. Section 406121.20 “Process Control System Testing” for factory and field-testing requirements.
3. Section 406650 “Radio Telemetry Equipment” for radio power supply requirements.
4. Section 406717 “Industrial Enclosures” for enclosures housing power supplies
5. Section 406733 “Panel Wiring” for panel wiring requirements.
6. Section 406763 “Control Panel Mounted UPS” for information on input power to power supplies.

1.3 DEFINITIONS

A. Not used.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

B. Shop Drawings:

1. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for any PCSS requirements regarding informational submittals for instruments.

B. Product Test Reports: For each power supply, for tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Refer to Section 406100 “Process Control and Enterprise Management System General Provisions.”

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Power Supplies: For each type of power supply, provide one fully replaceable unit with all accessories to fully replace any installation.

1.8 QUALITY ASSURANCE

A. Provide components compatible with functions required to form complete working system.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 016000 “Product Requirements” for delivery, storage, and handling requirements.

1.10 FIELD CONDITIONS

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

1.11 WARRANTY

A. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions.”

PART 2 - PRODUCTS

2.1 POWER SUPPLIES (24VDC)

A. Manufacturers:

1. Manufacturers and their products are subject to compliance with requirements. Provide one of the following:

a. Allen-Bradley.
b. Phoenix Contact.
c. SOLA HD.
d. Or equal.

B. Type:

1. Redundant power supplies that operate in parallel with an independent redundancy module to power field instruments and panel devices as shown on the drawings.

a. Redundant 24 VDC power supplies shall be powered from the UPS power conditioning system in Section 406763 “Control Panel Mounted UPS.”

C. Function/Performance:

1. Input power: 115VAC, plus or minus 10 percent, 60 Hz.
2. Output voltage: 24VDC.
3. Output voltage adjustment: 5 percent.
4. Line regulation: 0.05 percent for 10V line change.
5. Load regulation: 0.15 percent no load to full load.
6. Ripple: 3 mV RMS.
7. Operating temperature: 32 to 140 degrees F.
8. Sized to accommodate the design load plus a minimum 25 percent spare capacity.

D. Physical:

1. Mounting: DIN rail. Mounted such that heat dissipation does not adversely affect other panel components.
2. Equipped with power on/off circuit breaker.
3. Provide relay contact (internal to the power supply or redundancy module or external if the power supply is not so equipped) to indicate on/off status of the power supply.
4. Provide relay contact to indicate power supply fault.
5. Output overvoltage and overcurrent protective devices to protect from damage due to power supply failure and external failure.

2.2 SOURCE QUALITY CONTROL

A. Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine enclosures and process area for suitable conditions where power supplies will be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer’s instructions for installation of power supplies.

B. Comply with NECA 1.

C. Wiring Method:

1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

D. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.

3.3 CONNECTIONS

A. Refer to Section 260526 “Grounding and Bonding for Electrical Systems.”

3.4 IDENTIFICATION

A. Refer to Drawings for tagging designations.

B. Refer to Section 406100 “Process Control and Enterprise Management Systems General Provisions” for component identification requirements.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test and inspect components, assemblies, and equipment installations, including connections.
2. All tests and inspections required by the manufacturer to certify installation.
3. All tests and inspections required by Section 406121.20 “Process Control System Testing.”

B. See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

C. Power supplies will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports in accordance with Section 406100 “Process Control and Enterprise Management General Provisions.”

E. Prepare evaluation reports in accordance with Section 406121.20 “Process Control System Testing.”

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3.6 STARTUP SERVICE

A. Perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.7 MAINTENANCE SERVICE

A. Not required.

3.8 DEMONSTRATION

A. Not required.

END OF SECTION 407859

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SECTION 462433 - OPEN-CHANNEL GRINDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Open-channel grinders.

B. Related Requirements:

1. Section 099100 “Painting” for product and execution requirements for painting specified by this Section.
2. Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for electric motors and their accessories normally supplied as part of equipment assemblies.
3. Section 406717 “Industrial Enclosures.”
4. Section 406733 “Panel Wiring.”
5. Section 406763 “Control Panel Mounted UPS.”

1.3 DEFINITIONS

A. Open-Channel Grinder: A type of sewage grinder that typically operates at relatively low speed, using a series of disks to shred objects into smaller pieces. Also referred to as "macerators."

1.4 COORDINATION

A. Coordinate Work of this Section with other process work in Section 333256 “Submersible Pumping Stations.”

1.5 ACTION SUBMITTALS

A. Product Data: Manufacturer's product data for system materials and component equipment, including performance characteristics.

B. Shop Drawings:

1. System materials and component equipment including frame and guiderails.
2. Total weight of the equipment including the weight of the major components.
3. Complete bill of materials for each equipment item specified.
4. Manufacturer's recommended spare parts lists. Include gaskets, packing, etc. on the list.
5. Complete data on motors as specified in Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment.”

6. Drawings of control panels showing components, both doors mounted and internal and complete wiring schematics, to completely illustrate the equipment to be supplied. Typical diagrams are not acceptable.
7. Description of surface preparation and shop prime painting.
8. A statement indicating and supporting bearing life.

1.6 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificate: Products meet or exceed specified requirements.

B. Manufacturer's Instructions: Detailed instructions on installation requirements, including storage and handling procedures.

C. Source Quality-Control Submittals: Results of factory inspections.

D. Field Quality-Control Submittals: Results of Contractor-furnished tests and inspections.

E. Manufacturer Reports: Certify equipment is installed according to manufacturer's instructions.

F. Qualifications Statement: Qualifications for manufacturer.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Furnish one set of manufacturer's recommended spare parts for each grinder provided. Recommended spare parts shall include but not be limited to the following:

1. Two bearing and seal cartridges.
2. Three cutters and three spacers.
3. One complete set of gaskets, seals and O-rings.
4. One set of controller lights (6V, long-life) & fuses.

B. Tools: Furnish special tools and other devices required for Owner to maintain supplied equipment.

1.8 QUALITY ASSURANCE

A. Furnish grinders and motor controls by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. Design, construct and install the equipment in accordance with the best practices and methods.

B. Should equipment which differs from this Section be offered and determined to be the equal of that specified, such equipment may be acceptable only on the basis that any revisions in the design and construction of the structure, piping, appurtenant equipment, electrical work, etc. required to accommodate such a substitution are made at no additional cost to the Owner and be as approved by the Engineer.

C. Maintain a copy of each standard affecting Work of this Section on Site.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's packaging, including application instructions.

B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.

C. Store equipment according to manufacturer instructions.

D. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
2. Protect finished iron or steel surfaces not painted to prevent rust and corrosion.
3. Provide additional protection according to manufacturer instructions.

1.11 EXISTING CONDITIONS

A. Field Measurements:

1. Verify field measurements prior to fabrication.
2. Indicate field measurements on Shop Drawings.

1.12 WARRANTY

A. Furnish one-year manufacturer's warranty for open-channel grinders.

PART 2 - PRODUCTS

2.1 OPEN-CHANNEL GRINDERS

A. Manufacturers:

1. JWC Environmental, Santa Ana, CA;
2. Franklin Miller, Livingston, NJ;
3. Or equal.

B. Performance and Design Criteria:

1. Grinder G-0100-1 (Pumping Station No.1)

a. Minimum Flow Rate: 50 gpm.
b. Average Daily Flow Rate: 300 gpm.
c. Maximum Flow Rate: 1300 gpm.

d. Influent Sewer Diameter: 15 inches.

2. Grinder G-0200-1 (Pumping Station No.2)

a. Minimum Flow Rate: 100 gpm.
b. Average Daily Flow Rate: 500 gpm.
c. Maximum Flow Rate: 2500 gpm.
d. Influent Sewer Diameter: 24 inches.

C. Dual-shaft heavy-duty units operating continuously, with low-speed, high-torque power, processing wet or dry and designed for grinding. Capable of chopping and shredding rags, wood, plastics and similar materials.

1. Operates submerged or dry with no seal flush required.
2. Dual-shaft cutters counter-rotate to draw in and grind solids.
3. Include coil screen(s) beside cutter shaft(s).
4. Grinder shall be self-cleaning without the use of an external flushing system.

D. Frame:

1. Material: Type 316 Stainless steel.
2. Attachment: Pump station wet well.
3. Components: Guide rails grinder support base subchannel and overflow bar racks.

E. Cutting Elements:

1. Material: Hardened steel 4130 heat treated alloy.
2. Hardened to 43 to 48 Rockwell "C".
3. Size: 4.5-inch minimum outside diameter.
4. Cutting elements and spacers mounted on hexagonal hardened steel shafts.
5. Cutting stack shall be a minimum nominal height of 40-in.

F. Shafts: Two-shaft configuration.

1. Minimum output torque: 4,255lb-in/hp.
2. Seals: Reverse pressure.

G. Gear Reducer:

1. Grease speed reducer for life. Gearing shall be classified for continuous duty, AGMA Class III, 24 hour, heavy shock duty with 2.0 service factor based on motor nameplate rating.
2. Output shaft of the gear reducer shall be directly coupled to the grinder input shaft using a two piece coupling.

H. Operation:

1. Electrical Characteristics:

a. Grinder Motor: 5hp (Maximum).
b. Voltage: 480 V, three phase, 60 Hz.
c. Maximum Circuit Breaker Size: 65,000 A.

2. Motors:

    a. As specified in Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for Water and Wastewater Equipment.
    b. Constant speed, explosion proof, immersible and non-ventilated.
    c. UL listed for Class I, Division I, Group D service; conform to NEMA MG 1.
    d. Housing: ASTM A48 (A48M), cast iron.

3. Controls: Automatic drive motor reversal with time delay for jamming protection.
4. Alarms: Audible and visual.
5. Disconnect Switch: Factory mounted in control panel.

I. Control Panel: per Section 406717 “Industrial Enclosures” unless noted below.

1. Factory mounted.
2. Enclosure: Stainless steel.
3. NEMA 250 Type 4X.
4. Single-point power connection and grounding lug.
5. Main circuit breaker disconnect with a flange mounted operating handle.
6. Transformer for 120 Volt control power.
7. Full voltage reversing combination magnetic motor starter.

J. Accessories:

1. Fasteners and Supports: ASTM F593, Type 316 stainless steel.
2. Anchor Bolts and Nuts: ASTM F593, Type 316 stainless steel.
3. Provide anti-seize compound for threaded components to prevent galling.

2.2 BEARINGS

A. Rating-Life: L-10 of 100,000 hours under continuous operation.

B. Materials: According to ABMA 9.

C. Type: Ball.

D. Protection: Replaceable seals and end face mechanical seals.

E. Lubrication: Grease.

2.3 LUBRICATION

A. Lubricate moving parts and protect from flooding according to manufacturer's recommendations.

2.4 CONTROLS

A. Selector Switch: LOCAL-OFF-REMOTE

B. Pushbuttons: START and STOP/RESET

C. Pilot Lights:

1. POWER ON – White.
2. RUN – Red.
3. OVERLOAD – Amber.

D. Operation Sequences: Operate in a "local", "off", or "remote" mode.

1. Remote Mode: Grinder can be automatically started when another piece of equipment in the system, such as a pump, starts and stopped when another piece of equipment in the system stops.
2. Sense Overload (jam) Conditions: Momentarily reverse to clear the condition and return to a forward direction.

    a. If overload clears, return to normal operation.
    b. If overload does not clear, repeat procedure.
    c. If overload does not clear within 30 seconds, unit will reverse, shut down and energize a light and alarm circuit.

3. Resetting Overload Condition: Only at local control panel.
4. Include thermal motor overload protection and single-phase protection in the control panel.

2.5 SOURCE QUALITY CONTROL

A. See Section 014000 “Quality Requirements” for testing, inspection, and analysis requirements.

B. Owner Witnessing:

1. Allow witnessing of factory inspections and tests at manufacturer's test facility.
2. Notify Owner at least seven days before inspections and tests are scheduled.

C. Certificate of Compliance:

1. When manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
2. Specified shop tests are not required for Work performed by approved manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 INSTALLATION

A. Install open-channel grinders and appurtenances according to manufacturer instructions.

B. Electrical: As specified in Section 400593.23 “Low-Voltage Motor Requirements for Process Equipment” for Water and Wastewater Equipment.

C. Painting: As specified in Section 099100 “Painting.” Provide two factory-applied finish coats according to recommendations of manufacturer.

3.3 FIELD QUALITY CONTROL

A. Inspection: Ensure grinder is installed correctly, there is no objectionable heat or vibration, and bearings are adequately lubricated.

B. Test for proper alignment.

C. Manufacturer Services: Manufacturer's representative experienced in installation of products furnished under this Section for not less than 8 days hours on-Site for installation, inspection, startup, field testing, and instructing Owner's personnel in operation and maintenance of equipment.

D. Equipment Acceptance:

1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.
2. Make final adjustments to equipment under direction of manufacturer's representative.

E. Furnish installation certificate from equipment manufacturer's representative attesting equipment has been properly installed and is ready for startup and testing.

3.4 DEMONSTRATION

A. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION 462433

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Appendix A

Yarmouth Contract 6 Borings Logs 2011

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Boring Number: B-PS2

Client: Town of Yarmouth
Project Name: Yarmouth Sewers
Project Location: Yarmouth, MA
Project Number: 273132

Drilling Contractor/Driller: Northern Drill Services/Steve Perry
Drilling Method/Bore Hole Diameter: Drive and Wash/4 in.
Hammer Style/Weight/Drop Height/Spoon Size: Automatic/140 lb/30 in./2 in.
Bore Hole Location: East Parking lot of 280 MA-28
Lat: **Long:**
Drilling Date: **Start:** 9/9/2025 **End:** 9/9/2025

Surface Elevation (ft): 10.0
Total Depth (ft): 50.0
Depth to Initial Water Level (ft):

Depth	Date	Time
9.0	9/9/2025	15:00

Abandonment Method: Completed as well. Refer to diagram.
Logged By: Bryan Deely

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Graphic Log	Strata	Material Description	Remarks
10.0	0	SS	S-1	24	7 8 6 5	15	14		SILTY SAND	Moist, medium dense, brown, fine to coarse SAND, little silt, trace gravel (SM).	
		SS	S-2	24	4 4 3 4	17	7		SAND	Moist, loose, brown, fine to medium SAND, trace silt (SP).	
5.0	5	SS	S-3	24	5 5 5 5	15	10			Moist, medium dense, tan, fine to medium SAND, trace silt (SP).	
		SS	S-4	24	6 4 3 3	12	7			Moist, loose, tan, fine to medium SAND, trace silt (SP).	
▼		SS	S-5	24	3 2 2 2	11	4			Wet, very loose, orange, fine to coarse SAND, trace gravel, trace silt (SP).	
0.0	10	SS	S-6	24	2 2 2 1	14	4			Wet, loose, tan, fine to medium SAND, trace silt (SP).	
		SS	S-7	24	2 2 2 3	10	4			Wet, loose, tan, fine to medium SAND, trace silt (SP).	
										Moist to wet, medium dense, tan, fine to medium SAND, trace silt (SP).	

Sample Types

AS - Auger/Grab Sample
CS - California Sampler
NQ - 1.9" Rock Core
NX - 2.2" Rock Core
HP - Hydro Punch
SS - Split Spoon
ST - Shelby Tube
WS - Wash Sample
GP - Geoprobe

Consistency vs Blowcount/Foot

Granular (Sand):

V. Loose:	0-4	Dense:	30-50
Loose:	4-10	V. Dense:	>50
M. Dense:	10-30		

Fine Grained (Clay):

V. Soft:	<2	Stiff:	8-15
Soft:	2-4	V. Stiff:	15-30
M. Stiff:	4-8	Hard:	>30

Burmister Classification

and	50 - 35%
some	35 - 20%
little	20 - 10%
trace	< 10%

moisture, density, color

Reviewed by: C. Treiling **Date:** 11/4/2025 **Boring Number:** B-PS2

Boring Number: B-PS2

Client: Town of Yarmouth
Project Name: Yarmouth Sewers
Project Location: Yarmouth, MA
Project Number: 273132

Elev. (ft)	Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Graphic Log	Strata	Material Description	Remarks
-5.0	15	SS	S-8	24	6 6 7 8	10	13		SAND	Moist to wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
		SS	S-9	24	7 5 6 6	10	11			Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
-10.0	20	SS	S-10	24	5 5 5 8	4	10			Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
-15.0	25	SS	S-11	24	10 9 7 8	2	16			Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
		SS	S-12	24	4 5 4 4	2	9			Wet, loose, tan, fine to medium SAND, trace silt (SP).	
		SS	S-13	24	5 4 6 7	3	10			Wet, medium dense, brown, fine to medium SAND, trace silt (SP).	
-20.0	30										
		SS	S-14	24	6 9 8 8	5	17			Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	

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Boring Number: B-PS2

Client: Town of Yarmouth
Project Name: Yarmouth Sewers
Project Location: Yarmouth, MA
Project Number: 273132

Elev. (ft) / Depth (ft)	Sample Type	Sample Number	Sample Length (in)	Blows per 6 inches	Sample Recovery (in)	N-Value	Graphic Log	Strata	Material Description	Remarks
-25.0 / 35								SAND	Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
	SS	S-15	24	7 7 8 5	4	15			Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
-30.0 / 40										
	SS	S-16	24	4 5 6 5	7	11			Wet, medium dense, tan, fine to coarse SAND, trace silt (SP).	
-35.0 / 45										
	SS	S-17	24	7 9 8 6	6	17			Wet, medium dense, tan, fine to medium SAND, trace silt (SP).	
-40.0 / 50									Test boring terminated at 50.0 feet bgs.	

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-001B SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Tyler Lancaster INSPECTOR:	BORING LOCATION 51 Bayview Road, NB GROUND SURFACE ELEVATION DATUM DATE START 4/27/2011 DATE END 4/27/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS				
DATE	TIME	WATER	CASING	STABILIZATION TIME

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/10	0-1	13-11-7-3	Dry, medium dense, brown, FINE SAND, some medium sand		
5		S-2	24/10	4-6	2-2-2-2	Moist, loose, brown, FINE SAND, some medium sand		
10		S-3	24/14	9-11	3-4-7-7	Dry, medium dense, light brown, FINE SAND, trace coarse sand		
15		S-4	24/15	14-16	6-7-8-9	Dry, medium dense, brown, FINE SAND		
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 6"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-001B

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-2 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 4 Bayview
GROUND SURFACE ELEVATION DATUM
DATE START 2/16/2011 DATE END 2/16/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/16/2011	9:30	n/a		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/17	6"-2'6"	18-21	Dry, brown/black, dense, FINE TO MEDIUM SAND		
					28-19			
5		S-2	24/16	5-7	12-15	Dry, tan, medium dense, FINE SAND, trace fine gravel		
					10-9			
10		S-3	24/13	10-12	5-6	Dry, tan, medium dense, FINE TO MEDIUM SAND,		
					10-10	trace fine gravel		
		S-4	24/19	13-15	16-17	Dry, tan/brown, dense, FINE TO COARSE SAND		
15					21-19	trace fine gravel		
						BOE15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-2

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-3 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper:
INSPECTOR:

BORING LOCATION 5 E. Main St, right side curb
GROUND SURFACE ELEVATION DATUM
DATE START 3/17/2011 DATE END 3/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/17/2011		13'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/7	1-3	9-7-9-9	Dry,medium dense, dark brown, FINE SAND, some medium sand, trace silt		
		S-2	24/12	4-6	7-4-4-6	Dry, loose, brown, FINE SAND, trace medium sand		
5								
		S-3	24/10	9-11	6-9-12-14	Moist, medium dense, brown, FINE SAND, some coarse sand, trace fine gravel		
10								
		S-4	24/16	14-16	12-12-9-4	Moist, medium dense, brown, FINE SAND, some coarse sand, trace fine gravel		
15								
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 8"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-3

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-4 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper:
INSPECTOR:

BORING LOCATION 17 E. Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/17/2011 DATE END 3/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/17/2011		14½'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/12	1-3	9-19-18-11	Dry, dense, brown, FINE SAND, trace medium sand		
		S-2	24/8	4-6	5-3-4-6	Wet, loose, brown, FINE SAND, trace coarse sand		
5								
		S-3	24/4	9-11	6-6-6-6	Wet, medium dense, light brown, FINE SAND, some medium sand, trace coarse sand		
10								
		S-4	24/10	14-16	6-8-8-10	Wet, medium dense, light brown, FINE SAND, some medium sand, trace coarse sand		
15						**BOE 16'**		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 8"
4" Concrete

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-4

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-5 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 33 Main Street, right side curb GROUND SURFACE ELEVATION DATUM DATE START 3/17/2011 DATE END 3/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/17/2011		14'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/10	1-3	28-25-23-17	Dry, dense, brown, FINE SAND, trace medium sand		
		S-2	24/14	4-6	11-9-8-8	Dry, medium dense, brown, FINE SAND, trace medium sand, trace silt		
5								
		S-3	24/7	9-11	7-4-5-7	Moist, loose, light brown, FINE SAND, trace medium sand		
10								
		S-4	24/10	14-16	5-8-10-12	Moist, medium dense, light brown, FINE SAND, trace medium sand		
15								
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 7"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-5

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-6 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Gary Twombly Jr.
INSPECTOR:

BORING LOCATION 41 Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/18/2011 DATE END 3/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/18/2011		13'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/12	1-3	48-31-36-25	Moist, very dense, light brown, FINE SAND, trace coarse sand		
			S-2	24/10	4-6	36-31-24-30	Dry, very dense, light brown, FINE SAND, trace coarse sand, trace fine gravel		
5									
			S-3	24/6	9-11	5-8-8-9	Wet, medium dense, light brown, FINE SAND, some medium sand		
10									
			S-4	24/15	14-16	8-6-8-8	Wet, medium dense, light brown, FINE SAND, trace medium sand		
15									
							BOE 16'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 9"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-6

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-7 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Drews Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/15/2011 DATE END 2/15/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/15/2011	12:00	15'		2.5 hours

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1		0-2	Hand Dug	Dry, brown, FINE SAND		
		S-2		2-4	Hand Dug	Dry, brown, FINE SAND		
5		S-3	24/19	5-7	12-15 17-18	Dry, tan, medium dense, FINE TO MEDIUM SAND		
10		S-4	24/15	10-12	7-9 12-12	Dry, tan, medium dense, FINE SAND		
15		S-5	24/17	15-17	15-20 19-15	Wet, tan, dense, FINE TO MEDIUM SAND		
		S-6	24/14	18-20	7-8 7-8	Wet, brown, medium dense, FINE TO COARSE SAND		
20						**BOE 20'**		
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-7

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-8 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes Helper: Bob Brennan INSPECTOR:	BORING LOCATION 34 Drews Way GROUND SURFACE ELEVATION DATUM DATE START 2/15/2011 DATE END 2/15/2011	

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/15/2011	8:00	14'		3 hours

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1		0-2	Hand Dug	Dry, brown, FINE TO MEDIUM SAND		
		S-2		2-4	Hand Dug	Dry, brown, FINE TO MEDIUM SAND *(HAND DUG TO 4')*		
5		S-3	24/16	5-7	8-7 8-6	Dry, tan, medium dense, FINE TO MEDIUM SAND, trace fine gravel		
10		S-4	24/17	10-12	5-6 8-10	Dry, tan, medium dense, FINE TO MEDIUM SAND		
		S-5	24/15	13-15	12-11 8-9	Wet, brown, medium dense, FINE TO COARSE SAND		
15						**BOE 15'**		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-8

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-9 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Gary Twombly Jr.
INSPECTOR:

BORING LOCATION 69 Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/18/2011 DATE END 3/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/18/2011		14'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/14	1-3	58-50-47-52	Dry, very dense, blackish, FINE SAND, trace coarse sand, trace fine gravel		
		S-2	24/15	4-6	20-19-20-22	Dry, dense, brown, FINE SAND, some coarse sand, trace fine gravel		
5								
		S-3	24/8	9-11	11-13-15-14	Wet, medium dense, brown, FINE SAND, trace medium sand		
10								
		S-4	24/12	14-16	12-12-13-14	Wet, medium dense, light brown, FINE SAND, trace medium sand		
15								
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 12"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-9

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-010 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Gary Twombly Jr
INSPECTOR:

BORING LOCATION 85 Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/21/2011 DATE END 3/21/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/21/2011		22'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/12	1-3	20-18-16-15	Dry, dense, brown, FINE SAND, some coarse sand, trace fine gravel		
5		S-2	24/12	4-6	24-20-20-17	Dry, dense, brown, FINE SAND, some coarse sand trace fine gravel		
10		S-3	24/14	9-11	2-5-11-13	Moist, medium dense, light grown, FINE SAND, trace medium sand		
15		S-4	24/15	14-16	11-18-11-13	Moist, medium dense, light brown, FINE SAND, some medium sand, trace coarse sand		
20		S-5	24/6	19-21	4-4-7-7	Moist, medium dense, light brown, FINE SAND, some medium sand, trace coarse sand		
25		S-6	24/11	24-26	5-7-11-10	Moist, medium dense, light brown, FINE SAND		
30		S-7	24/12	29-31	5-5-7-10	Wet, medium dense, light brown, FINE SAND, trace medium sand		
						BOE 31'		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 12"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-010

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-11 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Wendward Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/3/2011 DATE END 2/3/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/3/2011	9:00	n/a		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	6"-2'6"	12-16	Dry, brown, medium dense, FINE SAND		
						10-5			
5			S-2	24/17	5-7	28-31	Dry, tan, very dense, FINE TO COARSE SAND, trace		
						26-27	fine gravel		
10			S-3	24/16	10-12	8-9	Dry, tan, medium dense, FINE TO COARSE SAND		
						14-21			
			S-4	24/15	13-15	29-25	Dry, tan, dense, FINE SAND, trace fine gravel		
15						18-15			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-11

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-12 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 23 Wendward Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/3/2011 DATE END 2/3/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/3/2011	2:30	n/a		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	4"-2'4"	8-7	Dry, brown, medium dense, FINE SAND		
						5-4			
5			S-2	24/16	5-7	5-6	Dry, brown, medium dense, FINE SAND, trace fine		
						9-11	gravel		
			S-3	24/13	8-10	7-10	Dry, brown, medium dense, FINE SAND, trace fine		
						19-17	gravel		
10									
							BOE 10'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-12

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-13 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 23 Wendward Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/3/2011 DATE END 2/3/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/3/2011	10:00	n/a		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	3"-2'3"	5-6	Dry, brown, medium dense, FINE SAND, trace fine		
						5-6	gravel		
5			S-2	24/9	5-7	6-9	Dry, tan, medium dense, FINE TO MEDIUM SAND, trace		
						12-14	fine gravel		
10			S-3	24/7	10-12	6-7	Dry, tan, medium dense, FINE TO MEDIUM SAND, trace		
						6-8	fine gravel		
15			S-4	24/13	14-16	6-7	Dry, tan, medium dense, FINE TO COARSE SAND,		
						6-8	trace fine gravel		
							BOE 16'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-13

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-14 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 48 Wendward Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/11/2011 DATE END 2/11/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/11/2011	10:30	19.5'	4"	2 hours

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/15	3'-2'3"	16-15	Dry, brown, medium dense, FINE SAND		
					14-10			
5		S-2	24/18	5-7	7-6	Dry, tan, medium dense, FINE SAND, trace fine gravel		
					7-6			
10		S-3	24/10	10-12	8-9	Dry, tan, medium dense, FINE TO MEDIUM SAND		
					10-9			
		S-4	24/17	13-15	5-6	Dry, tan, medium dense, FINE SAND, trace fine gravel		
15					7-6			
		S-5	24/11	18-20	5-5	Wet, tan, medium dense, FINE TO COARSE SAND,		
20					6-7	trace fine gravel		
						BOE 20'		
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-14

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-15 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 63 Wendward Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/3/2011 DATE END 2/3/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/3/2011	10:30	n/a		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	6"-2'6"	5-6	Dry, brown, medium dense, FINE SAND		
						5-6			
5			S-2	24/14	5-7	7-12	Dry, brown, dense, FINE TO MEDIUM SAND, trace		
						21-33	fine gravel		
10			S-3	24/17	10-12	8-12	Dry, brown, dense, FINE TO MEDIUM SAND, trace		
						18-21	fine gravel		
			S-4	24/13	13-15	7-8	Dry, brown, dense, FINE TO MEDIUM SAND, trace		
15						9-10	fine gravel		
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-15

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-016A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Gary Twombly Jr
INSPECTOR:

BORING LOCATION 91 Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/21/2011 DATE END 3/21/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/21/2011		18½'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMARKS	STRATUM DESCRIPTION
0		S-1	24/15	1-3	35-26-27-26	Dry, very dense, brown, FINE SAND, trace coarse sand, trace fine gravel		
5		S-2	24/12	4-6	18-21-23-24	Dry, dense, brown, FINE SAND, trace fine gravel		
10		S-3	24/10	9-11	7-12-18-19	Wet, dense, light brown, FINE SAND, trace coarse sand		
15		S-4	24/22	14-16	16-23-20-20	Wet, dense, light brown, FINE SAND, some coarse sand		
20		S-5	24/7	19-21	7-12-17-17	Wet, medium dense, light brown, FINE SAND, some medium sand		
25		S-6	24/9	24-26	9-10-16-17	Wet, medium dense, light brown, FINE SAND, some medium sand, trace coarse sand		
30						**BOE 26'**		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 12"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-016A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-017A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 99 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/21/2011 DATE END 3/21/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/21/2011		20'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	1-3	71-42-31-29	Dry, very dense, brown, FINE SAND, some medium sand, trace coarse sand		
5			S-2	24/10	4-6	35-34-24-20	Dry, very dense, brown, FINE SAND, trace fine gravel		
10			S-3	24/16	9-11	19-16-18-22	Dry, dense, light brown, FINE SAND, trace coarse sand		
15			S-4	24/15	14-16	12-17-20-23	Wet, dense, light brown, FINE SAND, trace coarse sand		
20			S-5	24/8	19-21	8-10-10-15-8	Wet, medium dense, light brown, FINE SAND, trace coarse sand		
							BOE 21'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 11"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-017A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-18 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Gary Twombly Jr.
INSPECTOR:

BORING LOCATION 119 Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/18/2011 DATE END 3/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/18/2011		12'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/14	1-3	12-11-11-8	Dry, medium dense, brown, FINE SAND, trace medium sand		
		S-2	24/11	4-6	6-8-11-12	Dry, medium dense, brown, FINE SAND, trace medium sand		
5								
		S-3	24/10	9-11	16-15-10-8	Dry, medium dense, brown, FINE SAND, trace medium sand		
10								
		S-4	24/8	14-16	8-4-4-6	Wet, loose, light brown, FINE SAND, trace medium sand		
15								
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-18

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-018A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 142 Main Street (westbound side) GROUND SURFACE ELEVATION DATUM DATE START 3/22/2011 DATE END 3/22/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/22/2011		8½'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/12	1-3	29-34-31-25	Dry, very dense, brown, FINE SAND, some coarse sand		
5			S-2	24/15	4-6	15-15-16-17	Dry, dense, light brown, FINE SAND, some medium sand		
10			S-3	24/14	9-11	3-4-7-9	Wet, medium dense, brown, FINE SAND		
15			S-4	24/10	14-16	7-10-12-12	Wet, medium dense, brown, FINE SAND, trace medium sand, trace coarse sand		
							BOE 16'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 11"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-018A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-19 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Baxter
GROUND SURFACE ELEVATION DATUM
DATE START 1/31/2011 DATE END 1/31/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/31/2011	2:00	10'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/13	3"-2'3"	12-14	Dry, dark brown, medium dense, FINE SAND		
					10-8			
5		S-2	24/19	5-7	8-6	Dry, tan, medium dense, FINE SAND		
					5-5			
10		S-3	24/17	10-12	6-7	Wet, brown, medium dense, FINE TO MEDIUM SAND		
					9-7			
		S-4	24/14	13-15	5-6	Wet, tan, medium dense, MEDIUM TO COARSE SAND,		
15					6-7	trace fine gravel		
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-19

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-20 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 34 Baxter
GROUND SURFACE ELEVATION DATUM
DATE START 1/31/2011 DATE END 1/31/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/31/2011	1:00	n/a		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/13	6"-2'6"	8-6	Dry, dark brown, FINE TO MEDIUM SAND, trace fine		
						5-6	gravel		
5			S-2	24/16	5-7	9-10	Dry, tan, medium dense, FINE SAND		
						11-14			
10			S-3	24/17	10-12	7-6	Dry, tan, medium dense, FINE TO COARSE SAND,		
						5-6	trace fine gravel		
			S-4	24/16	13-15	14-13	Dry, tan, medium dense, FINE SAND		
15						10-12			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-20

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-21 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 48 Baxter
GROUND SURFACE ELEVATION DATUM
DATE START 1/31/2011 DATE END 1/31/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/31/2011	11:00	n/a		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/9	3"-2'3"	16-18	Dry, dark brown, dense, FINE SAND, trace fine gravel		
					16-15			
5		S-2	24/17	5-7	15-24	Dry, tan, dense, FINE SAND		
					18-9			
10		S-3	24/14	10-12	10-9	Dry, tan, medium dense, FINE TO MEDIUM SAND		
					6-5			
15		S-4	24/17	14-16	12-14	Dry, tan, medium dense, FINE TO MEDIUM SAND		
					15-16			
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-21

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-22 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 35 Gleason Ave
GROUND SURFACE ELEVATION DATUM
DATE START 1/17/2011 DATE END 1/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/17/2011	1:30	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/12	3"-2.3"	14-12	Dry, brown, medium dense, FINE SAND, trace fine		
						13-10	gravel		
5			S-2	24/16	5-7	8-13	Dry, tan, medium dense, FINE SAND		
						12-13			
10			S-3	24/17	10-12	4-6	Dry, tan, medium dense, FINE SAND, trace fine gravel		
						4-4			
			S-4	24/16	13-15	5-7	Dry, tan, medium dense, FINE TO MEDIUM SAND		
15						8-10			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-22

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-23 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Murray Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/31/2011 DATE END 1/31/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/31/2011	9:00	12'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/13	0-2	16-12	Dry, brown, medium dense, FINE SAND, trace fine		
					5-5	gravel		
5		S-2	24/14	5-7	3-4	Dry, tan, loose, FINE TO MEDIUM SAND, trace fine		
					4-4	gravel		
10		S-3	24/7	10-12	4-6	Dry, tan, medium dense, FINE TO MEDIUM SAND		
					6-7			
		S-4	24/11	13-15	3-4	Wet, brown, loose, FINE TO MEDIUM SAND, trace		
15					3-4	fine gravel		
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 0"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-23

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-024 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 142 Main Street (westbound side) GROUND SURFACE ELEVATION DATUM DATE START 3/22/2011 DATE END 3/22/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/22/2011		4';		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMARKS	STRATUM DESCRIPTION
0		S-1	24/7	1-3	20-13-10-9	Dry, medium dense, brown, FINE SAND		
5		S-2	24/6	4-6	7-8-6-4	Wet, medium dense, brown, FINE SAND, trace coarse sand, trace fine gravel		
10		S-3	24/8	9-11	3-6-11-12	Wet, medium dense, blackish, COARSE SAND, some fine gravel, trace fine sand, trace silt		
15		S-4	24/4	14-16	18-12-23-17	Wet, dense, blackish, FINE SAND, some medium sand, trace fine gravel, trace silt		
20		S-5	24/10	19-21	4-8-11-12	Wet, medium dense, light brown, FINE SAND		
25						**BOE 21'**		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 10"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-024

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-025A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 149 Main Street (east bound side) GROUND SURFACE ELEVATION DATUM DATE START 3/23/2011 DATE END 3/23/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/23/2011		5'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/16	1-3	74-39-19-17	Dry, very dense, brown, FINE SAND, trace coarse sand		
5		S-2	24/20	4-6	12-14-11-9	Dry, medium dense, brown, FINE SAND, trace coarse sand		
10		S-3	24/9	9-11	6-10-10-12	Wet, medium dense, brown, FINE SAND, some medium sand, trace coarse sand		
15		S-4	24/20	14-16	9-10-16-23	Wet, medium dense, brown, FINE SAND, trace medium sand		
20		S-5	24/8	19-21	4-3-4-10	Wet, loose, light brown, FINE SAND, trace medium sand		
25		S-6	24/10	24-26	6-10-12-18	Wet, medium dense, light brown, FINE SAND, trace medium sand		
30						**BOE 26'**		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 11"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-025A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-26 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 14 Mill Pond Road
GROUND SURFACE ELEVATION DATUM
DATE START 2/14/2011 DATE END 2/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/14/2011	11:00	17'	4"	4 hours

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./ REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/19	0-2	8-7	Dry, brown, medium dense, FINE SAND, trace		
						6-5	coarse sand		
5			S-2	24/4	4-6	3-4	Wet, brown, loose, FINE SAND		
						3-4			
10			S-3	24/7	9-11	4-3	Wet, brown, loose, FINE TO COARSE SAND		
						4-5			
15			S-4	24/11	14-16	3-4	Wet, tan, loose, FINE SAND		
						4-6			
20			S-5	24/17	19-21	8-10	Wet, tan, dense, FINE TO MEDIUM SAND		
						15-17			
25			S-6	24/9	24-25	8-41	Wet, gray, dense, FINE TO MEDIUM SAND, trace silt		
			S-7	24/5	25-26	28-21			
30			S-8	24/14	28-30	11-8	Wet, gray, medium dense, FINE SAND, trace silt		
						9-8			

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 0"
Set well @ 27', 15' screen, 12' Riser

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-26

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-27 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Mill Pond Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/18/2011 DATE END 1/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/18/2011	12:00	16'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	10-11	Dry, brown, medium dense, FINE SAND, trace fine		
						12-10	gravel		
5			S-2	24/17	5-7	5-11	Dry, tan, medium dense, FINE SAND		
						16-17			
10			S-3	24/14	10-12	8-9	Dry, tan, medium dense, FINE SAND		
						10-12			
15			S-4	24/16	15-17	5-6	Wet, tan, medium dense, FINE SAND		
						6-7			
20			S-5	24/19	19-21	5-8	Wet, tan, medium dense, FINE TO COARSE SAND		
						6-8			
							BOE 21'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-27

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-28 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 35 Race Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/18/2011 DATE END 1/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/18/2011	10:00	19'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	3"-2'3"	8-8	Dry, brown, medium dense, FINE SAND		
						7-3			
5			S-2	24/10	5-7	2-2	Dry, brown, loose, FINE SAND, trace fine gravel		
						3-3			
10			S-3	24/19	10-12	9-12	Dry, tan, medium dense, FINE TO MEDIUM SAND		
						14-17			
15			S-4		15-17	10-12	Dry, tan, medium dense, FINE SAND		
						15-15			
			S-5		18-20	13-15	Wet, tan, dense, FINE TO MEDIUM SAND, trace fine gravel		
20						16-17			
							BOE 20'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-28

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-29 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 59 Race Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/17/2011 DATE END 1/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/17/2011	3:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	6"-2'6"	11-14	Dry, brown, medium dense, FINE SAND		
						12-8			
5			S-2	24/18	5-7	7-9	Dry, tan, medium dense, FINE SAND		
						12-11			
10			S-3	24/17	10-12	5-5	Dry, tan, loose, FINE SAND		
						3-3			
			S-4	24/14	13-15	3-3	Dry, tan, loose, FINE SAND, trace fine gravel		
15						5-5			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-29

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-30 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 5 Evergreen
GROUND SURFACE ELEVATION DATUM
DATE START 1/18/2011 DATE END 1/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/18/2011	9:00	16'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/13	6"-2'6"	12-15	Dry, dark brown, dense, FINE SAND		
						16-14			
5			S-2	24/18	5-7	8-7	Dry, tan, medium dense, FINE SAND		
						8-10			
10			S-3	24/14	10-12	5-6	Dry, tan, medium dense, FINE SAND		
						9-13			
15			S-4	24/17	15-17	9-10	Wet, tan, medium dense, FINE TO MEDIUM SAND		
						15-12			
			S-5	24/15	18-20	6-5	Wet, tan, medium dense, FINE TO MEDIUM SAND		
						7-7			
20									
							BOE 20'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-30

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-31 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Tower Brook Road
GROUND SURFACE ELEVATION DATUM
DATE START 2/9/2011 DATE END 2/9/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/9/2011	10:30	9'		30 mins

DEPTH	CASINGS	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/18	4"-2'4"	21-28	Dry, brown, dense, FINE TO COARSE SAND		
						19-10			
5			S-2	24/7	5-7	14-17	Dry, brown, medium dense, FINE TO MEDIUM SAND		
						12-17			
10			S-3	24/12	10-12	6-7	Wet, brown, medium dense, FINE TO COARSE SAND		
						7-6			
			S-4	24/22	13-15	3-3	Wet, brown, loose, FINE TO COARSE SAND		
15						4-5			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-31

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-32 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 8 Town Brook Road
GROUND SURFACE ELEVATION DATUM
DATE START 2/9/2011 DATE END 2/9/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/9/2011	12:30	14'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/20	4"-2'4"	8-10	Dry, brown, medium dense, FINE TO MEDIUM SAND		
					6-6			
5		S-2	24/24	5-7	11-18	Dry, brown, dense, FINE TO COARSE SAND		
					14-15			
10		S-3	24/20	10-12	4-5	Dry, brown, medium dense, FINE TO MEDIUM SAND		
					7-9			
15		S-4	24/16	15-17	4-7	Wet, brown, medium dense, FINE TO MEDIUM SAND		
					7-5			
		S-5	24/17	18-20	3-4	Wet, brown, loose, FINE TO COARSE SAND		
20					5-6			
						BOE 20'		
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TC OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-32

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-033A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 175 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/23/2011 DATE END 3/23/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/23/2011		19½'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	1-3	14-16-10-10	Dry, medium dense, brown, FINE SAND, trace coarse sand, trace silt		
5			S-2	24/10	4-6	13-14-15-25	Dry, medium dense, light brown, FINE SAND, trace coarse sand		
10			S-3	24/15	9-11	17-16-19-23	Dry, dense, light brown, FINE SAND		
15			S-4	24/16	14-16	28-25-23-26	Dry, very dense, light brown, FINE SAND		
20			S-5	24/14	19-21	23-23-21-17	Moist, dense, light brown, FINE SAND, trace medium sand, trace coarse sand		
							BOE 21'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 10"
Moved boring to center of road because of Verizon

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-033A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-34 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 16 Woodbine Ave
GROUND SURFACE ELEVATION DATUM
DATE START 1/17/2011 DATE END 1/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/17/2011	12:30	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	6"-2'6"	14-15	Dry, brown, medium dense, FINE SAND		
						13-9			
5			S-2	24/18	5-7	4-6	Dry, brown, medium dense, FINE SAND		
						6-9			
10			S-3	24/15	10-12	7-3	Dry, tan, loose, FINE SAND		
						3-5			
			S-4	24/17	13-15	9-8	Dry, tan, medium dense, FINE TO MEDIUM SAND		
						8-7			
15									
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-34

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-35 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 30 Woodbine Ave
GROUND SURFACE ELEVATION DATUM
DATE START 1/17/2011 DATE END 1/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/17/2011	11:30	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	3"-2'3"	9-11	Dry, brown, medium dense, FINE SAND		
						10-7			
5			S-2	24/15	5-7	5-5	Dry, tan, medium dense, FINE SAND		
						7-10			
10			S-3	24/16	10-12	5-6	Dry, tan, medium dense, FINE SAND		
						8-7			
			S-4	24/17	13-15	6-9	Dry, tan, medium dense, FINE SAND		
15						8-7			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-35

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-036A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 188 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/22/2011 DATE END 3/22/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/22/2011		16'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./ REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/10	1-3	12-23-21-22	Dry, dense, brown, FINE SAND, trace medium sand		
5			S-2	24/7	4-6	25-18-9-9	Moist, medium dense, brown, FINE SAND, some medium sand, trace silt		
10			S-3	24/12	9-11	13-20-22-18	Dry, dense, brown, FINE SAND, trace medium sand and coarse sand		
15			S-4	24/10	14-16	20-17-18-15	Dry, dense, brown, FINE SAND, trace medium sand and coarse sand		
20			S-5	24/8	19-21	19-20-22-17	Dry, dense, brown, FINE SAND, trace medium sand and coarse sand		
25							**BOE 21'**		
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 11"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-036A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-37 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 11 Marigold Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/14/2011 DATE END 1/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/14/2011	2:30	12'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	6"-2'6"	8-7	Dry, brown, medium dense, FINE SAND		
						4-4			
5			S-2	24/18	5-7	6-5	Dry, tan, medium dense, FINE TO MEDIUM SAND		
						5-5			
10			S-3	24/19	10-12	3-4	Dry, tan, loose, FINE SAND		
						3-3			
			S-4	24/15	13-15	3-5	Wet, brown, loose, FINE TO MEDIUM SAND		
15						4-5			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-37

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-38 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 35 Marigold Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/17/2011 DATE END 1/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/17/2011	12:30	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	6-10	Dry, brown, medium dense, FINE SAND		
						8-5			
5			S-2	24/19	5-7	4-6	Dry, tan, medium dense, FINE SAND		
						4-8			
10			S-3	24/17	10-12	4-7	Dry, tan, medium dense, FINE SAND		
						7-9			
			S-4	24/18	13-15	3-4	Wet, brown, loose, FINE TO MEDIUM SAND		
15						4-6			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR [DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-38

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-039A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 183 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/23/2011 DATE END 3/23/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/23/2011				

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	1-3	51-42-24-20	Dry, very dense, reddish/brown, FINE SAND, trace silt, trace medium sand		
5			S-2	24/18	4-6	20-21-28-29	Dry, very dense, light brown, FINE SAND		
10			S-3	24/20	9-11	14-17-16-18	Wet, dense, light brown, FINE SAND, some medium sand		
15			S-4	24/16	14-16	19-24-25-25	Dry, very dense, light brown, FINE SAND, trace medium sand, trace coarse sand		
20			S-5	24/11	19-21	21-27-29-27	Dry, very dense, light brown, FINE SAND, trace medium sand, trace coarse sand		
							BOE 21'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 10"
Moved boring to center of road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-039A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-40 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Rosemary Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/14/2011 DATE END 1/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/14/2011	1:00	11.5'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	8-9	Dry, brown, medium dense, FINE SAND		
						5-4			
5			S-2	24/18	5-7	3-4	Dry, brown, medium dense, FINE TO COARSE SAND		
						6-7			
10			S-3	24/19	10-12	4-4	Wet, brown, loose, FINE TO MEDIUM SAND		
						4-5			
			S-4	24/19	13-15	3-3	Wet, brown, loose, FINE TO COARSE SAND		
15						4-5			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-40

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-41 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 35 Rosemary Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/14/2011 DATE END 1/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/14/2011	1:00	12'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/19	3"-2.3"	9-7	Dry, brown, medium dense, FINE SAND		
					6-4			
5		S-2	24/15	5-7	6-4	Dry, brown, loose, FINE SAND		
					5-4			
10		S-3	24/17	10-12	6-8	Moist, brown, medium dense, FINE TO MEDIUM SAND		
					8-6			
		S-4	24/16	13-15	7-6	Wet, tan, medium dense, FINE TO LOOSE SAND, trace fine gravel		
15					5-6			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-41

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-042 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Robert Brennan
INSPECTOR:

BORING LOCATION 14-16 Iris Road
GROUND SURFACE ELEVATION DATUM
DATE START 3/18/2011 DATE END 3/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	0-2	12-11-11-8	Dry, brown, medium dense, FINE SAND		
5			S-2	24/11	4-6	6-8-11-12	Dry, brown, medium dense, FINE SAND		
10			S-3	24/10	9-11	16-15-10-8	Dry, brown, medium dense, FINE SAND, trace fine gravel		
15			S-4	24/8	14-16	8-4-4-6	Wet, brown, loose, FINE SAND, some medium sand		
							BOE 16'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-042

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-0043A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 216 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/25/2011 DATE END 3/25/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/25/2011		9'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	1-3	85-38-41-51	Dry, very dense, brown, FINE SAND, some coarse sand, trace silt		
5			S-2	24/10	4-6	17-19-22-19	Dry, dense, brown, FINE SAND, some coarse sand trace silt		
10			S-3	24/11	9-11	12-15-17-15	Wet, dense, light brown, FINE SAND, some medium sand, trace coarse sand		
15			S-4	24/10	14-16	9-7-7-5	Wet, medium dense, FINE SAND		
20			S-5	24/8	19-21	5-5-8-10	Wet, medium dense, light brown, FINE SAND, trace medium sand		
25							**BOE 21'**		
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 12"
Moved to center of Road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-043A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-044A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Tyler Lancaster INSPECTOR:	BORING LOCATION 233 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/25/2011 DATE END 3/25/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/25/2011		17'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/17	1-3	42-47-46-32	Dry, very dense, brown, FINE SAND, trace medium sand		
5		S-2	24/14	4-6	15-29-16-16	Dry, dense, brown, FINE SAND, trace medium sand		
10		S-3	24/16	9-11	18-23-24-27	Moist, dense, light brown, FINE SAND, some medium sand		
15		S-4	24/18	14-16	17-22-26-30	Moist, dense, brown, FINE SAND, some medium sand		
20		S-5	24/10	19-21	7-8-12-14	Wet, medium dense, light brown, FINE SAND		
25		S-6	24/17	24-26	7-12-19-25	Wet, dense, light brown, FINE SAND, trace medium sand		
30						**BOE 26'**		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 10"
Moved to center of Road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-044A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-45 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 17 Kens Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/18/2011 DATE END 1/18/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/18/2011	2:30	8'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/15	3"-2'3"	8-7	Dry, tan, medium dense, FINE SAND		
					5-4			
5		S-2	24/16	5-7	7-8	Dry, tan, medium dense, FINE SAND, trace fine gravel		
					6-8			
10		S-3	24/18	10-12	3-3	Wet, brown, loose, FINE SAND		
					2-4			
		S-4	24/16	13-15	3-4	Wet, tan, loose, FINE TO MEDIUM SAND		
15					5-6			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-45

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-046A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 251 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/25/2011 DATE END 3/25/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/25/2011		17'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	1-3	70-55-31-29	Dry, very dense, brown, FINE SAND, some coarse sand, trace fine gravel, trace silt		
5			S-2	24/12	4-6	25-19-19-17	Dry, dense, brown, FINE SAND, trace medium sand, trace silt		
10			S-3	24/10	9-11	14-12-12-14	Moist, medium dense, light brown, FINE SAND, trace medium sand		
15			S-4	24/12	14-16	10-11-9-9	Moist, medium dense, brown, FINE SAND		
20			S-5	24/9	19-21	7-6-8-10	Wet, medium dense, brown, FINE SAND, some medium sand		
25							**BOE 21'**		
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 10"
Moved to center of Road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-046A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-47 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Cozy Home Terrace
GROUND SURFACE ELEVATION DATUM
DATE START 1/26/2011 DATE END 1/26/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/26/2011	1:30	7'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/15	6"-2'6"	10-7	Dry, tan, medium dense, FINE SAND		
					8-6			
5		S-2	24/14	5-7	5-6	Dry, tan, medium dense, FINE TO MEDIUM SAND, trace		
					8-8	fine gravel		
10		S-3	24/17	10-12	4-4	Wet, brown, loose, FINE TO COARSE SAND		
					3-4			
		S-4	24/20	13-15	4-5	Wet, brown, medium dense, FINE TO COARSE		
15					5-6	SAND, trace fine gravel		
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-47

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-48 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 21 Cozy Home Terrace
GROUND SURFACE ELEVATION DATUM
DATE START 1/26/2011 DATE END 1/26/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/26/2011	2:30	6'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	8-10	Dry, brown, medium dense, FINE SAND		
						12-7			
5			S-2	24/11	5-7	6-5	Wet, brown, medium dense, FINE TO MEDIUM SAND,		
						6-8	trace fine gravel		
10			S-3	24/19	10-12	3-3	Wet, brown, loose, FINE SAND, some medium sand		
						4-5			
			S-4	24/16	13-15	4-6	Wet, tan, medium dense, FINE TO MEDIUM SAND		
15						7-8			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-48

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-049A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 275 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/25/2011 DATE END 3/25/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/25/2011		7'		

DEPTH	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/14	1-3	38-18-12-10	Dry, medium dense, brown, FINE SAND, trace medium sand		
5		S-2	24/8	4-6	5-4-2-2	Moist, loose, dark brown, FINE SAND, some medium sand, trace silt		
10		S-3	24/12	9-11	2-4-6-8	Wet, medium dense, brown, FINE SAND, trace coarse sand		
15		S-4	24/16	14-16	7-7-9-10	Wet, medium dense, brown, FINE SAND, trace medium sand		
20		S-5	24/20	19-21	6-8-16-18	Wet, medium dense, light brown, FINE SAND, trace coarse sand		
25						**BOE 21'**		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 10"
Moved to center of Road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-049A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-050A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Gary Twombly Jr INSPECTOR:	BORING LOCATION 275 Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/25/2011 DATE END 3/25/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/25/2011		7'		

DEPTH	BLOWS	SAMPLE NO.	PEN./REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/12	1-3	41-39-34-32	Dry, very dense, reddish/brown, FINE SAND, some coarse sand		
5		S-2	24/9	4-6	19-12-8-7	Dry, medium dense, brown, FINE SAND, trace medium sand		
10		S-3	24/16	9-11	4-3-4-6	Wet, loose, light brown, FINE SAND		
15		S-4	24/15	14-16	6-8-9-12	Wet, medium dense, light brown, FINE SAND, trace medium sand		
20		S-5	24/19	19-21	12-15-16-17	Wet, dense, light brown, FINE SAND, trace medium sand		
						BOE 21'		
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 11"
Moved to center of Road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-050A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-051 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Tyler Lancaster INSPECTOR:	BORING LOCATION 299 Main Street (west bound) GROUND SURFACE ELEVATION DATUM DATE START 3/28/2011 DATE END 3/28/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/28/2011		9'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/16	1-3	42-39-25-23	Dry, very dense, brown, FINE SAND, trace medium sand		
5		S-2	24/10	4-6	17-14-14-12	Dry, medium dense, brown, FINE SAND		
10		S-3	24/15	9-11	5-5-8-7	Wet, medium dense, brown, FINE SAND, trace medium sand, trace silt		
15		S-4	24/18	14-16	5-4-6-7	Wet, medium dense, brown, FINE SAND, trace medium sand		
20		S-5	24/20	19-21	4-8-9-14	Wet, medium dense, light brown, FINE SAND, trace medium sand		
25		S-6	24/15	24-26	11-12-14-18	Wet, medium dense, light brown, FINE SAND, some medium sand, trace coarse sand		
						BOE 26'		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 14"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-051

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-52 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 18 Standish Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/3/2011 DATE END 2/3/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/3/2011	1:00	13'		

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	3"-2'3"	12-10	Dry, brown, medium dense, FINE SAND		
						8-6			
5			S-2	24/19	5-7	3-3	Dry, tan, loose, FINE SAND		
						4-4			
10			S-3	24/16	10-12	3-4	Dry, tan, loose, FINE TO MEDIUM SAND		
						5-5			
15			S-4	24/16	15-17	3-3	Wet, brown, loose, FINE TO MEDIUM SAND		
						4-5			
			S-5	24/13	18-20	4-4	Wet, brown, loose, FINE TO MEDIUM SAND		
20						5-6			
							BOE 20'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR [DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-52

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-53 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 14 Bradford Way
GROUND SURFACE ELEVATION DATUM
DATE START 2/1/2011 DATE END 2/1/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/1/2011	9:30	15'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/13	3"-2'3"	24-31	Dry, dark brown, very dense, FINE SAND		
						28-17			
5			S-2	24/18	5-7	4-5	Dry, tan, medium dense, FINE TO MEDIUM SAND		
						6-6			
10			S-3	24/16	10-12	5-7	Dry, tan, medium dense, FINE SAND		
						8-7			
			S-4	24/13	13-15	5-6	Dry, tan, medium dense, FINE SAND		
15						5-5			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2.5"
Tip of Spoon wet - 15'

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-53

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-054 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Tyler Lancaster
INSPECTOR:

BORING LOCATION 311 Main Street (east bound)
GROUND SURFACE ELEVATION DATUM
DATE START 3/29/2011 DATE END 3/29/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/29/2011		10'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/10	1-3	17-15-15-8	Dry, dense, brown/reddish, FINE SAND, trace medium sand		
5		S-2	24/12	4-6	5-4-6-3	Moist, medium dense, blackish/brown, FINE SAND, trace coarse sand		
10		S-3	24/15	9-11	2-3-4-6	Wet, loose, brown, FINE SAND, trace medium sand		
15		S-4	24/10	14-16	4-6-9-10	Wet, medium dense, brown, FINE SAND, some medium sand		
20		S-5	24/12	19-21	3-3-4-5	Wet, loose, light brown, FINE SAND, trace medium sand, trace fine gravel		
25		S-6	24/14	24-26	6-6-7-14	Wet, medium dense, light brown, FINE SAND, trace medium sand		
30						**BOE 26'**		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 13"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-054

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-055 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Tyler Lancaster
INSPECTOR:

BORING LOCATION 327 Main Street (east bound)
GROUND SURFACE ELEVATION DATUM
DATE START 3/29/2011 DATE END 3/29/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/29/2011		12'		

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/16	1-3	13-10-8-7	Dry, medium dense, brown, FINE SAND, trace coarse sand, trace silt		
5		S-2	24/12	4-6	6-7-5-7	Moist, medium dense, brown, FINE SAND, trace coarse sand		
10		S-3	24/11	9-11	3-3-3-6	Wet, loose, brown, FINE SAND		
15		S-4	24/12	14-16	5-6-5-6	Wet, medium dense, brown, FINE SAND, trace medium sand		
20		S-5	24/15	19-21	2-4-4-5	Wet, loose, light brown, FINE SAND, some medium sand		
25		S-6	24/16	24-26	3-6-8-12	Wet, medium dense, light brown, FINE SAND, trace medium sand		
30						**BOE 26'**		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 15"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-055

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-56 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 30 Traders Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/19/2011 DATE END 1/19/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/19/2011	10:30	12'	23'	30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/17	3"-2'7"	8-9	Dry, brown, medium dense, FINE SAND		
					8-5			
5		S-2	24/19	4-6	6-5	Dry, tan, medium dense, FINE SAND, trace fine gravel		
					6-7			
10		S-3	24/16	9-11	7-9	Dry, tan, medium dense, FINE SAND, trace fine gravel		
					11-12			
15		S-4	24/12	14-16	4-5	Wet, tan, medium dense, FINE SAND		
					7-9			
20		S-5	24/9	19-21	5-8	Wet, tan, medium dense, FINE TO MEDIUM SAND		
					8-7			
25						**BOE 21'**		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-56

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-57 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 32 Traders Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/19/2011 DATE END 1/19/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/19/2011	11:00	12½'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/16	3"-2'3"	8-12	Dry, brown, medium dense, FINE SAND		
					14-8			
5		S-2	24/14	4-6	4-4	Dry, tan, loose, FINE SAND		
					5-6			
10		S-3	24/10	9-11	7-8	Dry, brown, medium dense, FINE TO COARSE SAND		
					10-14			
15		S-4	24/15	13-15	3-3	Wet, brown, loose, FINE TO MEDIUM SAND		
					5-6			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-57

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-58 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 51 Traders Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/26/2011 DATE END 1/26/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/26/2011	9:00	11'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/9	6"-2'6"	8-10	Dry, brown, medium dense, FINE SAND		
					12-13			
5		S-2	24/13	5-7	8-9	Wet, brown, medium dense, FINE TO MEDIUM SAND,		
					7-8	trace fine gravel		
10		S-3	24/15	10-12	10-7	Wet, brown, loose, FINE SAND, some medium sand		
					7-9			
		S-4	24/9	13-15	7-5	Wet, tan, medium dense, FINE TO MEDIUM SAND		
15					5-7			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-58

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-59 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Denver Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/17/2011 DATE END 1/17/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/17/2011	10:30	10'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	3"-2'3"	10-14	Dry, brown, medium dense, FINE SAND		
						12-9			
5			S-2	24/14	5-7	5-4	Dry, brown, loose, FINE TO MEDIUM SAND		
						5-7			
10			S-3	24/16	10-12	2-2	Wet, brown, loose, FINE SAND		
						2-3			
			S-4	24/19	13-15	2-3	Wet, tan, loose, FINE SAND		
15						2-2			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-59

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-60 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes Helper: Bob Brennan INSPECTOR:	BORING LOCATION 66 Traders Lane GROUND SURFACE ELEVATION DATUM DATE START 1/19/2011 DATE END 1/19/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/19/2011	11:30	12.5"	23'	30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/17	3"-2'3"	5-5	Dry, brown, medium dense, FINE SAND		
					6-7			
		S-2	24/17	4-6	5-6	Dry, red/brown, medium dense, FINE SAND		
5					7-8			
		S-3	24/12	9-11	8-9	Dry, tan, medium dense, FINE SAND		
10					9-11			
		S-4	24/10	14-16	7-9	Wet, tan, medium dense, FINE TO MEDIUM SAND		
15					10-9			
		S-5	24/12	19-21	7-6	Wet, tan, medium dense, FINE TO MEDIUM SAND		
20					8-9			
		S-6	24/8	23-25	6-6	Wet, tan, medium dense, FINE TO MEDIUM SAND,		
25					7-9	trace fine gravel		
						BOE 25'		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-60

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-61 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 85 Traders Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/20/2011 DATE END 1/20/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/20/2011	11:00	16'	28'	30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	3"-2'3"	8-7	Dry, brown, medium dense, FINE SAND		
						7-8			
5			S-2	24/13	4-6	3-4	Wet, brown, medium dense, FINE TO MEDIUM SAND,		
						6-9	trace coarse sand		
10			S-3	24/15	9-11	7-13	Wet, brown, medium dense, FINE SAND		
						9-8			
15			S-4	24/9	14-16	7-7	Wet, tan, medium dense, FINE SAND		
						7-8			
20			S-5	24/14	19-21	10-9	Wet, brown, medium dense, FINE TO MEDIUM SAND		
						13-14			
25			S-6	24/13	24-26	7-8	Wet, brown, medium dense, FINE SAND		
						9-9			
			S-7	24/16	28-30	5-7	Wet, brown, medium dense, FINE TO MEDIUM SAND		
30						12-9			
							BOE 30'		

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2.5"
Set well at 23'

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-61

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-62 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 106 Traders Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/20/2011 DATE END 1/20/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/20/2011	2:00	15'	3"	30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/11	3"-2'3"	7-6	Dry, tan, medium dense, FINE SAND		
						5-4			
5			S-2	24/15	4-6	9-8	Dry, tan, medium dense, FINE SAND		
						7-6			
10			S-3	24/14	9-11	4-4	Wet, tan, loose, FINE SAND		
						4-6			
15			S-4	24/11	14-16	5-7	Wet, tan, medium dense, FINE TO MEDIUM SAND		
						8-9			
20			S-5	24/9	19-21	8-6	Wet, tan, medium dense, FINE TO MEDIUM SAND		
						7-13			
25			S-6	24/10	23-25	8-9	Wet, brown, medium dense, FINE SAND		
						10-12			
							BOE 25'		
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-62

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-063 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Tyler Lancaster
INSPECTOR:

BORING LOCATION 343 Main Street (east bound)
GROUND SURFACE ELEVATION DATUM
DATE START 3/29/2011 DATE END 3/29/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/29/2011		11'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	1-3	18-15-10-9	Dry, medium dense, brown, FINE SAND, trace medium sand		
5			S-2	24/11	4-6	4-5-5-6	Moist, medium dense, brown, FINE SAND		
10			S-3	24/12	9-11	4-7-10-8	Moist, medium dense, light brown, FINE SAND		
15			S-4	24/10	14-16	6-10-9-8	Wet, medium dense, light brown, FINE SAND		
20			S-5	24/16	19-21	7-10-16-17	Wet, medium dense, light brown, FINE SAND, some medium sand		
25							**BOE 21'**		
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 13"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-063

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-064 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee
Helper: Tyler Lancaster
INSPECTOR:

BORING LOCATION 349 Main Street
GROUND SURFACE ELEVATION DATUM
DATE START 3/30/2011 DATE END 3/30/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/30/2011		8'		

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/12	1-3	18-24-30-22	Dry, very dense, brown, FINE SAND, trace medium sand		
5		S-2	24/14	4-6	17-16-14-15	Dry, dense, brown, FINE SAND		
10		S-3	24/12	9-11	2-3-4-6	Wet, loose, rust, FINE SAND		
15		S-4	24/18	14-16	7-9-10-9	Wet, medium dense, light brown, FINE SAND, trace medium sand		
20		S-5	24/8	19-21	4-5-5-4	Wet, medium dense, brown, FINE SAND, trace medium sand		
25						**BOE 21'**		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 18"
Moved to center of the road

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-064

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-65 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Hemeon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/6/2011 DATE END 1/6/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/6/2011	3:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/19	6"-2'6"	14-12	Dry, brown, medium dense, FINE SAND		
						8-8			
5			S-2	24/14	5-7	4-6	Dry, tan, medium dense, FINE SAND		
						6-7			
10			S-3	24/16	10-12	3-4	Dry, tan, loose, FINE SAND		
						5-5			
							BOE 12'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-65

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-66 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 29 Hemeon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/7/2011 DATE END 1/7/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/7/2011	9:30	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	6"-2'6"	7-9	Dry, brown, medium dense, FINE SAND		
						6-5			
5			S-2	24/12	5-7	3-3	Dry, brown, loose, FINE SAND		
						3-4			
10			S-3	24/19	8-10	3-4	Dry, tan, loose, FINE SAND		
						3-5			
							BOE 10'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-66

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-67 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 49 Hemeon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/7/2011 DATE END 1/7/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/7/2011	8:30	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/19	6"-2'6"	7-10	Dry, brown, medium dense, FINE SAND		
						7-5			
5			S-2	24/19	5-7	2-2	Dry, brown, loose, FINE SAND		
						2-3			
10			S-3	24/17	10-12	3-3	Dry, tan, loose, FINE SAND		
						3-4			
							BOE 12'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-67

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-68 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 63 Hemeon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/7/2011 DATE END 1/7/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/7/2011	11:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	6"-2'6"	6-8	Dry, brown, medium dense, FINE SAND		
						5-4			
5			S-2	24/16	5-7	6-3	Dry, tan, loose, FINE SAND		
						3-6			
10			S-3	24/16	10-12	2-3	Dry, tan, loose, FINE SAND		
						5-6			
			S-4	24/19	13-15	9-5	Dry, tan, medium dense, FINE SAND		
						5-6			
15									
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR [DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-68

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-69 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 81 Hemeon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/7/2011 DATE END 1/7/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/7/2011	1:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/19	6"-2'6"	7-6	Dry, brown, medium dense, FINE SAND		
						5-4			
5			S-2	24/16	5-7	5-7	Dry, tan, medium dense, FINE SAND		
						5-5			
10			S-3	24/15	10-12	3-4	Dry, tan, loose, FINE SAND		
						5-6			
			S-4	24/17	13-15	5-4	Dry, tan, medium dense, FINE SAND		
15						6-6			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-69

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-070B SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Tyler Lancaster INSPECTOR:	BORING LOCATION Intersection of Lewis & Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/30/2011 DATE END 3/30/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/30/2011		6½'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/18	1-3	75-39-25-16	Dry, very dense, brown, FINE SAND, trace medium sand		
5		S-2	24/12	4-6	11-10-9-7	Moist, medium dense, brown, FINE SAND		
10		S-3	24/8	9-11	3-2-5-8	Wet, loose, brown, FINE SAND, trace medium sand		
15		S-4	24/10	14-16	10-10-12-15	Wet, medium dense, reddish/brown, FINE SAND, some medium sand, trace coarse sand		
20						**BOE 16'**		
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 14"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-070B

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-71 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 12 North Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/11/2011 DATE END 1/11/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/11/2011	10:00	12'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	6"-2'6"	6-8	Dry, brown, medium dense, FINE SAND		
						5-6			
5			S-2	24/6	5-7	3-4	Dry, brown, medium dense, FINE TO MEDIUM SAND		
						6-6			
10			S-3	24/17	10-12	3-2	Wet, brown, loose, FINE SAND		
						2-3			
			S-4	24/18	13-15	4-6	Wet, brown, medium dense, FINE TO COARSE SAND		
15						7-8			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-71

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-72 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 30 North Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/10/2011 DATE END 1/10/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/10/2011	11:30			30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/14	3"-2'3"	7-6	Dry, brown, medium dense, FINE SAND		
						5-4			
5			S-2	24/17	5-7	2-4	Dry, tan, loose, FINE SAND		
						5-5			
10			S-3	24/19	10-12	4-5	Dry, tan, loose, FINE SAND		
						5-7			
			S-4	24/14	13-15	3-3	Moist, tan, loose, FINE SAND		
						4-5			
15									
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 1½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-72

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-73 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 50 North Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/10/2011 DATE END 1/10/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/10/2011	8:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	6-5	Dry, brown, loose, FINE SAND		
						4-4			
5			S-2	24/17	5-7	6-6	Dry, tan, medium dense, FINE SAND		
						5-6			
10			S-3	24/13	10-12	5-4	Dry, tan, loose, FINE SAND		
						4-4			
			S-4	24/16	13-15	3-5	Dry, tan, medium dense, FINE SAND		
						5-6			
15									
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-73

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-74 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 71 North Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/7/2011 DATE END 1/7/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/7/2011	12:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	6-5	Dry, brown, medium dense, FINE SAND		
						5-5			
5			S-2	24/19	5-7	3-4	Dry, tan, loose, FINE SAND		
						5-5			
10			S-3	24/17	10-12	4-5	Dry, tan, medium dense, FINE SAND		
						7-9			
							BOE 12'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-74

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-75 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 87 North Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/26/2011 DATE END 1/26/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/26/2011	10:00	n/a		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1		3"-2'3"	12-15	Dry, brown, medium dense, FINE SAND		
					9-6			
5		S-2	24/13	5-7	8-4	Dry, tan, loose, FINE SAND		
					5-5			
10		S-3	24/13	10-12	7-8	Dry, tan, medium dense, FINE TO MEDIUM SAND		
					8-8			
						BOE 12'		
15								
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-75

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-76 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 10 Calico Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/7/2011 DATE END 1/7/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/7/2011	2:00	N/A		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1		6"-2'6"	3-4	Dry, brown, loose, FINE SAND		
						4-5			
			S-2	24/19	4-6	3-3	Dry, tan, oose, FINE SAND		
5						3-4			
			S-3	24/16	8-10	4-4	Dry, tan, medium dense, FINE SAND		
						6-6			
10									
							BOE 10'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 1½"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-76

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-77 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Wimbledon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/26/2011 DATE END 1/26/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/26/2011	11:30	7.5'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/16	6"-2'	12-14	Dry, brown, medium dense, FINE SAND		
					10-9			
5		S-2	24/19	5-7	8-6	Dry, tan, medium dense, FINE TO MEDIUM SAND		
					5-5			
10		S-3	24/9	10-12	6-7	Wet, brown, medium dense, FINE SAND		
					5-5			
						BOE 12'		
15								
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3.5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-77

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-78 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 31 Wimbledon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/10/2011 DATE END 1/10/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/10/2011	10:30	13'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/19	6"-2'6"	8-7	Dry, brown, medium dense, FINE SAND		
						4-4			
5			S-2	24/20	5-7	3-2	Dry, tan, loose, FINE SAND		
						3-4			
10			S-3	24/18	10-12	3-6	Dry, tan, medium dense, FINE SAND		
						6-8			
			S-4	24/15	14-16	2-4	Wet, tan, loose, FINE SAND		
15						4-4			
							BOE 16'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-78

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-079A SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Donald Dunklee Helper: Tyler Lancaster INSPECTOR:	BORING LOCATION Intersection of Lewis & Main Street GROUND SURFACE ELEVATION DATUM DATE START 3/30/2011 DATE END 3/30/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/30/2011		7½'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/14	1-3	44-37-29-20	Dry, very dense, brown, FINE SAND, trace fine gravel, trace coarse sand		
5		S-2	24/10	4-6	12-15-11-19	Moist, medium dense, light brown, FINE SAND		
10		S-3	24/12	9-11	8-9-11-14	Wet, medium dense, light brown, FINE SAND		
15		S-4	24/14	14-16	8-10-10-15	Wet, medium dense, light brown, FINE SAND, trace medium sand		
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 14"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TC OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-079A

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-80 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 14 South Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/11/2011 DATE END 1/11/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/11/2011	8:00	10'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	3"-2'3"	6-5	Moist, brown, loose, FINE TO MEDIUM SAND		
						4-5			
5			S-2	24/18	5-7	3-4	Dry, brown, loose, FINE SAND		
						3-5			
10			S-3	24/18	10-12	4-8	Wet, brown, medium dense, FINE SAND		
						9-9			
							BOE 12'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-80

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-81 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 24 South Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/10/2011 DATE END 1/10/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/10/2011	10:30	13'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	3"-2'3"	6-5	Dry, brown, loose, FINE SAND		
						4-4			
5			S-2	24/19	5-7	2-2	Dry, tan, loose, FINE SAND		
						3-4			
10			S-3	24/15	10-12	5-4	Dry, tan, loose, FINE SAND		
						5-4			
			S-4	24/17	13-15	2-3	Wet, tan, loose, FINE SAND		
						4-5			
15									
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-81

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-82 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 11 Featherbed Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/10/2011 DATE END 1/10/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/10/2011	12:30	14'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/19	3"-2'3"	8-9	Dry, brown, medium dense, FINE SAND		
						5-5			
5			S-2	24/16	5-7	3-4	Dry, tan, loose, FINE SAND		
						4-4			
10			S-3	24/19	10-12	3-4	Dry, tan, loose, FINE SAND		
						4-4			
			S-4	24/17	13-15	4-3	Wet, tan, loose, MEDIUM TO FINE SAND		
15						3-4			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-82

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-83 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 10 Arbor Street
GROUND SURFACE ELEVATION DATUM
DATE START 1/11/2011 DATE END 1/11/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/11/2011	9:00	10'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	6"-2'6"	8-7	Dry, brown, medium dense, FINE TO COARSE SAND		
						5-3			
5			S-2	24/18	5-7	3-3	Dry, brown, loose, FINE SAND		
						4-6			
10			S-3	24/18	10-12	5-6	Wet, brown, medium dense, FINE TO COARSE SAND		
						10-13			
							BOE 12'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR [DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-83

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-84 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 7 Holmes Way
GROUND SURFACE ELEVATION DATUM
DATE START 1/28/2011 DATE END 1/28/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/28/2011	9:00	n/a		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/16	0-2	29-31	Dry, brown, dense, FINE SAND		
					10-6			
5		S-2	24/7	5-7	4-3	Dry, tan, loose, FINE SAND.		
					4-5			
10		S-3	24/19	10-12	5-6	Dry, tan, medium dense, FINE SAND		
					7-7			
		S-4	24/15	13-15	5-6	Dry, tan, medium dense, FINE TO MEDIUM SAND		
15					6-7			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 0"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-84

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-85 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Lewis Street
GROUND SURFACE ELEVATION DATUM
DATE START 1/14/2011 DATE END 1/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/14/2011	9:00	13'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/13	6"-2'6"	10-9	Dry, brown, medium dense, FINE TO MEDIUM SAND		
						8-6			
5			S-2	24/17	5-7	4-4	Dry, brown, loose, FINE SAND		
						5-7			
10			S-3	24/19	10-12	6-4	Dry, brown, loose, FINE SAND		
						4-5			
15			S-4	24/19	15-17	4-4	Wet, brown, medium dense, FINE TO MEDIUM SAND		
						6-6			
			S-5	24/17	19-21	4-4	Wet, brown, loose, FINE TO MEDIUM SAND		
20						5-5			
							BOE 21'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 6"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-85

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-86 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 33 Lewis Road
GROUND SURFACE ELEVATION DATUM
DATE START 1/28/2011 DATE END 1/28/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/28/2011	2:30	12.5'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/17	6"-2'6"	14-16	Dry, brown/black, dense, FINE SAND		
						19-11			
5			S-2	24/11	5-7	7-9	Dry, tan, medium dense, FINE SAND		
						8-8			
10			S-3	24/16	10-12	4-7	Dry, tan, medium dense, FINE SAND		
						7-8			
15			S-4	24/9	14-16	3-4	Wet, brown, loose, FINE TO MEDIUM SAND, trace		
						5-4	fine gravel		
							BOH 16'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-86

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-87 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 53 Lewis Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/28/2011 DATE END 1/28/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/28/2011	10:00	15'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./ REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/14	6"-2'6"	23-21	Dry, brown, dense, FINE SAND		
					18-17			
5		S-2	24/13	5-7	5-5	Dry, tan, medium dense, FINE SAND		
					6-7			
10		S-3	24/15	10-12	4-6	Dry, tan, medium dense, FINE SAND		
					6-7			
15		S-4	24/18	14-16	5-7	Wet, brown, medium dense, FINE TO MEDIUM SAND,		
					7-7	trace silt		
						BOE 16'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 4"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-87

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-88 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 69 Lewis Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/28/2011 DATE END 1/28/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/28/2011	11:00	14.5'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/17	3"-2'3"	10-8	Dry, tan, medium dense, FINE SAND		
					7-6			
5		S-2	24/14	5-7	4-4	Dry, tan, loose, FINE SAND		
					5-6			
10		S-3	24/16	10-12	5-6	Dry, tan, medium dense, FINE SAND		
					7-8			
		S-4	24/19	13-15	6-7	Wet, brown, medium dense; FINE TO MEDIUM SAND		
15					8-6			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-88

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-89 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Prospect Ave
GROUND SURFACE ELEVATION DATUM
DATE START 2/14/2011 DATE END 2/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 4" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/14/2011	8:00	15.5'	4"	2.75 hours

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/9	3'-2'3"	14-18	Dry, brown, dense, FINE SAND		
						15-12			
5			S-2	24/16	5-7	4-6	Dry, brown/red, medium dense, FINE to MEDIUM SAND		
						9-11			
10			S-3	24/17	10-12	5-6	Dry, tan, medium dense, FINE SAND		
						6-6			
			S-4	24/14	13-15	6-6	Moist, tan, medium dense, FINE SAND		
15						7-9			
			S-5	24/16	18-20	5-6	Wet, brown, medium dense, FINE SAND		
20						7-6			
							BOE 20'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"
Set well @ 20', 10' screen, 10' riser

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-89

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-90 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Cadet Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/14/2011 DATE END 1/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/14/2011	12:00	12'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/11	3"-2.3"	8-14	Dry, brown, medium dense , FINE SAND		
					9-5			
5		S-2	24/16	5-7	5-5	Dry, brown, medium dense, FINE SAND		
					6-7			
10		S-3	24/15	10-12	6-8	Wet, brown, medium dense, FINE TO MEDIUM SAND		
					10-12			
		S-4	24/16	13-15	5-6	Wet, brown, medium dense, FINE TO MEDIUM SAND		
15					6-7			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-90

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-91 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 11 Cadet Street
GROUND SURFACE ELEVATION DATUM
DATE START 2/8/2011 DATE END 2/8/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/8/2011	8:00	13'		30 mins

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/13	3"-2'3"	6-5	Moist, brown, loose, FINE TO MEDIUM SAND		
					4-4			
5		S-2	24/12	5-7	5-7	Moist, brown, medium dense, FINE TO MEDIUM SAND		
					7-6			
10		S-3	24/15	10-12	6-6	Moist, brown, medium dense, FINE SAND		
					5-5			
		S-4	24/11	13-15	3-3	Wet, brown, loose, FINE TO COARSE SAND		
15					4-3			
						BOE 15'		
20								
25								
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE T(OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-91

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-92 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 33 Prospect Ave
GROUND SURFACE ELEVATION DATUM
DATE START 1/28/2011 DATE END 1/28/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/28/2011	1:30	15'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/20	3"-2'3"	14-16	Dry, brown, dense, FINE SAND		
						15-9			
5			S-2	24/13	5-7	5-6	Dry, tan, medium dense, FINE SAND		
						6-8			
10			S-3	24/15	10-12	13-12	Dry, tan, medium dense, FINE SAND		
						13-12			
			S-4	24/17	13-15	6-8	Dry, tan, medium dense, FINE TO MEDIUM SAND		
15						12-13			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 2.5"
Spoon tip wet

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TC OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-92

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-93 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 67 Wimbledon Drive
GROUND SURFACE ELEVATION DATUM
DATE START 1/10/2011 DATE END 1/10/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/10/2011	10:30	13'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/21	6"-2'6"	8-7	Dry, brown, medium dense, FINE SAND		
						5-4			
5			S-2	24/17	5-7	2-2	Dry, tan, loose, FINE SAND		
						3-4			
10			S-3	24/20	10-12	2-3	Dry, brown, loose, FINE SAND		
						3-5			
							BOE 12'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 5"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-93

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-95 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Robert Brennan
INSPECTOR:

BORING LOCATION Route 28
GROUND SURFACE ELEVATION DATUM
DATE START 3/31/11; 9:00 DATE END 3/31/11; 10:45

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/31/2011		14'		

DEPTH	CASING BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0		S-1	24/14	7"-2'7"	14-8-7-6	Dry, medium dense, brown, FINE SAND		
5		S-2	24/12	4-6	5-7-10-13	Moist, medium dense, brown, FINE TO COARSE SAND		
10		S-3	24/9	9-11	7-8-10-11	Wet, medium dense, tan, FINE TO MEDIUM SAND		
15		S-4	24/14	14-16	5-7-10-8	Wet, medium dense, tan, FINE TO COARSE SAND, trace fine gravel		
20		S-5	24/10	18-20	5-6-6-7	Wet, medium dense, tan, FINE TO MEDIUM SAND, trace fine gravel		
25						**BOE 20'**		
30								

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 7"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR I DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-95

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-96 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 15 Thomas Path
GROUND SURFACE ELEVATION DATUM
DATE START 2/4/2011 DATE END 2/4/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/4/2011	9:30	14'		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	6"-2'6"	31-28	Dry, brown, dense, FINE SAND		
						14-17			
5			S-2	24/12	5-7	3-3	Dry, tan, loose, FINE SAND		
						3-5			
10			S-3	24/18	10-12	5-7	Dry, tan, medium dense, FINE SAND		
						5-6			
			S-4	24/12	13-15	4-5	Moist, brown, medium dense, MEDIUM TO COARSE		
15						7-8	SAND, trace fine gravel		
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-96

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-98 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION 31 Thomas Path
GROUND SURFACE ELEVATION DATUM
DATE START 2/4/2011 DATE END 2/4/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
2/4/2011	8:30	n/a		30 mins

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/16	6"-2'6"	26-38	Dry, brown, very dense, FINE SAND		
						13-11			
5			S-2	24/14	5-7	13-6	Dry, tan, medium dense, FINE SAND		
						5-9			
10			S-3	24/12	10-12	4-8	Dry, tan, medium dense, FINE SAND		
						11-11			
			S-4	24/18	13-15	9-12	Dry, tan, medium dense, FINE SAND		
15						12-11			
							BOE 15'		
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-98

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-100 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Bob Brennan
INSPECTOR:

BORING LOCATION Holiday Lane
GROUND SURFACE ELEVATION DATUM
DATE START 1/14/2011 DATE END 1/14/2011

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: OTHER: HSA 2¼"

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
1/14/2011		N/A		

DEPTH	CASING	BLOWS	SAMPLE NO.	PEN./ REC	DEPTH (Ft.)	BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/18	3"-2.3"	8-11	Dry, brown, medium dense, FINE SAND		
						10-6			
5			S-2	24/10	5-7	4-4	Dry, brown, loose, FINE SAND		
						5-5			
			S-3	24/17	8-10	6-7	Dry, brown, medium dense, FINE SAND		
10						7-10			
							BOE 10'		
15									
20									
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 3"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-100

NEW HAMPSHIRE BORING, INC. 1215 W. CHESTNUT ST., BROCKTON, MA 02301	PROJECT Sewerage Works Improvements Phase I - Yarmouth, MA Camp Dresser & McKee, Inc.	REPORT OF BORING No. B-101 SHEET 1 OF 1 FILE No. 20391 CHKD. BY

Driller: Jason Stokes
Helper: Robert Brennan
INSPECTOR:

BORING LOCATION Route 28
GROUND SURFACE ELEVATION DATUM
DATE START 3/31/11; 11:00 DATE END 3/31/11; 12:30

SAMPLER: UNLESS OTHERWISE NOTED, SAMPLER CONSISTS OF A 2" SPLIT SPOON DRIVEN USING A 140 lb. HAMMER FALLING 30 In.

CASING: UNLESS OTHERWISE NOTED, CASING DRIVEN USING A 300 lb. HAMMER FALLING 24 In.

CASING SIZE: 3" OTHER:

GROUNDWATER READINGS

DATE	TIME	WATER	CASING	STABILIZATION TIME
3/31/2011		14'		

DEPTH	CASING	BLOWS	SAMPLE NO.	SAMPLE PEN./REC	SAMPLE DEPTH (Ft.)	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	REMKS	STRATUM DESCRIPTION
0			S-1	24/15	7"-2'7"	4-5-5-6	Dry, loose, brown, FINE SAND		
5			S-2	24/10	4-6	3-3-3-4	Moist, loose, brown, FINE TO MEDIUM SAND		
10			S-3	24/14	9-11	6-7-8-12	Wet, medium dense, brown, FINE SAND		
15			S-4	24/12	14-16	6-7-8-12	Wet, medium dense, tan, FINE SAND, trace fine gravel		
20			S-5	24/15	18-20	7-8-10-15	Wet, medium dense, brown, FINE TO COARSE SAND, trace fine gravel		
							BOE 20'		
25									
30									

GRANULAR SOILS Blows/Ft	Density	COHESIVE SOILS Blows/Ft	Density
0 - 4	V. LOOSE	<2	V. SOFT
4-10	LOOSE	2-4	SOFT
10-30	M. DENSE	4-8	M. STIFF
30-50	DENSE	8-15	STIFF
>50	V. DENSE	15-30	V. STIFF
		>30	HARD

REMARKS:
Asphalt 7"

NOTES: 1) STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY BETWEEN SOIL TYPES, TRANSITIONS MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE AT TIMES AND UNDER CONDITIONS STATED, FLUCTUATIONS OF GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE

BORING No B-101

Appendix B

MassDOT State Highway Access Permit

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Maura Healey, Governor
Kimberley Driscoll, Lieutenant Governor
Monica Tibbits-Nutt, Secretary & CEO
Jonathan L. Gulliver, Highway Administrator

5-2024-0531

PERMIT – YARMOUTH

Subject to all terms, conditions, and restrictions printed or written below, permission is hereby granted to **YARMOUTH DEPARTMENT OF PUBLIC WORKS,** Jeffrey Colby, 99 Buck Island Road, Yarmouth, MA 02673 to enter upon State Highway in the Town of **YARMOUTH** on Auto Route 28, locally known as Main Street, for the purpose of performing sewer main and water main improvements within the State Highway Layout (SHLO), from #1 Iyannough Road to #438 Main Street. The work under this Permit is for Phase 1 – Contract No. 6 (Project No. CWSRF- 8349/6). The work will involve installing Approximately 10,200 linear feet of 8" (inch) to 24" (inch) gravity sewer main, 3,000 linear feet of 8" (inch) to 12" (inch) force main and 7,000 linear feet of 8" (inch) to 16" (inch) water main and appurtenances, as shown on the approved plans.

LONGITUDINAL GRAVITY SEWER MAIN & HDPE SEWER FORCE MAIN

The longitudinal mains will be installed within the roadway pavement area as shown on the approved plans.

LATERAL SEWER MAIN

A total of sixteen (16) sections of lateral sewer mains will be installed from the new gravity sewer main and will extend northerly and/or southerly to several intersections, as shown on the approved plans.

LATERAL SEWER SERVICE CONNECTIONS

Service connections to the various properties and side streets will be installed from the new sewer force main to the property lines, as shown on the approved plans.

SEWER MANHOLES

A number of new sewer manholes will be installed along the paved roadway as shown on the approved plans.

LONGITUDINAL WATER MAIN

The proposed 12" (inch) water main installation will continue from Permit #5-2024-0308 work area at #438 Main Street, on the northerly side of the roadway. The water main will proceed westerly within an open cut trench along the paved roadway to the intersection of Iyannough Road and Main where it will branch out along Main Street to end in front of #8 Main Street, and along Iyannough Road to end at #1 Iyannough Road, as shown on the approved plans.

LATERAL WATER SERVICE CONNECTION

Water service connections to the various properties and side streets will extend from the new water main northerly and/or southerly to the properties, as shown on the approved plans.

District 5, 1000 County Street Taunton, MA 02780
Tel: (857) 368-5000, FAX: (508) 880-6102
www.mass.gov/orgs/highway-division

HYDRANTS

Existing fire hydrant assemblies will be removed and replaced, the new hydrants and assemblies will be installed in the soft shoulder along the northerly and/or southerly sides of Main Street, as shown on the approved plans.

THE EXISTING WATER MAIN, AS SHOWN ON THE PLAN, WILL BE CUT, CAPPED AND/OR ABANDONED IN PLACE.

A three (3) year Performance Bond for the amount of $14,020,000.00 is required before construction starts. The life of the Performance Bond shall continue for three (3) years beyond the date MassDOT-Highway Division signs off on the Permit.

Work must be phased to ensure adequate drainage of the roadway at all times. If the State's drainage system is impacted by this work, any repairs will be the responsibility of the Grantee.

At locations where sewer services are proposed within the existing sidewalk, the Grantee will be required to replace in kind the sidewalk (minimum 5-feet wide) and meet ADA/AAB standards. The sidewalk needs to have a 1.5% cross slope (± 0.5% construction tolerance) and the transitions at the driveway shall have a longitudinal slope of 7.5% or flatter. Furthermore, the roadway gutter line must be maintained through aprons to direct the roadway runoff along the gutter so as not to impact any abutting properties.

THE PROPOSED WORK FALLS WITHIN THE AREA OF A SIGNALIZED INTERSECTION

The Grantee(s) must contact the Assistant Traffic Engineer for Operations and Maintenance at (857) 368-5261 at least two (2) weeks prior to the commencement of said work to locate the existing traffic signal conduit/detectors and to coordinate this work so as not to disturb the traffic signals. The Grantee(s) shall provide the Assistant Traffic Engineer for Operations and Maintenance with the Permit number, the approximate Stations where the work will take place, and the limits of the work. The Grantee(s) will be responsible for marking the limits of the work in the field so that MassDOT, Highway Division, can mark the locations of all existing traffic signal conduit/detectors within those limits. **The Grantee(s) will be responsible to repair/replace all damaged items immediately and will be billed for any cost incurred to restore normal operation to MassDOT, Highway Division, signal equipment to the satisfaction of the Engineer.**

The Grantee(s) will assume all responsibility to restore any alteration on State Property due to this work, including but not limited to damage of pavement, curbing, edging, signs, drainage, guardrail, etc.

MassDOT has a Corridor project (Project #608264) which is scheduled to advertise in 2028. Should that project be continuing to move forward, final restoration may be limited to the impacted areas, or as directed by the Permits Inspector. Should that project be delayed, a more comprehensive pavement repair of the entire impacted lanes may be required. Anything outside limits of the project will require additional pavement restoration.

The proposed sewer design along Route 28 will need close coordination with the TIP project #608264 Barnstable-Yarmouth Route 28. Both CDM Smith and TIP designer GPI John Tamburrini 978-570-2999 will need to coordinate with each other to ensure no conflicts will result between both projects. A meeting will be required to meet and coordinate the sewer design.

District 5, 1000 County Street Taunton, MA 02780
Tel: (857) 368-5000, FAX: (508) 880-6102
www.mass.gov/orgs/highway-division

There is an existing guardrail located within the limits of the proposed work. If the Grantee(s) must remove the guardrail located within the limits of the proposed water main installation, all suitable material may therefore be reused on this project or removed from within the SHLO and properly stored or discarded at the expense of the Contractor or Grantee(s). When removal of the guardrail is required, the Grantee(s) shall ensure that all guardrail work, including the appropriate end treatments, must be completed according to MassDOT, Highway Division, Standards on the same day of the removal thereof. No unprotected, exposed guardrail ends shall be left overnight.

IT IS NOTED THAT THE LONGITUDINAL SEWER AND WATER MAINS ARE WITHIN THE TRAVEL LANE AND IMPACTS THE TRAVEL PATH OF MOTORISTS. THE PAVEMENT REPAIR FOR WORK ON ROUTE 28 WILL REQUIRE MILLING AND OVERLAYING WITH 2" (INCHES) OF SURFACE COURSE A MINIMUM OF 1’ (FOOT) ON EITHER SIDE OF THE TRENCH. THE PERMANENT REPAIR OF THE TRENCH, INCLUDING THE MILLING AND OVERLAYING, MUST BE DONE AFTER COMPLETION OF THE 90-DAY SETTLEMENT PERIOD AS DESCRIBED IN THIS PERMIT. FOR THE LATERAL MAINS/SERVICES, THE PAVEMENT REPAIR WILL REQUIRE MILLING AND OVERLAYING WITH 2” (INCHES) OF SURFACE COURSE A MINIMUM OF 1’ (FOOT) ON EITHER SIDE OF THE TRENCH.

FINAL PAVEMENT REPAIR JOINTS MUST BE SQUARE AND PERPENDICULAR TO THE DIRECTION OF TRAVEL.

The permanent trench repair shall be done as indicated below. Please note that the final trench repair must include a minimum of 7.5" (inches) of Hot Mix Asphalt or match the existing thickness of the Hot Mix Asphalt for the roadway, whichever is larger.

1. 8" (inches) of gravel plus 4" (inches) Dense Graded Crushed Stone (DGCS) over it.
2. 3.5" (inch) Intermediate or Base Course
3. 2.25" (inch) Intermediate Course
4. 1.75" (inch) Surface Course
5. Asphalt emulsion tack coat (RS-1H) must be placed between each course.
6. All vertical edges must be coated with hot poured joint sealer.
7. **All damaged pavement markings shall be restriped in kind.**

All openings in paved surfaces must be backfilled and paved with a temporary patch consisting of 3” (inches) of hot mix asphalt at the end of every workday. Exposed gravel will not be permitted within the SHLO.

Note: Final Restoration is based on the field conditions of the work performed and not the design plans.

All pavement compositions must meet MassDOT's latest Standards and Specifications for Highways and Bridges.

PLEASE BE ADVISED THAT MASSDOT, DISTRICT 5 RESERVES THE RIGHT TO REQUEST ADDITIONAL REPAIR IF THE REPAIR AREA IS FOUND TO BE LARGER THAN ANTICIPATED.

All work is to be done as described herein and as shown on the approved plans as follows:

- “Town of Yarmouth, Massachusetts – Wastewater Collection and Water Resource Recovery Facilities – Phase 1 – Contract No. 6, Project No. CWSRF - 8349/6” as drafted by CDM Smith, 3 Davol Square, Building A, Suite A-425, Providence, Rhode Island tel.: (401) 751-5360, and dated August 2024.

- Traffic Management Plans, Town of Yarmouth, Massachusetts – Wastewater Collection and Water Resource Recovery Facilities – Phase 1 – Contract No. 1, Project No. CWSRF 8349/6, drafted by CDM Smith, 3 Davol Square, Building A, Suite A-425, Providence, RI 02903, tel.: (401) 751-5360, and dated January 2024.

- Special Provisions prepared by CDM Smith and dated May 2024.

THIS PERMIT IS BEING ISSUED FOR WORK WITHIN THE SHLO ONLY. AUTHORIZATION TO PERFORM ASSOCIATED WORK OUTSIDE OF SHLO MUST BE GRANTED BY IMPACTED PROPERTY OWNERS.

The Grantee(s) shall assume all liabilities and expenses associated with all expected changes in design, labor, materials, etc. and for the project in its entirety to bring said project into compliance with the final plans, and the terms and conditions set forth by MassDOT, Highway Division.

MASSDOT, HIGHWAY DIVISION, DISTRICT 5 RESERVES THE RIGHT TO REQUIRE THE TOWN OF YARMOUTH DEPARTMENT OF PUBLIC WORKS TO PERFORM NECESSARY REPAIRS IN THE EVENT THAT ANY OF THE DRAINAGE STRUCTURES/PIPES ARE IMPACTED BY THIS WORK.

This Permit is being granted with the following conditions:

1. Test pits must be performed around any existing utilities and drainage structures to determine the elevation of conflicting utilities/structures.

2. The Grantee(s) must adjust drainage and all other utility structures as part of the final milling and paving of the impacted travel lane(s).

The Grantee(s) will be responsible for future corrective actions resulting from defective work under the subject permit. Any damage to roadway and/or shoulder as a result of the permitted work is the Grantee's responsibility and shall be repaired at his/her expense.

States of Emergencies and Executive Orders

In addition to the conditions and restrictions herein contained, the Grantee is responsible for complying with any relevant Executive Orders or States of Emergencies that may be issued by the Governor's Office while this permit is active. The Governor may declare a State of Emergency in the event or imminent threat of natural or man-made disasters. A State of Emergency can cover a specific municipality, multiple communities, or the entire Commonwealth.

Detailed Information on States of Emergencies and Executive Orders can be found on the Mass.GOV website. *https://www.mass.gov/service-details/state-of-emergency-infomation* and *https://www.mass.gov/massachusettsexecutive-orders*.

Prior to any work being done within the SHLO, the Grantee(s) must upload/submit a Work Request in State Highway Access Permit System (SHAPS) to obtain approval for the proposed work schedule. Said form to be completed/uploaded can be found under the Forms and Sample Submission Documents tab and is entitled "Work Request Form D1 - D5". One (1) of these forms must be uploaded by the close of business every Thursday for the entire duration of the project in order to request approval for the following week's work schedule.

The Grantee(s) must adhere to 520 CMR 14.00: Excavation and Trench Safety as promulgated by the Department of Public Safety in conjunction with the Division of Occupational Safety pursuant to authority granted by M.G.L. c. 82a § 1. If not already approved, a Trench Permit Rider must be completed and uploaded to SHAPS before any trench work is performed under this Permit.

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Prior to the commencement of work, the Grantee(s) shall contact the District 5 Permits Office at (857) 368-5230 to set up an on-site meeting with the Permits Site Inspector to discuss all necessary Preconstruction items. The meeting must be held at least five (5) business days prior to performing work within the SHLO.

The Grantee(s) must submit a soft copy of the "as-built" plans of the project in the AutoCAD Program currently in use by the District. A copy of the "as-built" plans for all abandoned and new piping, including dimensions and elevations for location by MassDOT District 5 Maintenance, must also be submitted/uploaded in SHAPS prior to submitting the Completion of Work Form/Requesting Permit Sign-off.

MASSDOT, HIGHWAY DIVISION RESERVES THE RIGHT TO RECOMMEND ADDITIONAL CONSTRUCTION CONDITIONS, WHICH SHALL DEPEND ON THE PROJECT AND ROADWAY CONDITIONS AND MAY SUPERSEDE THE REQUIREMENTS DESCRIBED IN THE AGREEMENT. THE EXPECTATION THAT THE RIDING SURFACE BE RESTORED IN A SAFE AND RIDABLE CONDITION SHALL CONTINUE AND BE INCLUDED IN MASSDOT'S SIGN-OFF PROCESS. THE GRANTEE SHALL BE RESPONSIBLE FOR FUTURE SETTLEMENTS RESULTING FROM THE PERMITTED WORK UNTIL THE ROADWAY IS RESURFACED OR RECONSTRUCTED.

Request for changes to the terms and conditions described within this Permit must be submitted in writing and approved by MassDOT, Highway Division, by way of an amendment to this Permit or via correspondence to the Grantee(s) prior to the commencement of any proposed changes.

The Grantee(s) may retain the services of a qualified engineering firm to provide for the continuous inspection of the work to be performed under this Permit by a full-time Resident Engineer or a qualified on-site Supervisor. The Grantee(s) shall notify MassDOT, Highway Division in writing as to what consulting firm/Supervisor will be used. Included in this notification, a list of 24-hour emergency contact names and numbers of all pertinent parties responsible for the project, The Resident Engineer/on-site Supervisor must coordinate any design changes and/or problems with the District Highway Director who will assign the proper personnel to expedite these issues.

When the work required under this Permit has been completed, the Grantee(s)/Supervisor shall conduct their own inspection prior to contacting MassDOT, Highway Division to schedule a Final Inspection. Once this pre-inspection is performed, the Grantee(s) will contact the Permits Section at (857) 368-5230 in order for a Final Inspection to be performed by MassDOT, Highway Division.

The Grantee(s) must strictly adhere to the Order of Conditions (MassDEP #083-2442) issued by the Yarmouth Conservation Commission which is considered an integral part of this Permit.

The Grantee(s) shall be responsible for all litter and debris generated from their property during the work as described herein and/or from all prospective residents, visitors or patrons of all existing or proposed facilities mentioned herein. This responsibility shall remain in effect for the entirety of all current or future owners of said property. The Grantee(s) shall perform routine inspections and upkeep within the State Highway Layout. If conditions warrant an individual to enter in or within the proximity of a travelled way, the Grantee(s) shall assume all liability and responsibility for the removal of all litter and debris or the hiring of an appropriate party to perform such duties. Significant work within the travelled way may require a police detail. In consideration of all abutters, the Grantee(s) must take notice to the drifting of debris and the removal thereof. If it is found that this requirement is not fulfilled in a satisfactory manner, MassDOT, Highway Division may decide to clean the area at the Grantee's expense.

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CONTROLLED DENSITY FILL (CDF) WAIVER

At the written request of the Grantee(s) and approval from MassDOT, Highway Division, CDF is NOT required on this project for trenches greater than 48" (inches) in depth. The Grantee(s) shall perform the work for conventional backfill methods as follows:

1. All methods used to determine and verify the proper compaction of backfill shall be in accordance with AASHTO Standard Specifications of Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth) (Designation T238-86 Method B - Direct Transmission shall be used to determine in-place density) and Moisture Content of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth) (Designation T239-91). Backfill material shall be in accordance with MassDOT, Highway Division Standard Specifications, Section 150.64, Subsection C.

All methods and work shall be performed by a technician on location certified in "soils" by the New England Transportation Technician Certification Program (NETTCP). All data and results shall be submitted to the appropriate District Highway Director for its review and acceptance.

Soil compaction needs to be performed every 6” (inches). Nuclear Gauge Density Testing shall be performed every 1' (foot) of depth and at least twice a week. Proctor/Sieve Analysis testing shall be performed once a week per source of material.

2. A **Performance Bond** in the amount of **$14,020,000.00** is required by the Grantee(s) to warranty the work described in this waiver. The Performance Bond must be submitted before any work commences on State Property. The life of the Performance Bond shall continue for three (3) additional years from the date MassDOT, Highway Division signs off on the permit.

The Performance Bond shall be in a form satisfactory to MassDOT, Highway Division, furnished by a surety company incorporated pursuant to M.G.L. chapter 175, section 105 or authorized to do business in the Commonwealth under M.G.L. Chapter 175, section 106 and satisfactory to the awarding authority. The name of the agency or agent writing these bonds shall be identified within the bond.

3. The Completion of Work Form shall be electronically uploaded, via the State Highway Access Permit System (SHAPS), as soon as possible after the completion of the physical work to begin the sign-off process. MassDOT, Highway Division, will hold the Permit on file for a period of not less than three (3) years.

4. The Grantee(s) shall assume full responsibility for the structural integrity of any trench described in this Permit. This responsibility shall remain in place for a period of three (3) years after the completion of work which time starts with MassDOT, Highway Division, receiving the Completion of Work Form.

The Grantee(s) shall immediately respond to trench maintenance requests by the District Highway Director. The Grantee(s) must respond within two (2) working days for non-emergency situations. Non-response within the specified time will result in the required maintenance work being done by MassDOT, Highway Division, with all expenses charged to the Grantee(s).

5. Supplying, positioning, adjusting, and re-positioning of all required signs and traffic warning devices shall be the responsibility of the Grantee(s). All signs and devices shall be in accordance with the current Manual on Uniform Traffic Control Devices. The number and location of all signs and devices shall be as deemed necessary by the District Highway Director for the safe and efficient performance of the work and safety of the travelling public.
Care must be exercised so as not to disturb any existing State Highway Drainage or Traffic Duct/wiring Systems or any underground structures that exist. If said system is disturbed, it shall be restored immediately to its original condition. All expenses for restoring conditions shall be the responsibility of the Grantee(s).

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6. Uniformed Police Officers or Certified Flaggers shall be provided and compensated by the Grantee(s) and shall be in attendance at all times until completion of the physical work.

"WORK WITHIN THE HARDENED SURFACE WITH CDF WAIVER APPROVED"

The pavement shall be saw-cut in neat, true lines along the length of the trench. The trench shall then be excavated, the utility installed, and backfilled. The backfill material shall consist of gravel or other suitable material conforming to MassDOT Specifications throughout, to a compacted depth of 3" (inches) below the existing surface.

The material shall be selected from excavation free from large lumps, clods, or rock placed between the pipe and the walls of the trench in layers not exceeding 6" (inches) in depth and thoroughly compacted. Each layer, if dry, shall be moistened and then compacted by rolling or by tamping with mechanical rammers. Special care shall be taken to thoroughly compact the fill under the haunches of the pipe or conduit. This method of filling and compacting shall be continued until the material is level with the top of the pipe or conduit. The remainder of the filling shall consist of suitable material placed in successive layers not more than 6" (inches) in depth. The top layer shall be thoroughly compacted to within 3" (inches) of the existing surface.

The trench will then be patched temporarily with a minimum of 3" (inches) of Surface Course placed in one (1) layer to the finished grade of the roadway surface. Be advised that a temporary patch with a minimum of 4" (inches) of Surface Course is required on high traffic volume roadways.

In cases where the trench needs to include the repair of the entire travel lane/paved shoulder/curb-to-curb, the Grantee may patch the temporary trench with a minimum of 7.5" (inches) of Hot Mix Asphalt pavement or match existing thickness of this for the roadway, whichever is larger. Pavement composition must meet MassDOT's latest standards. Then after the 90-day settlement period (SOP HMD-75-03-1-000), the Grantee will have to mill 2" (inches) of the existing pavement and overlay the travel lane/paved shoulder/curb-to-curb with two 2" (inches) of Surface Course.

If required, steel plates may be utilized for the safety of overnight motorists. However, steel plates create a slippery surface and should only be used when necessary. The plates may need to be recessed to the finished grade of the roadway as directed by the Engineer. No plates may be left over the weekend. Therefore, the Grantee(s) shall schedule the work accordingly.

Temporary patches shall remain in place for ninety (90) days before being replaced with permanent patch or until in the Engineer's judgment that final compaction and settlement of the trench area has taken place.

The Grantee(s) must then excavate the temporary patching and material to a depth of 7.5" (inches) below the existing surface and replace with the permanent patch which shall consist of 3.5" (inches) of Intermediate or Base Course, 2.25" (inches) of Intermediate Course, and 1.75" (inches) of Surface Course.

All abutting edges of the existing pavement shall be coated with hot poured joint sealer immediately prior to the placement of the permanent patch.

The District Office must be notified two (2) days prior to starting this work, so that an inspector may be assigned. This mix must be machine laid.

All traffic safety lines if disturbed shall be replaced in kind.

All trenches shall be maintained by the Grantee(s) from inception of this project at all times until the resurfacing of this particular portion of highway by MassDOT, Highway Division.

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If it becomes necessary, MassDOT, Highway Division shall assign an inspector on any project and the inspector will be paid for under a reimbursable account by the Grantee(s).

The Grantee(s) shall be responsible for the maintenance and repair of this portion of the roadway and shall perform routine inspections for deficiencies such as settling, heaving, cracks, etc. This responsibility remain in effect until the resurfacing of this particular portion of highway is performed by MassDOT, Highway Division.

THE BACKFILLING METHOD FOR WORK WITHIN THE SHOULDER AREA WILL BE AS FOLLOWS:

Backfill for conduit or pipe shall be selected from excavation free from large lumps, clods or rock placed between the pipe and the walls of the trench in layers not exceeding 6" (inches) in depth and thoroughly compacted. Each layer, if dry, shall be moistened and then compacted by rolling or by tamping with mechanical rammers. Special care should be taken to thoroughly compact the fill under the haunches of the pipe or conduit. This method of filling and compacting shall be continued until the material is level with the top of the pipe or conduit. The remainder of the filling shall consist of suitable material placed in successive layers not more than 6” (inches) in depth. Each layer shall be thoroughly compacted as specified above.

If the work is to be performed within the soft shoulder, the excavation might be performed within the immediate area along the edge of road and may diminish the integrity of the hardened surface. Therefore, if the excavation directly abuts or tapers under the hardened surface of the roadway, the opening must be backfilled with Controlled Density Fill (CDF) to prevent undermining and preserve the roadway.

The Grantee(s) shall be responsible for the shoulder and roadway areas affected by the proposed work to be performed as described herein and shall routinely inspect said areas for deficiencies such as settling, heaving, cracks etc. This responsibility shall remain until work is performed at the subject location by MassDOT, Highway Division.

UTILITY WORK IN DRIVE

Whereas the proposed work is to be performed within the apron of an existing drive, the Grantee(s) shall restore the drive with an 8” (inch) gravel base that has been machine compacted then paved with 4" (inches) of hot mix asphalt laid in two (2) courses consisting of a 2-1/2" (inch) intermediate course and a 1-1/2" (inch) surface course. Any hot mix asphalt berm or granite edging that exists in the driveway area must be sawcut and removed. The new pavement must butt into and not overlap the edge of the hardened surface of the roadway.

All abutting edges of the existing pavement shall be coated with hot poured joint sealer immediately prior to the placement of the permanent bituminous concrete.

The Grantee(s) shall be responsible for this portion of the drive and shall routinely inspect it for deficiencies such as settling, heaving, cracks etc. Such deficiencies shall be corrected at the cost of the Grantee(s) and to the satisfaction of the Engineer.

SIDEWALK RECONSTRUCTION

The sidewalk shall match the existing conditions and shall be reconstructed with 4" (inches) dense graded crushed stone with a 3" (inch) hot mix asphalt top course laid in two (2) lifts of 1.75" (inches) and 1.25" (inches), respectively, or 4" (inches) of cement concrete. If the cement concrete sidewalk crosses a driveway, the driveway apron shall be constructed with 6" (inches) cement concrete.

The reconstructed sidewalk must be compacted and graded in such a manner that no ponding of water occurs within the Highway Layout. If such ponding results, the Grantee(s) shall be responsible for its correction.

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Sidewalks and concrete wheelchair ramps shall be in conformance with the Architectural Access Board (AAB) Regulations within all sidewalk areas located at drives or roadway intersections that may be included in this project.

The Grantee(s) shall be responsible for the maintenance and repair of the portion of the proposed sidewalk located within the State Highway Layout and shall routinely inspect the sidewalk for deficiencies such as settling, heaving, cracks etc. This responsibility shall remain in effect until MassDOT, Highway Division or the Town reconstructs the sidewalk.

Upon completion of the work, the Grantee or Agent must upload into SHAPS, a letter from the local building inspector or governing authority, indicating the installed ramps and sidewalks are in conformance with AAB and ADA regulations.

PAVEMENT MILLING AND OVERLAY

This work will be performed as indicated on the approved plans. **All pavement must meet the latest MassDOT Superpave specifications. Pavement Mix design specifications to be discussed/approved by MassDOT prior to being utilized.**

No milling shall take place sooner than seventy-two (72) hours prior to the scheduled final paving operations. The Grantee/Resident shall ensure that the Permits Office is notified of this scheduled work at least five (5) days prior to the commencement of all milling.

All raised structures located within the roadway must be ramped with hot mix asphalt immediately after milling operations.

The Grantee/Resident/Contractor shall make every effort to protect the structural integrity of all edging and structures and prevent all cold planning material from entering the State Highway's drainage structures and inspect all structures and grates for damage and clogging.

All proposed work must transition to match the existing roadway conditions.

All proposed pavement markings must match existing conditions.

If existing pavement markings are so disturbed during construction or altered according to the Traffic Management Plan, the Grantee(s) shall restore said markings in conformance to MassDOT, Highway Division Standards and as per the final Traffic Markings Plan.

Before scheduling this work, the Grantee must provide the following information to the Permits Section:

I) Schedule of paving work with proposed work hours for review by the District.

II) The Town, Fire, and Police Department must be notified about this work

III) Information of the Qualified Contractor that will perform paving and the Plant that will be providing the mix.

IV) Specifications of the Superpave Mix and quantification (Tons) that will be used for the project.

V) Traffic Management Plan to be used during the milling/paving work.

VI) Advance notification should be provided to residents and businesses that may be affected by the work.

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TIME RESTRICTIONS AND NOTIFICATIONS

DUE TO HEAVY SUMMER TRAFFIC, NO WORK SHALL BE PERFORMED ON THIS PROJECT BETWEEN MEMORIAL DAY WEEKEND AND LABOR DAY WEEKEND WITHOUT PRIOR APPROVAL FROM THE DISTRICT HIGHWAY DIRECTOR.

Special attention shall be given when performing work that will impact MassDOT, Highway Division, snow and ice operations.

No work shall be performed in the hardened surface of the roadway between November 15th and April 1st of any year without prior written approval from the District Highway Director.

No pavement shall be laid between November 15th and April 1st of any year without prior written approval from the District Highway Director.

No work shall be performed on this project on Saturdays, Sundays, and Holidays, or on the Friday after a Thursday Holiday. Work is also restricted on the day before and the day after a long Holiday weekend without prior written approval by the District Highway Director.

No equipment, trucks, etc., shall occupy any part of the travelled way except between the hours of **9:00 a.m. and 3:00 p.m., Monday - Friday**. In no case will operations exceed the specified hours. This includes the placement of traffic control devices, equipment, or anything that restricts the flow of traffic through the construction zone. Any change in work hours will require prior written approval by the District Highway Director. The 12-minute rule will remain in effect for the duration of the permit.

All other work, off the pavement on this project is restricted to a normal 8-hour day, Monday - Friday, with the prime Contractor and all subcontractors working on the same shift. Any change in work hours will require prior written approval by the District Highway Director.

GENERAL TRAFFIC MANAGEMENT AND SAFETY REQUIREMENTS

If required by MassDOT, Highway Division District 5, variable message boards (VMBs) shall be utilized as part of the approved traffic management plan under this Permit which must be properly secured with regards to hacking and unauthorized tampering prevention. The Grantee(s) shall adhere to all appropriate security specifications and take all necessary precautions to mitigate the risk of the boards being hacked. All VMBs shall be stored in a secure area and shall have a lockable, weatherproof enclosure for the operator interface, removable local keyboards which shall be removed whenever possible, and a password protected controller with local administrative passwords changed on a regular basis.

When any portion of the roadway will be blocked with equipment to facilitate the proposed work, the Grantee(s) will be required to adhere to the approved Traffic Management Plan (TMP) for this permit. If the approved TMP is not appropriate or require changes, then the Grantee will submit the requested changes to MassDOT- Highway, to be reviewed and approved by the District prior to working within or impacting the roadway. TMP’s must include information relating to proper signing, traffic control device placement and police details.

It is imperative to maintain two-way traffic at all times and these operations are managed so that motorists travel "delay" is minimized. At any time during the operation when a traffic delay of over twelve (12) minutes occurs and the situation is worsening, the Resident Engineer, Contractor, or Police Detail will begin to suspend operations. Continuously increasing "delays" of over twelve (12) minutes are not to be permitted.

If traffic must be "stopped", the duration shall not be more than five (5) minutes.

Uniformed State/Local Police Officer(s) and their official vehicle(s) may be necessary to provide protection for those installing and removing all temporary traffic warning signs and devices and to perform all traffic management as required.

The Grantee(s) will monitor the flow of traffic during peak traffic volumes and if necessary, shall suspend all operations. Work will resume at the discretion of the Police detail officer and/or to the satisfaction of the supervising MassDOT, Highway Division, Engineer.

In the event of inclement weather or dense fog, which lessens the visibility of advance warning signs, vehicles and workers, the Grantee(s) will suspend all operations so as not to interfere with the safety of the motoring public and the operations of work. In the event of snow or icing conditions, all vehicles and equipment must be removed from the roadway and/or shoulder area so as not to interfere with Snow and Ice Operations.

The Grantee(s) shall provide safe and ready means of access and egress to all public and private roads and drives 24 hours per day. Every effort must be made as not to interfere with or inconvenience all abutters throughout the duration of this project.

Signs and traffic control devices are required for advance notice of the work and within the work area.

The Grantee(s) or Applicant will supply all required signs and traffic warning devices and shall be in accordance with the Massachusetts Manual on Uniform Traffic Control Devices. The number and location of all signs and devices shall be as deemed necessary by the Engineer for the safe and efficient performance of the work and the safety of the travelling public.

All warning devices shall be subject to removal, replacement, and/or repositioning by the applicant as often as deemed necessary by the Engineer.

Cones or non-reflectorized warning devices shall not be left in operating position on the highway when the daytime operations have ceased. If it becomes necessary for MassDOT, Highway Division, to remove the construction warning devices or their appurtenances from the project due to negligence by the applicant, all costs for this work will be charged to the Grantee(s).

All vehicles, except passenger cars, which are assigned to the permitted project, and which operate on the site at speeds of 25 MPH or less, shall have an official SLOW-MOVING VEHICLE emblem displayed. All vehicles and equipment on this project must be equipped with back-up alarms.

All personnel who are working on the travelled way or breakdown lanes shall wear approved safety vests and hard hats.

GENERAL CONDITIONS AND APPROVED PROCEDURES

The Grantee(s) must contact the "Dig Safe" Center at 811 to obtain a "Dig Safe" number prior to starting the proposed excavation for the purpose of identifying the location of underground utilities.

Unless otherwise stated, no hardened surface of the State Highway may be disturbed.

When an opening in the roadway is required and permitted herein, the opening must be as small as possible to perform the proposed work.

If the integrity of any existing sidewalks, catch basins, manholes or any other underground structures or equipment is compromised, the Grantee(s) will reconstruct and/or replace all items according to MassDOT, Highway Division, Standards at the cost of the Grantee(s) and to the satisfaction of the Engineer.

The Grantee(s) must not disturb or remove any MassDOT, Highway Division, bound(s) (MHB) associated with this project. If so disturbed or missing, the bound(s) must be reset/replaced by a Registered Land Surveyor. All procedures and materials must be in compliance with Massachusetts Design and Construction Standards. A copy of the paid bill must be submitted to this office upon completion of said work.

All traffic safety lines if disturbed shall be replaced in kind.

All disturbed areas within the SHLO must be graded, loamed, and seeded to the Engineer's satisfaction.

All debris and litter remaining from the proposed construction shall be removed by the Grantee(s) and the area left clean daily.

DRAINAGE IMPACTS

Note that existing drainage lines are not located/marked out by Dig-Safe, therefore, care should be taken during excavation operations to ensure that drainage components located within the limit(s) of work are not impacted during work to be performed under this Permit. The Grantee(s) may send a request for drainage plans in anticipation of the work to the Highway Maintenance Section. Requests should be sent a minimum of five (5) business days ahead of the proposed work. Be advised that if additional information is needed, the Grantee(s) will be required to perform survey work of the drainage structures to identify the location of the drainage components.

If the work under this Permit includes the installation or relocation of drainage structures or work alters the existing State drainage system, the Grantee(s) shall be responsible for cleaning the drainage system, including any other structure/drainage line/outfall within the project limits to ensure the drainage system works adequately.

The Grantee(s) shall be responsible for any damage that occurs to said drainage components as a result of the work. Should any damage(s) occur, the Grantee(s) must immediately contact the Highway Maintenance Section at (857) 368-5240.

DRAINAGE AND UTILITY CASTINGS

“The use of risers to adjust drainage and utility structures will not be allowed. All adjustment work done to existing or new drainage structures shall conform to Section 220 of MassDOT, Highway Division, Standard Specifications and according to Plates 201.3.0 and 2029.0 o MassDOT, Highway Division, Construction Standards.”

ENVIRONMENTAL LIABILITY AND COMPLIANCE

The Grantee(s) assumes all risk associated with any environmental condition within the subject property and shall be solely responsible for all costs associated with evaluating, assessing, and remediating, in accordance with all applicable laws, any environmental contamination (1) discovered during Grantee's work or activities under this Permit to the extent such evaluation, assessment or remediation is required for Grantee's work, or (2) resulting from the Grantee's work or activities under this Permit. The Grantee(s) shall notify MassDOT, Highway Division, of any such assessment and remediation activities.

The Grantee(s) is hereby held solely responsible for obtaining and maintaining any and all environmental compliance permits required by local, state, and federal laws and regulations when regular or emergency work is proposed within, or in close proximity to, any wetland area. These environmental compliance requirements include, but are not limited to, a Negative Determination of Applicability or Order of Conditions from the local Conservation Commission, a Water Quality Certificate from the Department of Environmental Protection, and a Programmatic General Permit from the U.S. Army Corps of Engineers. The Grantee(s) shall forward to MassDOT, Highway Division, a copy of each such environmental compliance permit.

CLOSING CONDITIONS

ALL OF SAID WORK SHALL COMPLY WITH THE TERMS AND CONDITIONS HEREIN, AND MUST BE DONE AS DIRECTED BY AND TO THE SATISFACTION OF THE ENGINEER.

All work done under this contract shall be in conformance with the Massachusetts Highway Department "Standard Specifications for Highways and Bridges" 2024 Edition and any subsequent "Supplemental Specifications". All construction shall conform to the June 2017 edition of the Massachusetts Department of Transportation, Highway Division "Construction Standard Details (English Edition)"; the latest Manual on Uniform Traffic Control Devices with Massachusetts Amendments; the latest edition to the following: the 1996 Construction and Traffic Standard Details (as related to Traffic Standard details only); the 1990 Standard Drawings for Traffic Signs and Supports; the 1968 Standard Drawings for Traffic Signals and Highway Lighting; the latest edition of American Standard for Nursery Stock; the Plans and these Special Provisions. These publications can be accessed from the SHAPS dashboard of from the following link: *https://www.mass.gov/lists/miscellaneous-publications*.

The Grantee(s) shall indemnify and save harmless the Commonwealth and MassDOT, Highway Division, against all suits, claims or liability of every name and nature arising at the time out of or in consequence of the acts of the Grantee(s) in the performance of the work covered by this Permit and/or failure to comply with the terms and conditions of this Permit whether by themselves or their employees or subcontractors.

It is noted that the Grantee(s) will be responsible for future corrective actions resulting from defective work under the subject permit. Any damage to the roadway and/or shoulder as a result of the permitted work is the Grantee's responsibility and shall be repaired at his/her expense.

THE GRANTEE(S) SHALL SUBMIT A COMPLETION OF WORK FORM, BY REQUESTING A SIGN–OFF USING THE ACTION LINK IN THE SHAPS DASHBOARD, WHEN THE WORK REQUIRED UNDER THIS PERMIT HAS BEEN COMPLETED IN ORDER FOR A FINAL INSPECTION TO BE PERFORMED BY MASSDOT, HIGHWAY DIVISION. THE LIABILITY ASSUMED UNDER THIS PERMIT WILL CONTINUE UNTIL THE WORK HAS BEEN SIGNED OFF AS COMPLETE.

A COPY OF THIS PERMIT MUST BE ON THE JOB SITE AT ALL TIMES FOR INSPECTION. FAILURE TO HAVE THIS PERMIT AVAILABLE AT THE SITE WILL RESULT IN SUSPENSION OF THE RIGHTS GRANTED BY THE PERMIT.

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"FOLLOWING CONDITIONS APPLY TO PERMITS"
Conditions Relating Particularly to Permits for the Laying of Pipes, Conduits, etc.

After any pipes, conduits, drains or other underground structures are laid, or any excavation is made in the roadway, the trenches or openings shall be properly backfilled with suitable material, the backfilling shall be thoroughly tamped, and the surface of the road over said structures shall be left even with the adjoining ground. If the work is done in cold weather no frozen material shall be used for backfilling.

Wherever the hardened surface of the roadway, gutters, or any part of the surface of the highway is disturbed it shall be replaced in as good condition as before it was disturbed, and if new materials are required, they shall correspond with those already in place on the road.

Where service pipes are to cross the highway, the connections shall be made without disturbing the hardened surface of the roadway, by driving the pipes under the roadway, or the service pipes shall be carried under and across the road in a larger pipe, unless otherwise ordered by the Director.

The Grantee shall maintain the surface of the roadway over said structures as long as MassDOT may deem necessary, until all signs of the trenches shall have been eliminated.

Conditions Relating Particularly to Permits for the Erection of Poles, Wires, and Overhead Structures, and the Cutting and Trimming of Trees

In the erection of pole lines, unless otherwise herein provided, no trees located within the limits of the State Highway shall be cut or trimmed. No guy wires shall be attached to trees without a special permit from MassDOT, and in no event shall they be so attached as to girdle the trees or in any way interfere with their growth. The wires shall be so protected at all time and places that they shall not interfere with or injure the trees either inside or outside the location of the highway.

Where the cutting or trimming of trees is authorized by this permit, only such cutting and trimming shall be done as may be designated by the Director.

In the construction or reconstruction of pole lines no guy wires shall be erected nearer to the surface of the ground than 6’ (feet); provided, however, that the owners of such lines may maintain such guy wires at a lower elevation than 6’ (feet) from the ground until such time as MassDOT shall notify them to remove said wires or to the elevation first stated.

In order to protect the trees through which any wires may pass, said wires shall be insulated and such other tree guards used as may be directed by the Director.

Where high tension wires are erected under this permit, they shall be so located that, under conditions of maximum severity as regards a coating of ice or snow, there shall be a space of at least 8’ (feet) between such high-tension wires and other wires.

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Tel: (857) 368-5000, FAX: (508) 880-6102
www.mass.gov/orgs/highway-division

The Grantee shall, within sixty (60) days from the date of completion of the work, file in the office of MassDOT a plan showing the location of each pole erected in accordance with the permit, said plan to be of such size and in such form as MassDOT may direct.

General and Additional Conditions

Whenever the word "MassDOT" is used herein it shall mean the Massachusetts Department of Transportation of the Commonwealth of Massachusetts.

Whenever the word "Director" is used herein it shall mean the District Highway Director or other authorized representative of MassDOT.

Whenever the word "Grantee" is used herein it shall mean the person or persons, corporation, or municipality to whom this permit is granted, or their legal representatives.

During the progress of the work all structures underground and above ground shall be properly protected from damage or injury; such barriers shall be erected and maintained as may be necessary for the protection of the traveling public; the same shall be properly lit at night; and the Grantee shall be responsible for the damages to persons or property due to or resulting from any work done under this permit.

Except as herein authorized, no excavation shall be made, or obstacle placed within the limits of the State highways in such a manner as to interfere unnecessarily with the travel over said road.

If any grading of sidewalk work done under this permit interferes with the drainage of the State highway in any way, such catch basins and outlets shall be constructed as may be necessary, in the opinion of the Director, to take proper care of such drainage.

Wherever the hardened surface of the roadway is disturbed, and the Director may consider it necessary or advisable to do so, said surface will be restored by the employees of MassDOT, at such time as MassDOT may direct, and the expense thereof shall be borne by the Grantee, who shall purchase and deliver on the road the materials necessary for said work if and when directed by the Director. All payments to the supplier and to laborers, inspectors, etc., employed by MassDOT for or on account of the work herein contemplated shall be made by said Grantee forthwith on receipt of written orders, pay rolls, or vouchers approved by MassDOT.

IF THE GRANTEE DOES ANY WORK CONTRARY TO THE ORDERS OF THE DIRECTOR, AND, AFTER DUE NOTICE, FAILS TO CORRECT SUCH WORK OR TO REMOVE STRUCTURES OR MATERIALS ORDERED TO BE REMOVED, OR FAILS TO COMPLETE WITHIN THE SPECIFIED TIME THE WORK AUTHORIZED BY THIS PERMIT, MASSDOT MAY, WITH OR WITHOUT NOTICE, CORRECT OR COMPLETE SUCH WORK IN WHOLE OR IN PART, OR REMOVE SUCH STRUCTURES OR MATERIALS, AND THE GRANTEE SHALL REIMBURSE MASSDOT FOR ANY EXPENSE INCURRED IN CORRECTING AND/OR COMPLETING THE WORK OR REMOVING THE STRUCTURES OR MATERIALS.

District 5, 1000 County Street Taunton, MA 02780
Tel: (857) 368-5000, FAX: (508) 880-6102
www.mass.gov/orgs/highway-division

ALL OF THE WORK HEREIN CONTEMPLATED SHALL BE DONE UNDER THE SUPERVISION AND TO THE SATISFACTION OF THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION, AND THE ENTIRE EXPENSE THEREOF SHALL BE BORNE BY THE GRANTEE.

On the completion of the work herein contemplated all rubbish and debris shall be removed, and the roadway and roadsides shall be left neat and presentable and satisfactory to the Director.

MassDOT hereby reserves the right to order the change of location or the removal of any structure or structures authorized by this permit at any time, said change or removal to be made by and at the expense of the Grantee or its / their successors or assigns.

This permit may be modified or revoked at any time by MassDOT without rendering said MassDOT or the Commonwealth of Massachusetts liable in any way.

The Grantee shall pay the salary, subsistence and travel expenses of any inspector appointed by MassDOT to supervise the work herein contemplated.

All of the above conditions shall be applicable to the work herein authorized, unless the same are inconsistent with the conditions on the face of the permit, in which case the conditions written or printed on the face of the permit shall apply.

The acceptance of this permit or the doing of any work thereunder shall constitute an agreement by the Grantee to comply with all of the conditions and restrictions printed or written herein.

Maura Healey, Governor
Kimberley Driscoll, Lieutenant Governor
Monica Tibbits-Nutt, Secretary & CEO
Jonathan L. Gulliver, Highway Administrator

massDOT
Massachusetts Department of Transportation
Highway Division

5-2024-0531

Approved Signature

Mary-Joe Perry by D.V.
District Highway Director

Date of Issue: November 22, 2024

Permit Expiration: Saturday, November 22, 2025

District 5, 1000 County Street Taunton, MA 02780
Tel: (857) 368-5000, FAX: (508) 880-6102
www.mass.gov/orgs/highway-division

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Appendix C

Yarmouth Contract 6 Water Service Tie Cards

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3001-30 PRO

Donald A. Dumont
3001-30 12/10/82

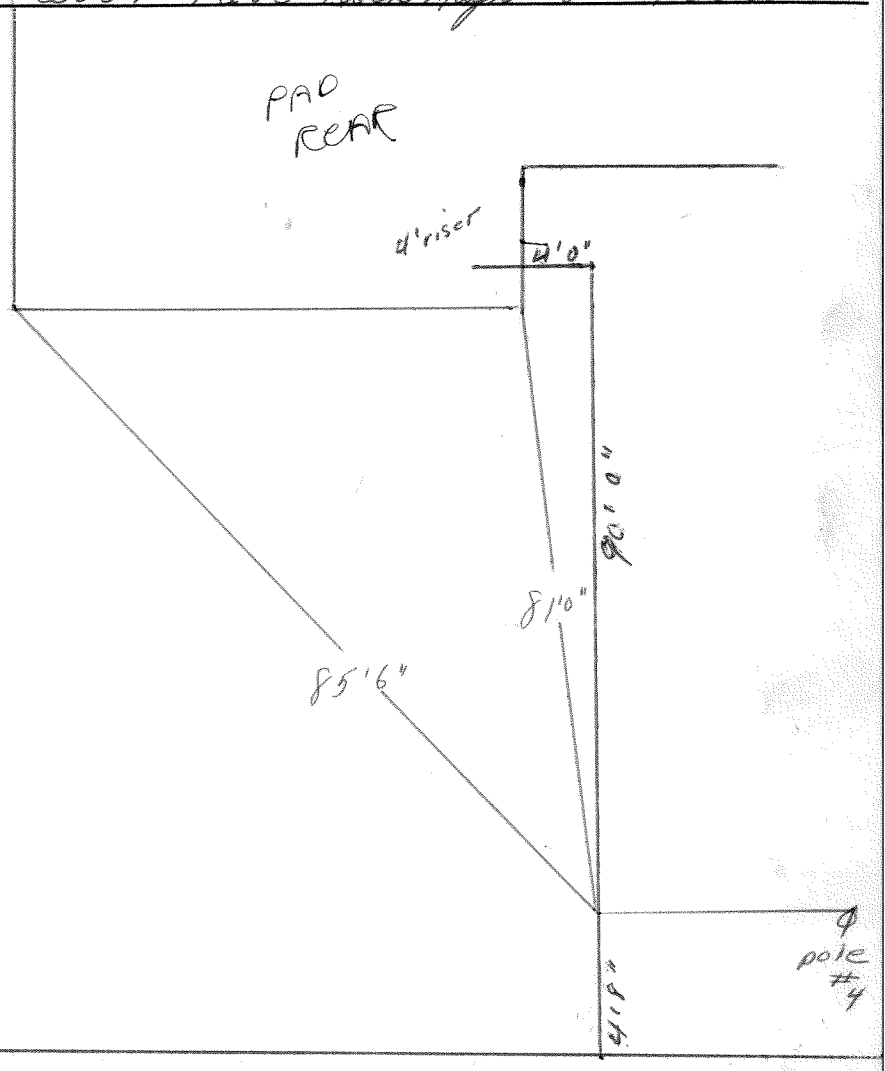
NAME

STREET 188 Route 28

VILLAGE West Yarmouth

SERVICE NO. 3001-30 R-37

METER NO. 44739026 5/8 12-9-98
~~2057 7283 Rock Mayn 5/8" 7-28-69~~



Marigold Road W.Y.

1969

3002-30

PRO

NAME [redacted] — Manuel Rodrigues

3002
Acilde Cruz
4-5-00

STREET 368 Main

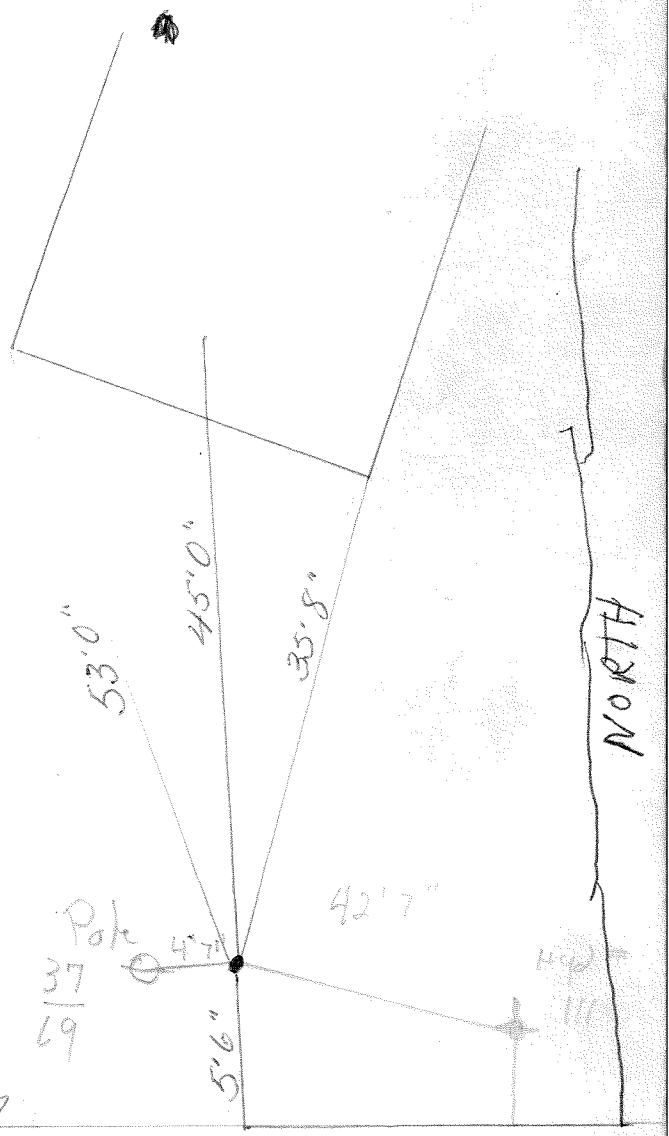
VILLAGE West Yarmouth

SERVICE NO. 3002-30

4473-9190 5/8 12-11-98

METER NO. ~~9520776~~ Meter # ~~20276503~~ 5/8 SR

Remote # ~~952257~~



ROUTE 28 WEST YARMOUTH

3004-30

PRO

3004 1/16/02
1750 Realty Trust
281 Route 28

NAME ~~ELE~~ E

281

STREET ~~MAIN~~ ST. 1750 HOUSE

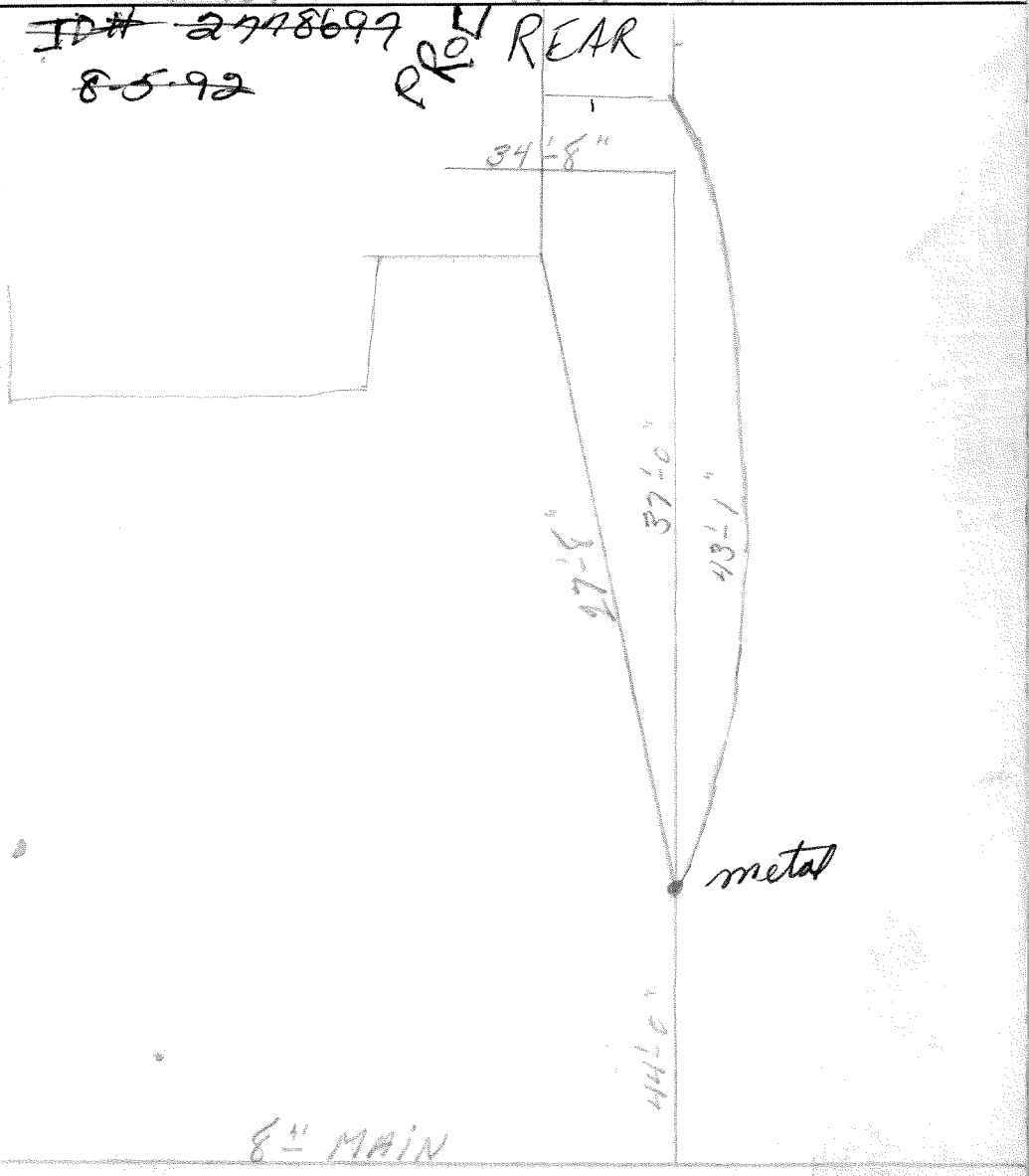
VILLAGE WEST YARMOUTH

SERVICE NO. 3004 - 30
~~1891234~~ ~~ROCK-HILL~~ 4620891 5/8" 12-2-99

METER NO. ~~3045~~ 4-17-65 ROW #21

~~ID# 2778697~~
~~8-5-92~~

PRO REAR



TRO

SERVICE NO. 3005

NAME Michael Weber

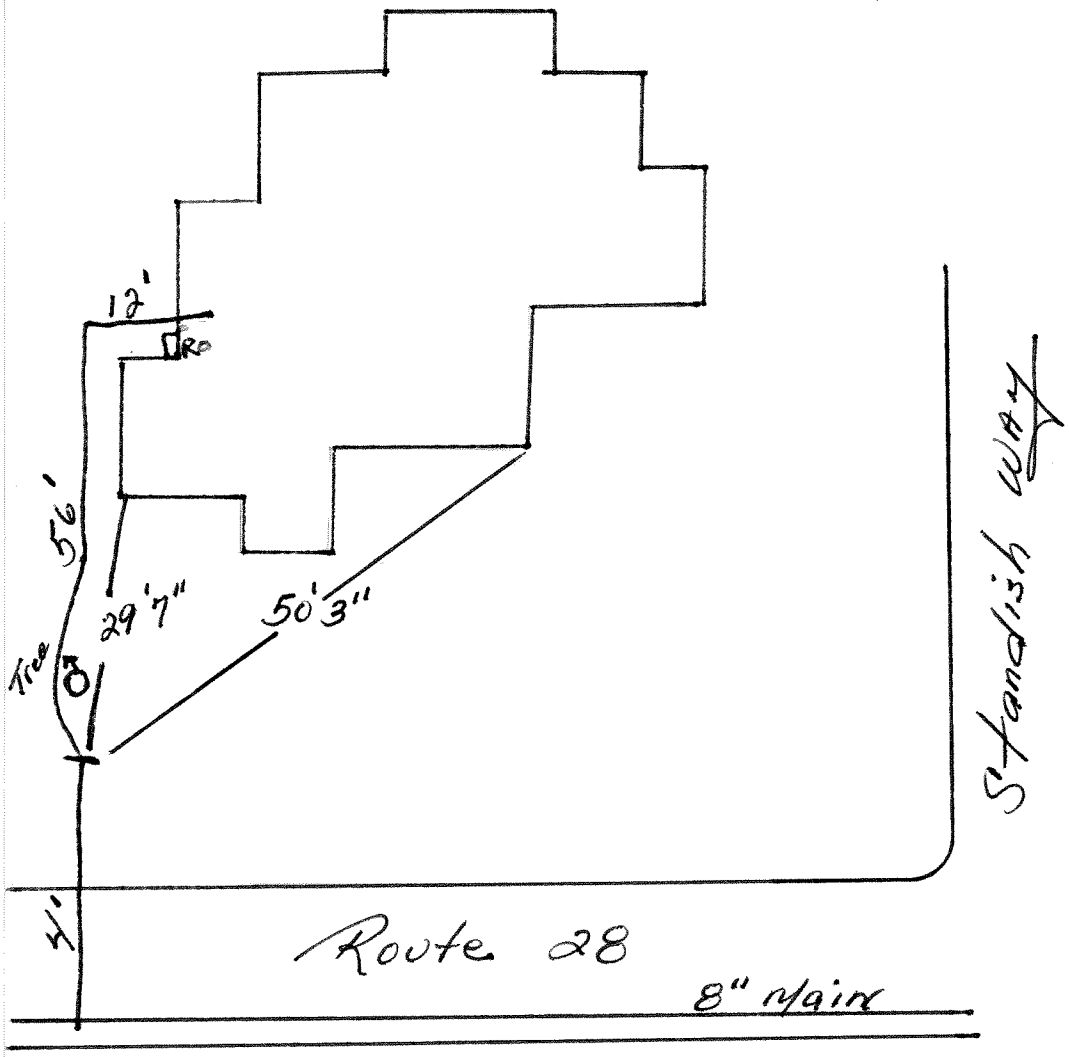
STREET 303 Route 28

VILLAGE West Yarmouth

~~A738719 5/8~~ 11-18-98

METER NO. ~~2126 9470~~ ex 5/8

~~R#~~ 50418 New Tyes 8-11-92



3006-30

PRO

3006-33

NAME Richard K Cannon

342

STREET Main

VILLAGE West Yarmouth

4473-9102 S/E

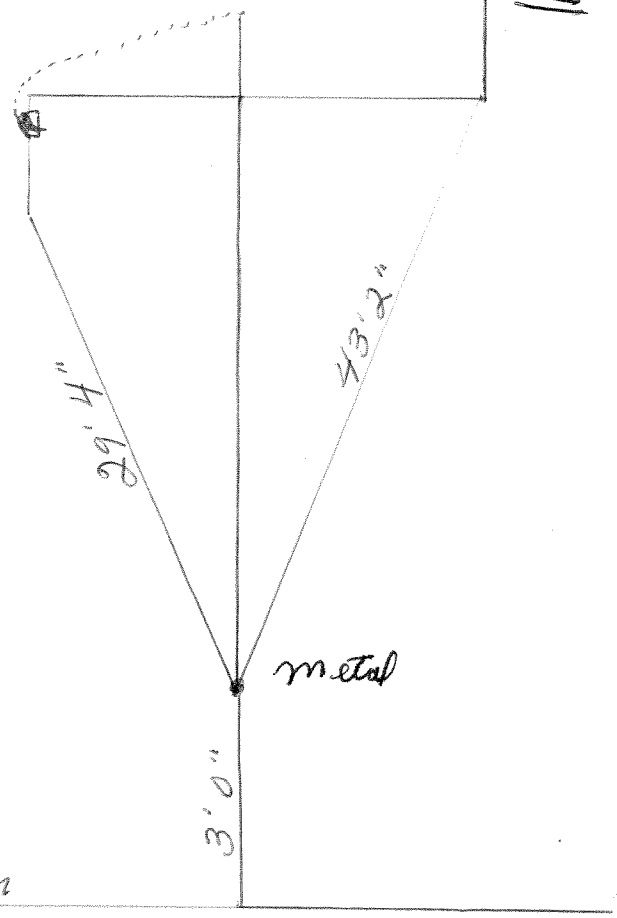
SERVICE NO. 3006-30 12-17-98

~~1908344~~ ~~7340658~~ ROCK MAG 8-15-65

METER NO. ~~REMOTE READER~~ #5555551 2-19-70

(left side of right front door)

PRO



3008-30 Salty's

PRO

NAME Antonio C. Pinto, Jr. 3008-30 10/3/79

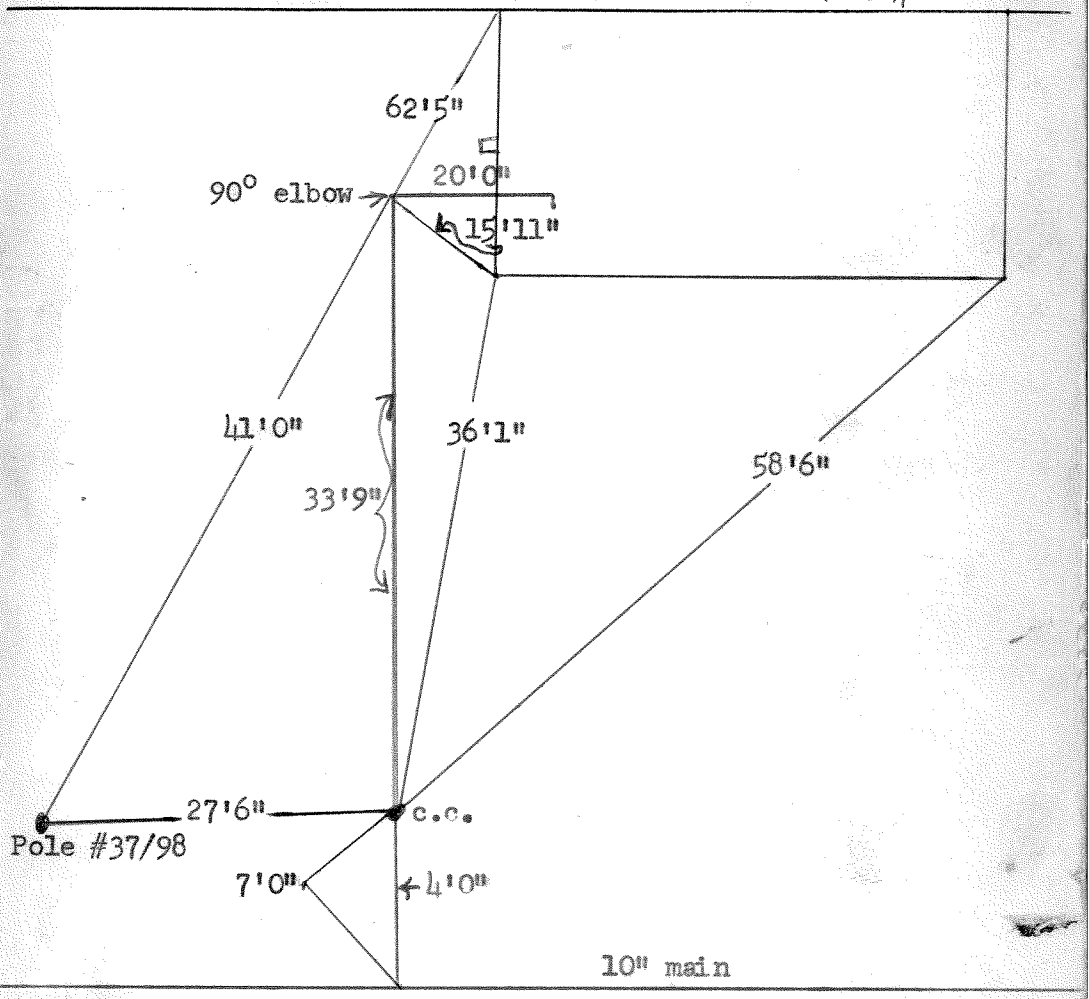
STREET 540 Main Street (Rt. 28) Lot #

VILLAGE West Yarmouth

SERVICE NO. 3008-30 Row 3 Key O.K.

4640736Q 11-5-99 5/8" PRO

METER NO. ~~20125772~~ 5/8" ~~rock magnetic~~ Pad front



Main Street (Route 28)

3017-30

PRO

SERVICE NO.

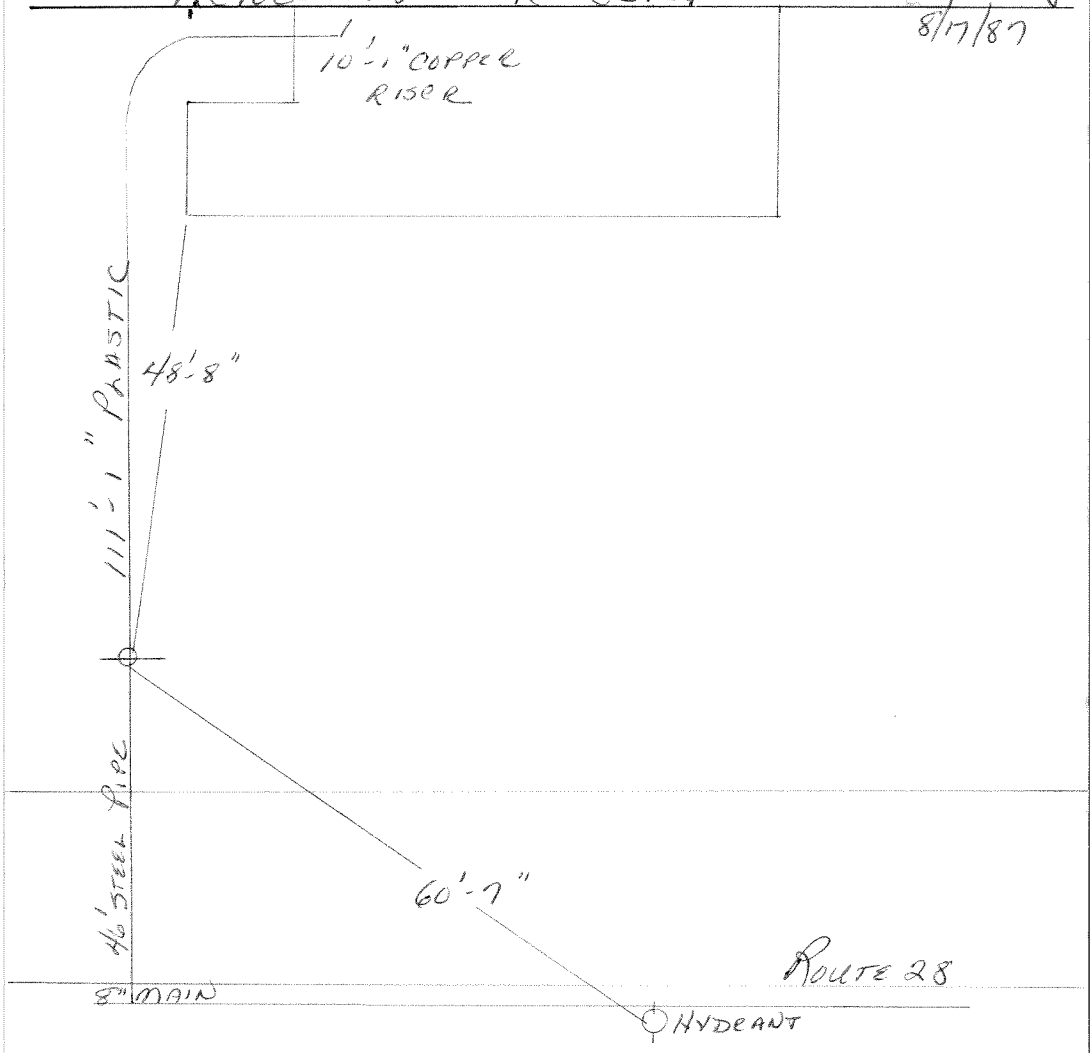
NAME ~~CDL~~ 3017 2/27/02 Chas White Managemen 251 Route 28 (FRUITLAND)

STREET 251 ROUTE 28 ~~BREWSTER~~ CLOVER FARMS

VILLAGE WEST YARMOUTH

METER NO. ~~2002 9629 RM~~ 44738943 5/8" PRO 12-1998 ~~2/14/88~~

Relocation ~~# 50484~~ Left side of bldg. 8/17/87



3085-38

PRO

SERVICE NO.

3085-47
Terri Noyes
8/92

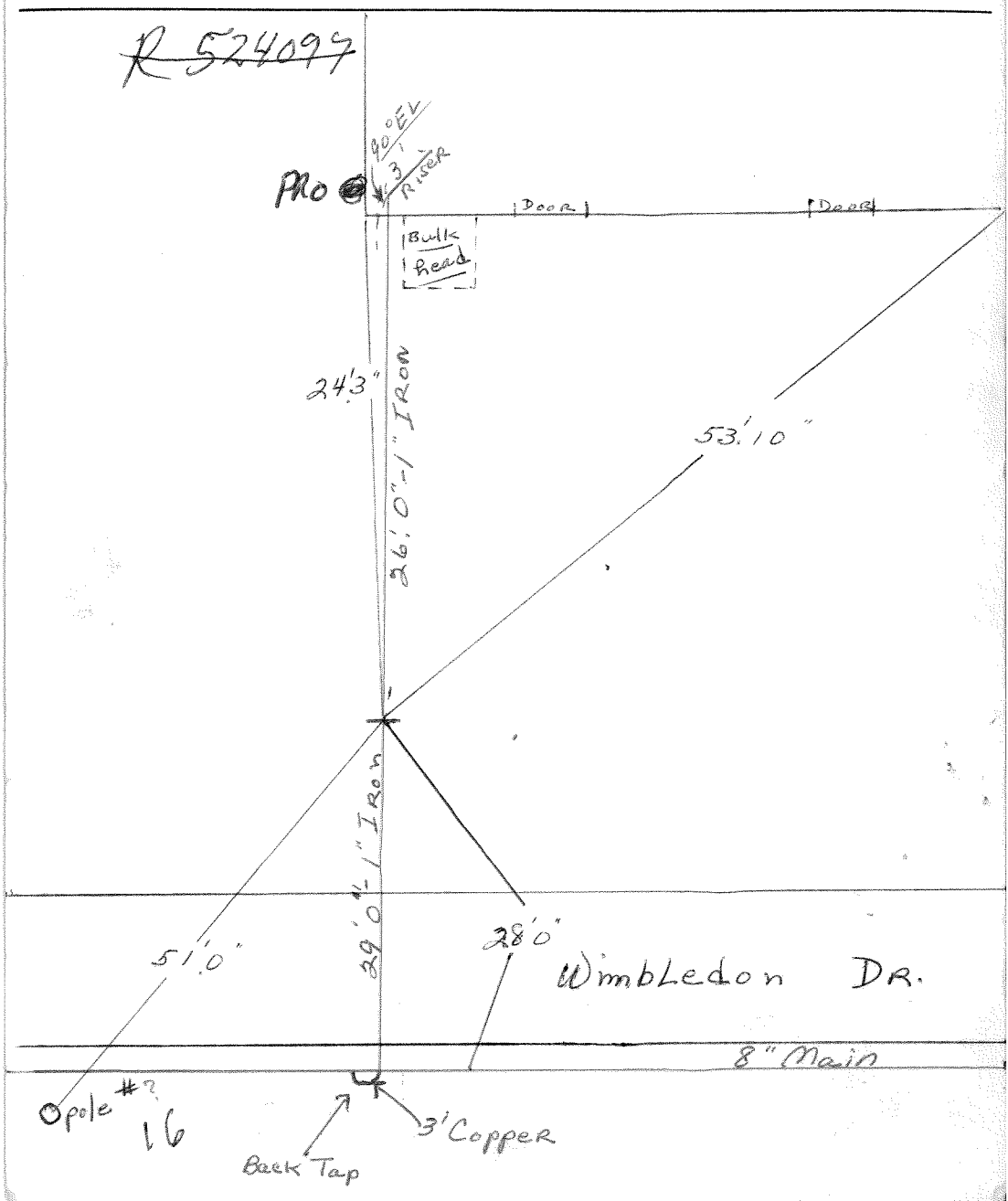
NAME

STREET Wimbledon & 371 Rte. 28 — 1+3 WIMBLEDON DR Lot S25

VILLAGE W. Yarmouth

METER NO. ~~5324044 Recente~~ ~~2324 95444 R.M. 5/8~~ ~~5-30-94~~
44584286 5/8" PRO 6-30-98

~~R 524094~~



SERVICE NO. 3118-30 11 114 28

3118 3/7/03
216 ROUTE 28
THUNDERBIRD MOTEL

NAME

STREET ~~216~~ 226 Main St., lot# 5, 20 units

VILLAGE West Yarmouth

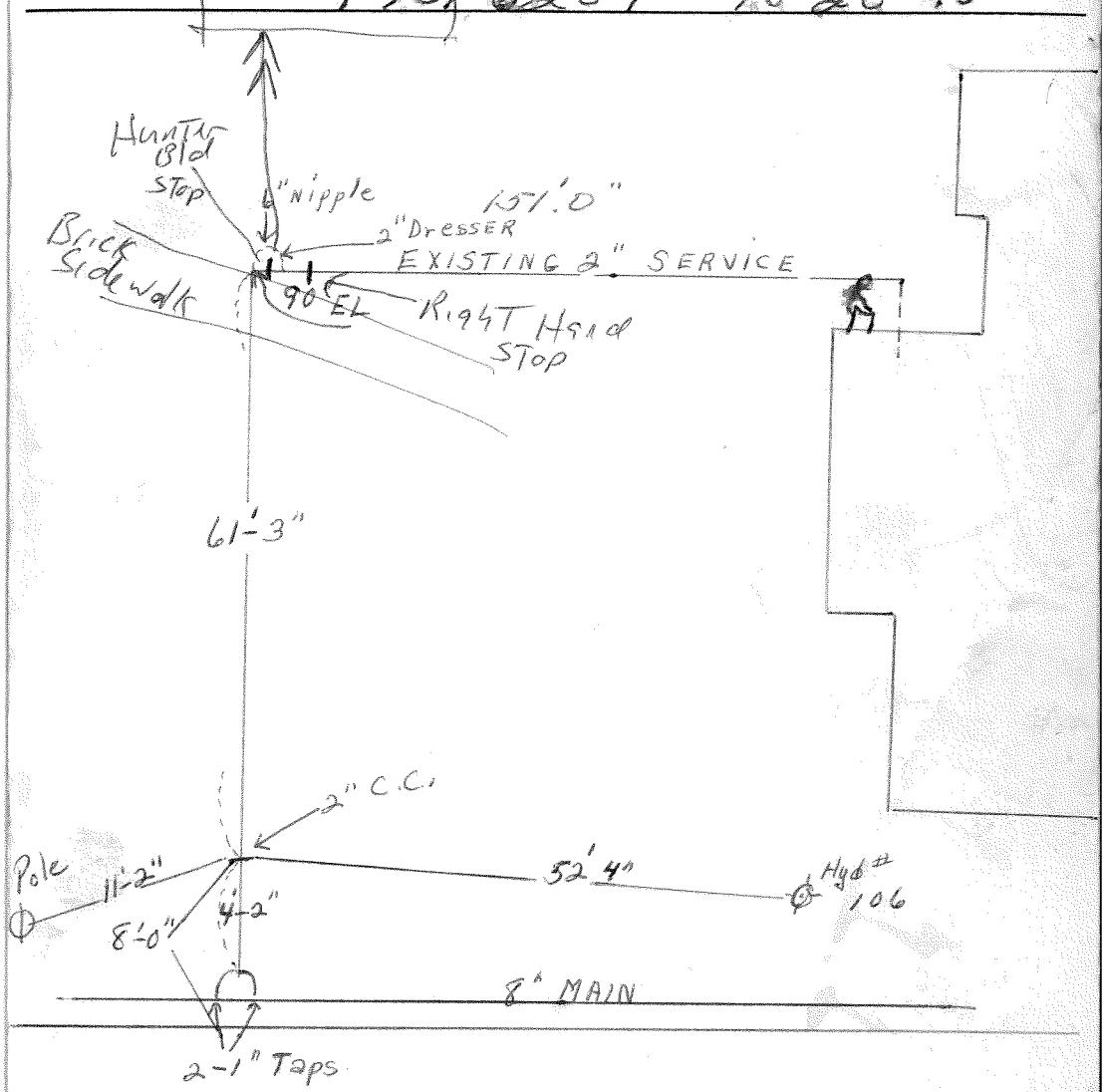
METER NO. ~~7322178 1~~ 1" -

ARB

NOTE: This Service- Also Has Fire Sprinkler House + 20 Line" units on right.

4-27-77 SR Row #13

470-6207 10-20 95



ROUTE 28

3139-30

SERVICE NO.

PRO

New Line Re-Located

NAME Roger H. Lucier
3139-30-(1520)
11-1-84

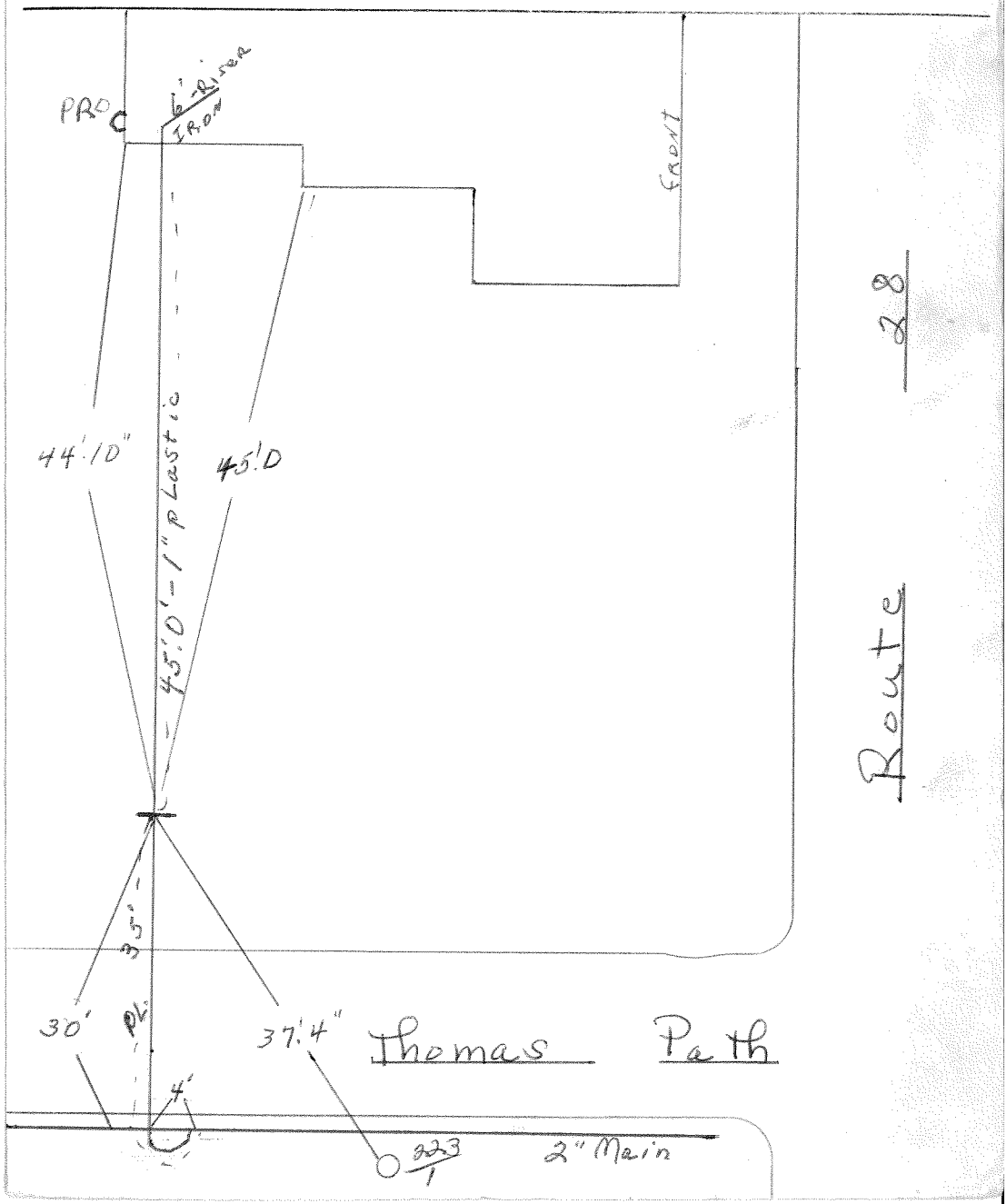
STREET 403 Main Street - Lot T-9

VILLAGE West Yarmouth

ROW 48

45132871 5/8" 1-20-77

METER NO. ~~2023 2654~~ - R-872738-7-29-77



SERVICE NO. 3168-30

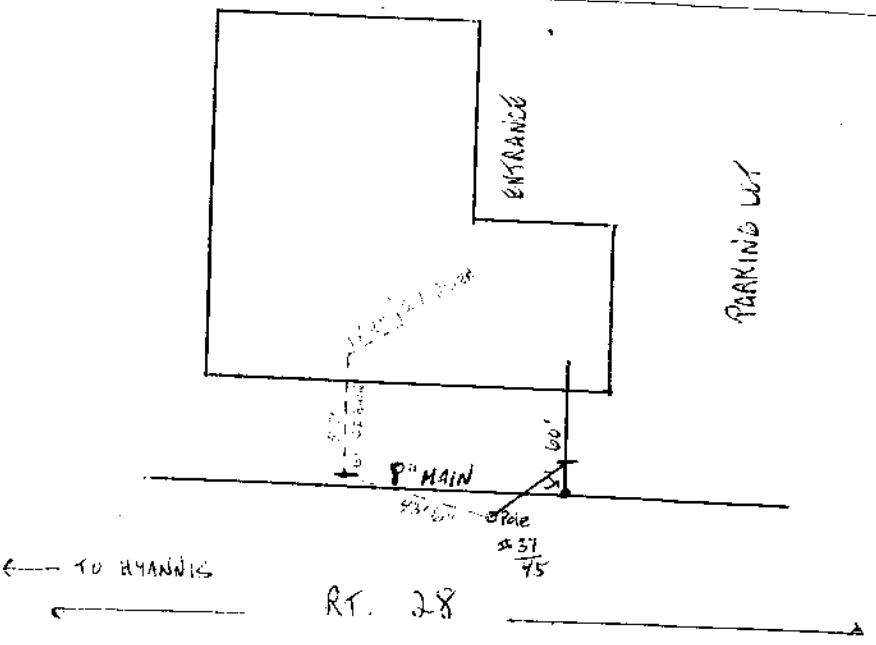
NAME CHINESE KITCHEN BUFFET

STREET 778 Rt. 28

VILLAGE WEST YARMOUTH

METER NO. 1" ABB

FIRELINE # 60073



This building has been torn down, domestic and fire lines were cut and capped at curb.

SERVICE NO. 3185

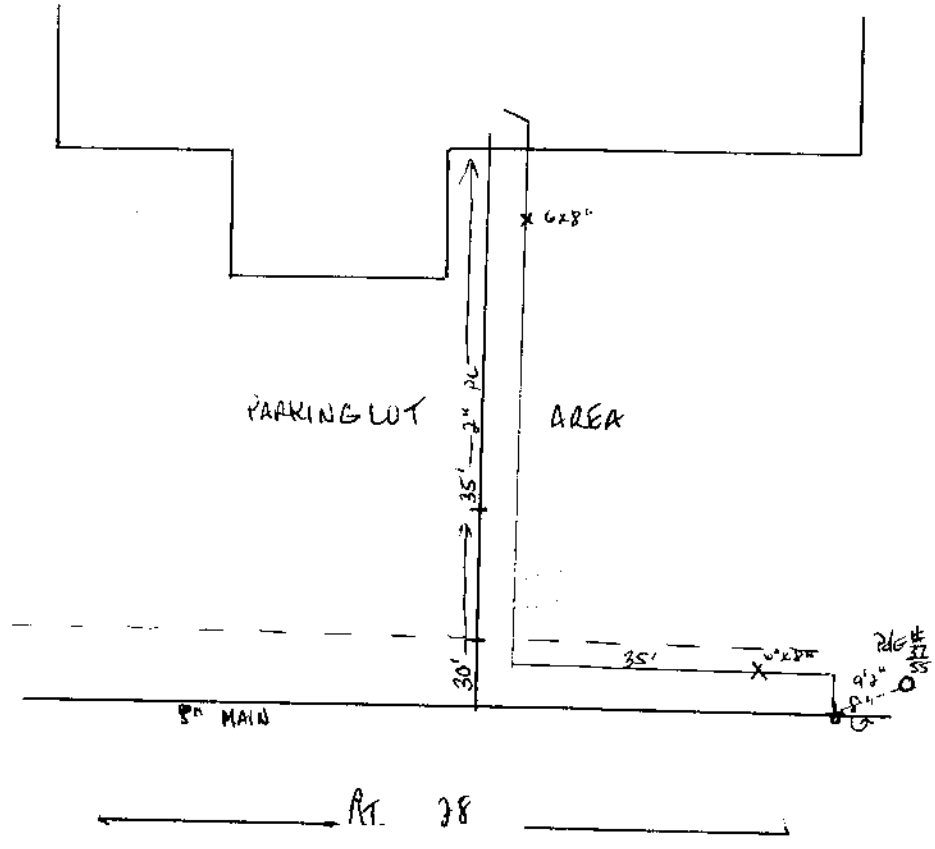
NAME

STREET 280 RT. 28

VILLAGE WEST YARMOUTH

METER NO. 5/8" 24332284 ID# 534346060 8-22-03

FIRELINE # 60072



3225

SERVICE NO.

PRO

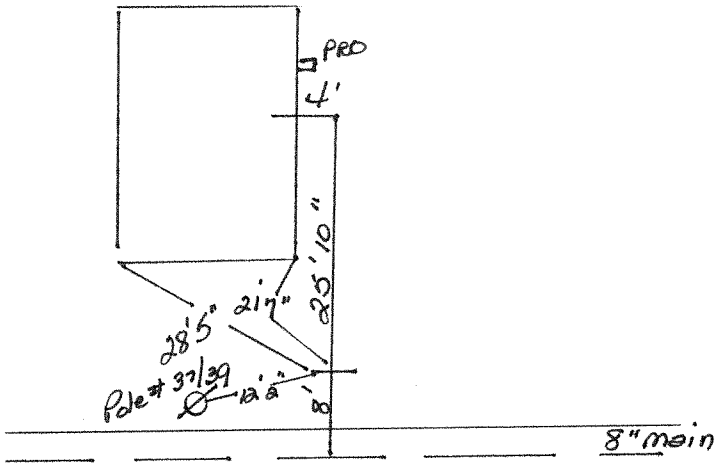
NAME Bill & Bobs Roast Beef

STREET 198 Route 28

VILLAGE West Yarmouth

METER NO. ~~3189~~ ~~5944~~ 45139717 5/8 3-4-99

New ties 3/41



Route 28

SERVICE NO. 3237

NAME

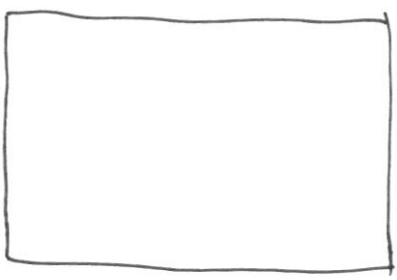
STREET 237 Route 28

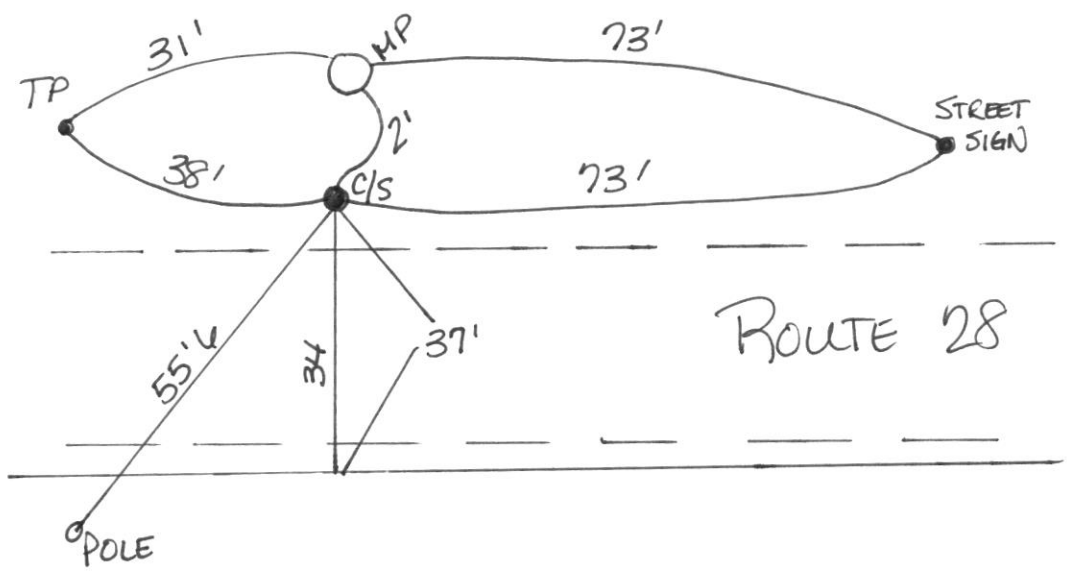
VILLAGE West Yarmouth.

METER NO. (Irrigation Pit) PKM

8/1/08

BEATRICE





PRO

SERVICE NO. 3250

NAME Yankee Village Motel

STREET 275 Route 28

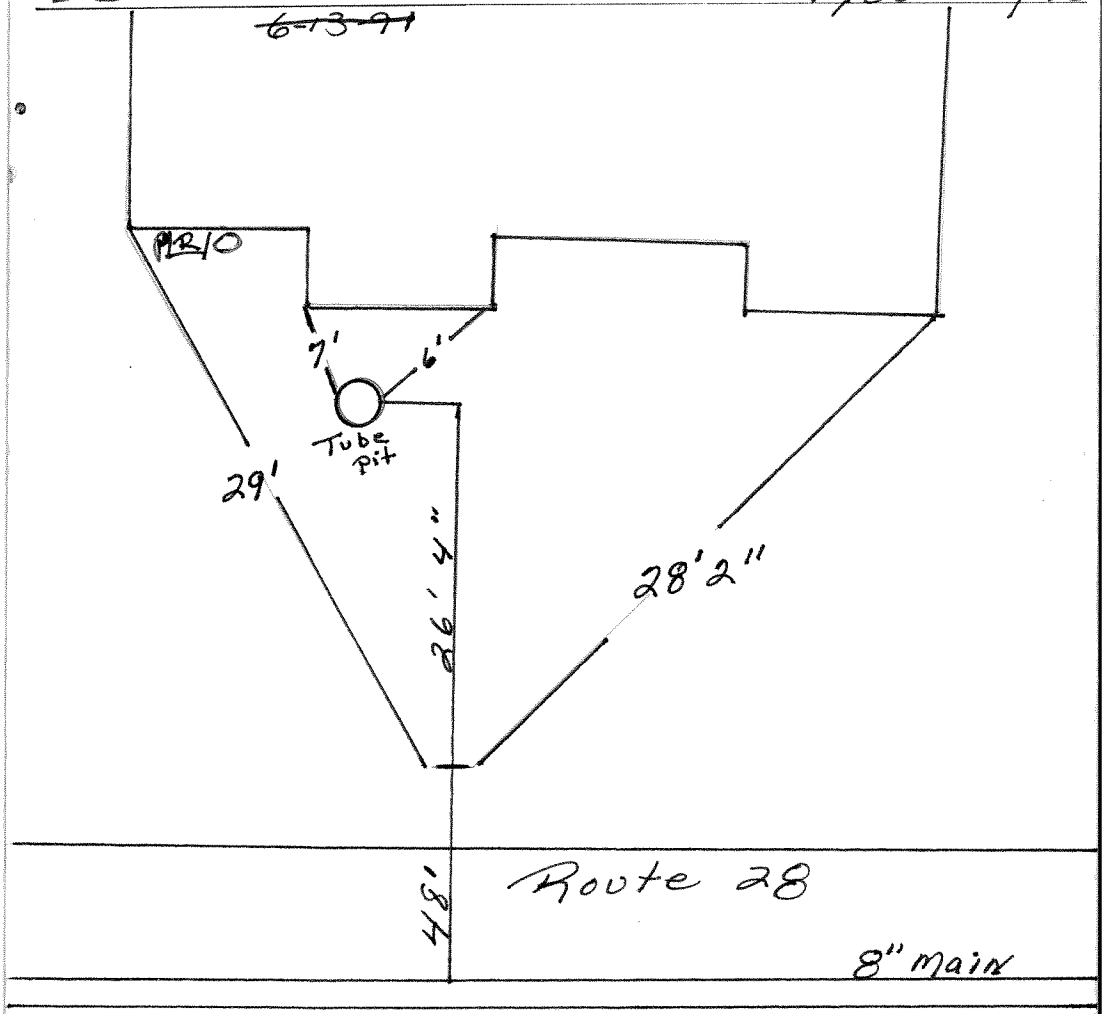
VILLAGE West Yarmouth

~~4791673~~ PRL # 2089990026 1" ~~5/8"~~ meter

METER NO. ~~7900787~~ ~~6-11-65~~

~~ID # 00796576~~ Tyes - 12/93

~~6-13-91~~



ABB

SERVICE NO. 3344-33

NAME Town of Yarmouth Hand Bank

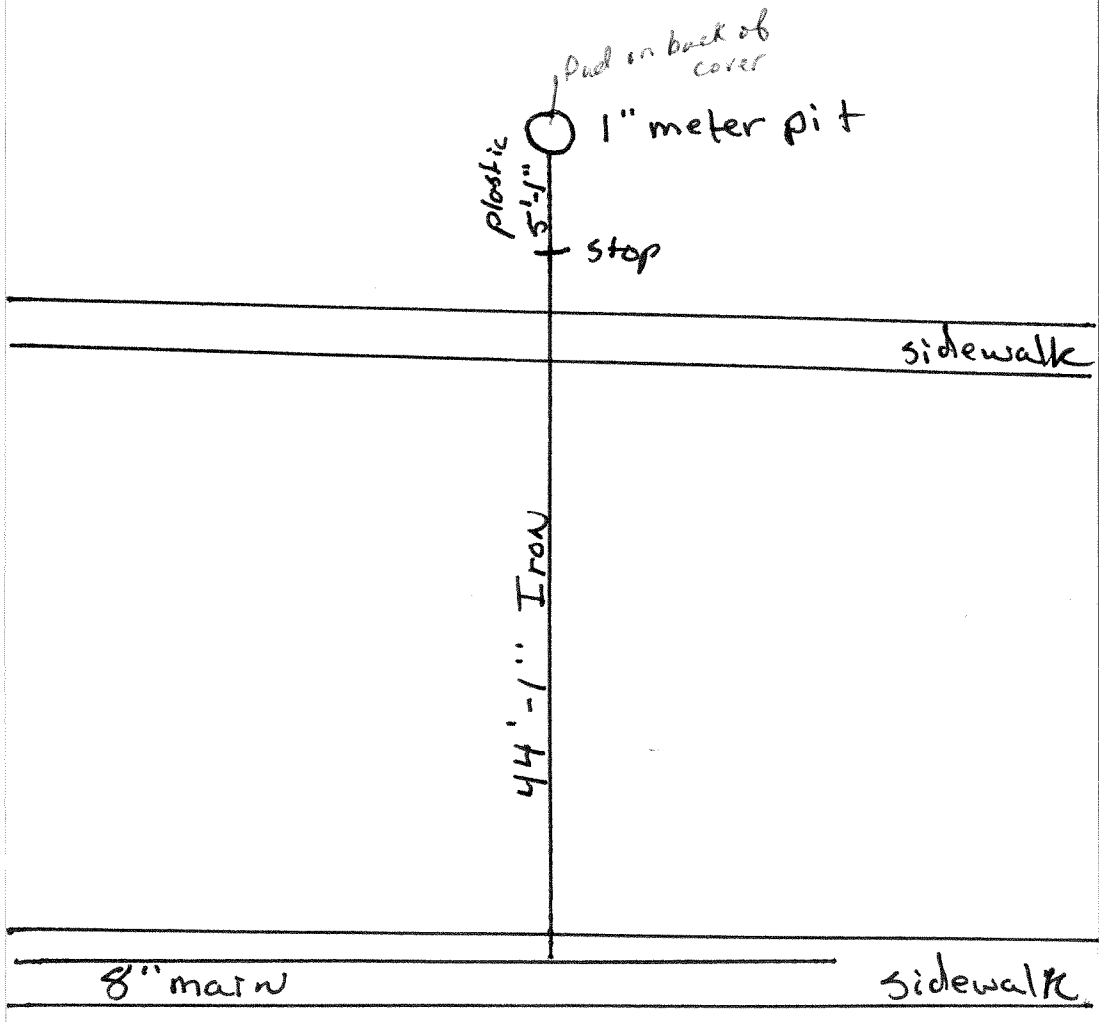
STREET 261 Rt 28 Chase Brook Park

VILLAGE W. Yarmouth

METER NO. 12076496 44120002266 1" 3-20-02

491 1" pl. 1st 8/22/01

Town Park



3421-30

PRO

SERVICE NO.

NAME J.R. SOUSA & SONS

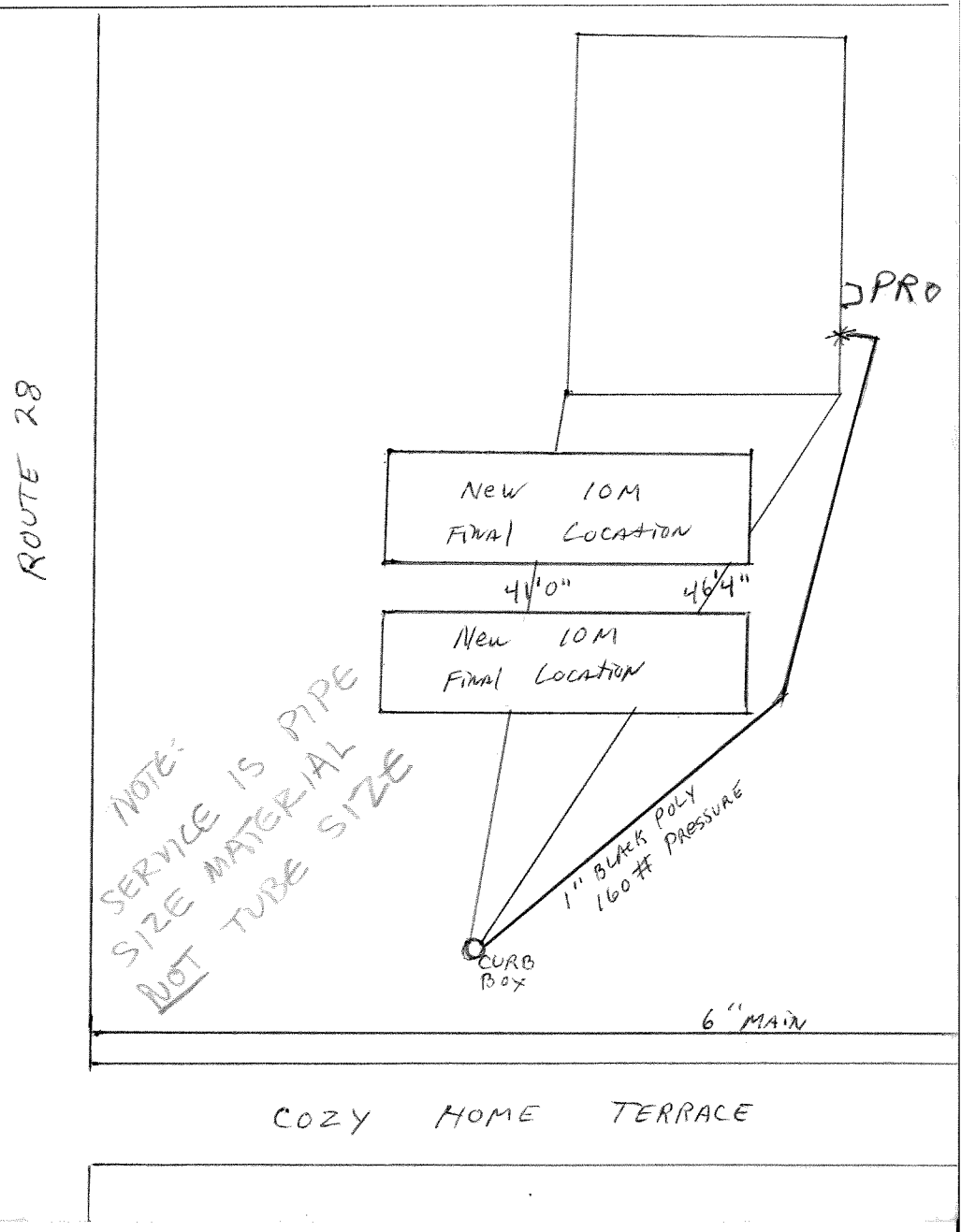
STREET 252 MAIN ST. RTE. 28 (ACROSS FROM FRUITLAND)

VILLAGE WEST YARMOUTH

4473-9855 5/8 12-4-98

METER NO. ~~2299-8827~~ 6-10-76 ROW:10

~~R# 31488~~ Back of building



FIRE Line #60,067 Note: This Service Also Has Fire Sprinkler Line

SERVICE NO. 3440- PRO

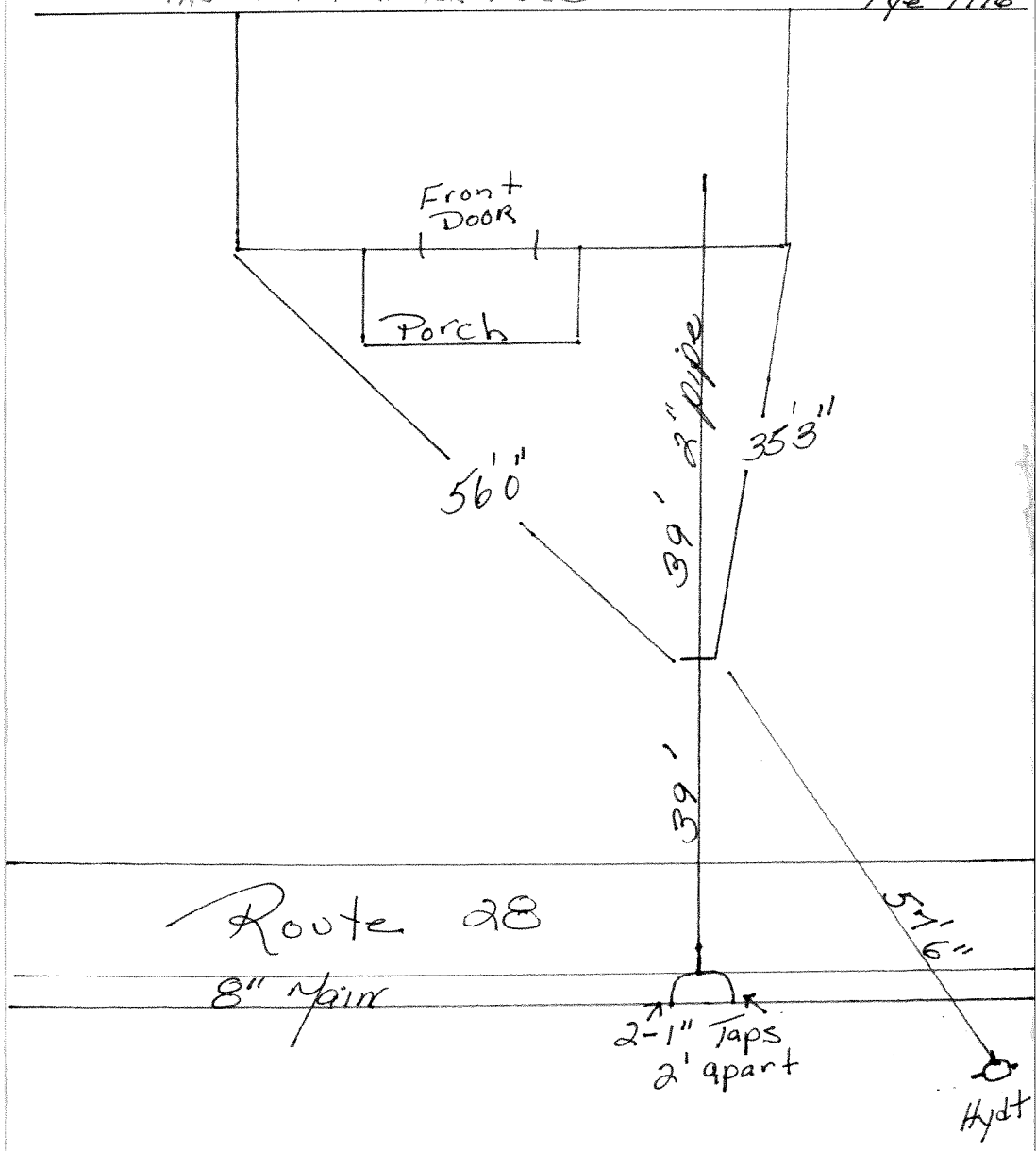
NAME Kounadis Enterprises

STREET 335 Main Street Route 28

VILLAGE West Yarmouth

METER NO. 60003938 08764438 1½" meter 9-6-02

Pad next to meter inside Tye 1996



3443 Lots Dawn

30

FCO

NAME Edward Gardiner

342
STREET Main St.

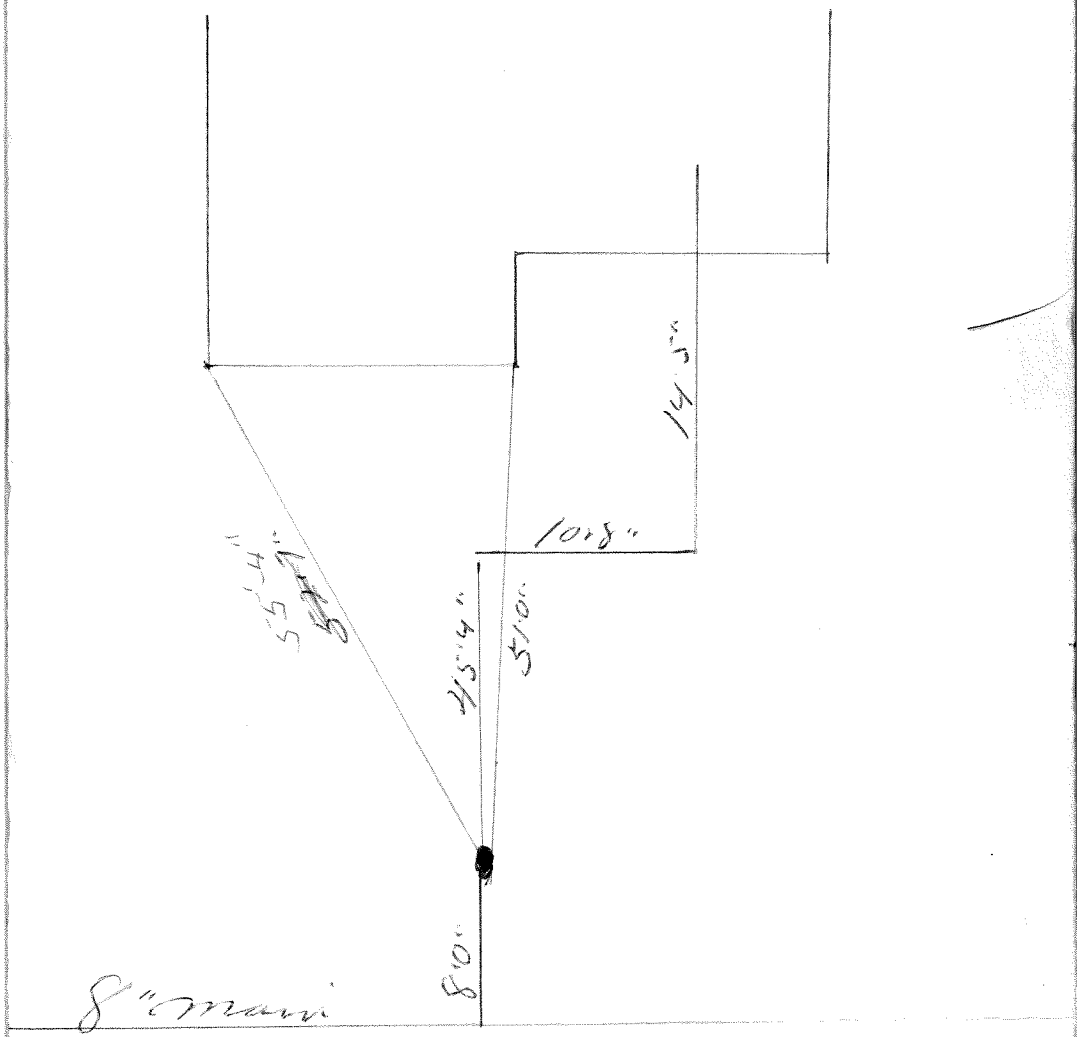
VILLAGE W.Y.

SERVICE NO. 3443-30

METER NO. 47916738 PAD 2089770338

1" METER

Rear of bldg.



Main St

SERVICE NO. 3447-33 PRO

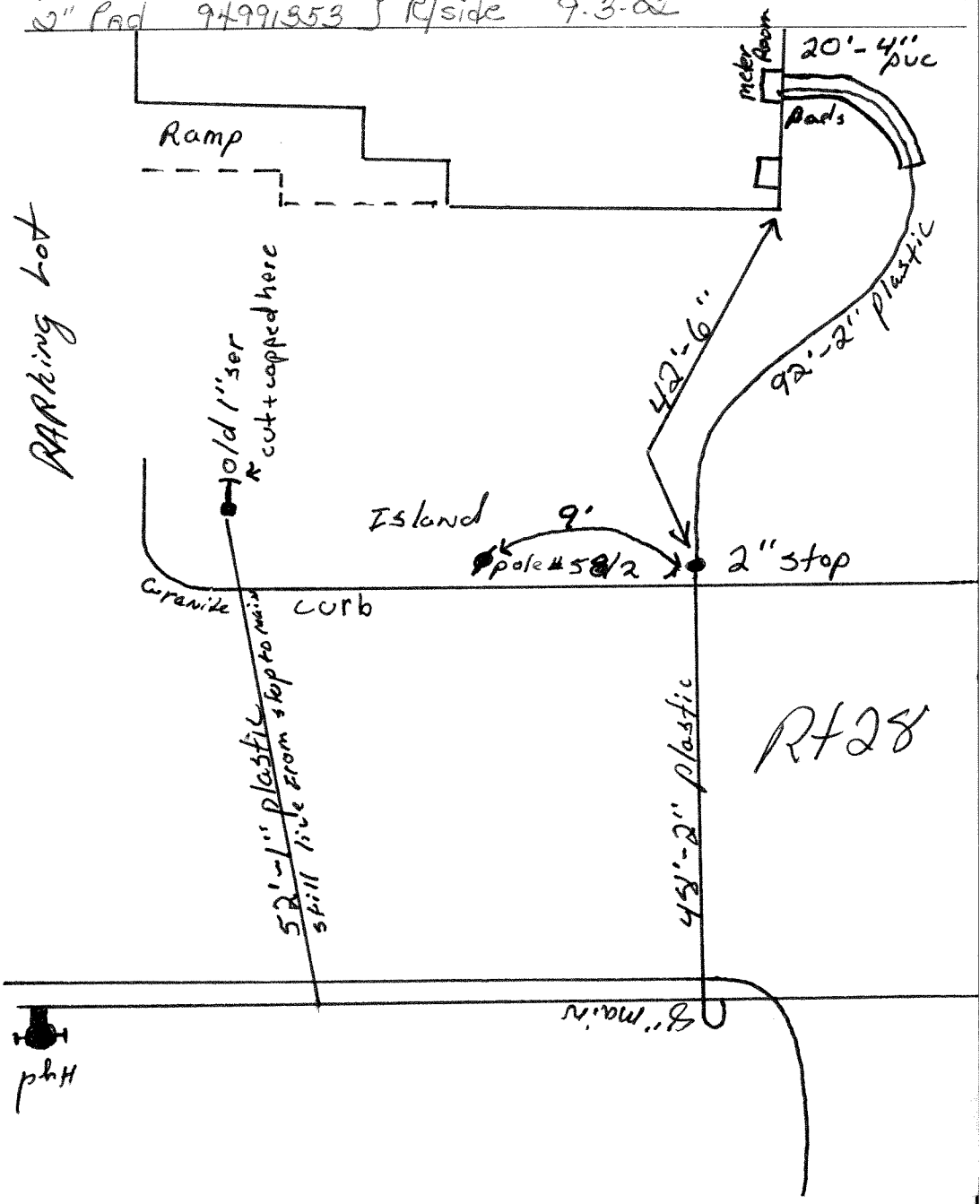
NAME Shields MRI Bldg.

STREET #21 Yarmouth Rd. Rt 28

VILLAGE W. Yarmouth

METER NO. 70009996 compound meter 2" meter

5/8" Pad 04011072
2" Pad 94991953 } R/side 9-3-02



3464-36A

~~PRO~~

CHAGNON - INSURANCE

NAME 411 INVESTMENT TRUST

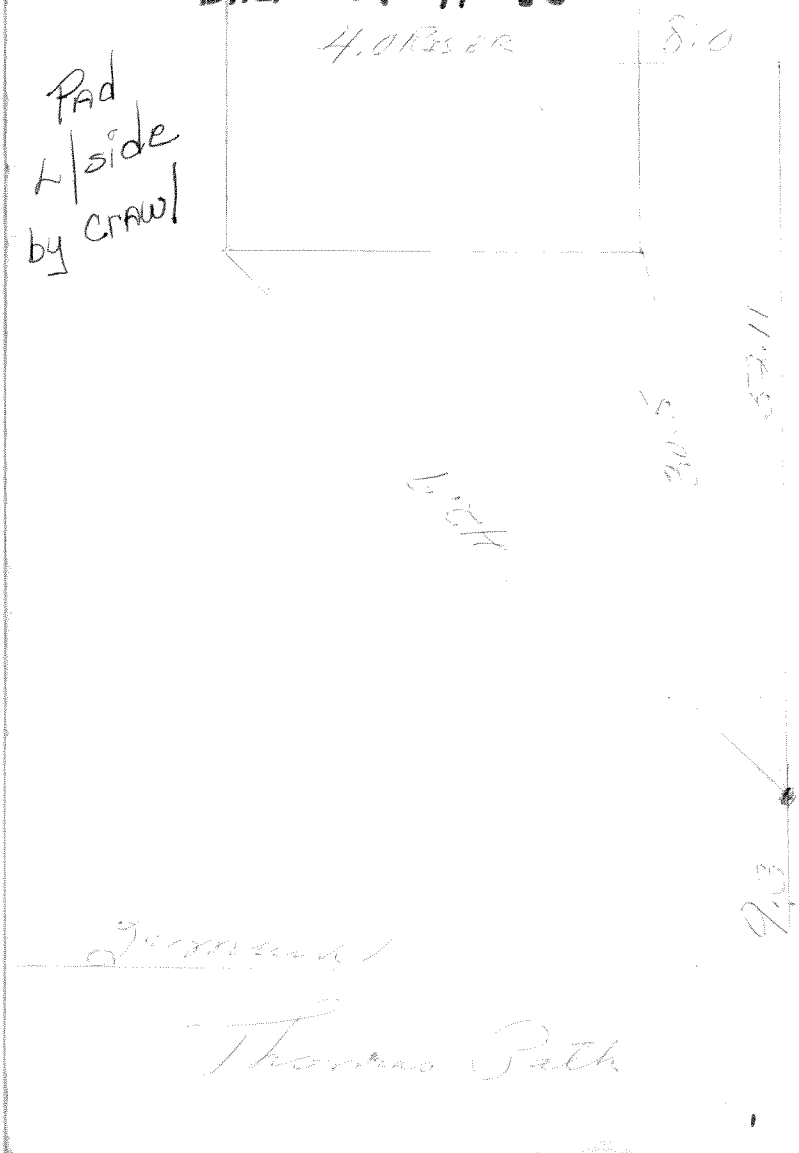
6
STREET THOMAS PATH LOT # 7-B

VILLAGE GY

SERVICE NO. 3464-36A ~~3584-3295~~ #417411 5/8" Pro 5-29-98

METER NO. ~~8936250~~ 1-15-86

~~READ ON # 87773~~
~~BACK OF HOUSE~~



Driveway

Thomas Path

34/23-30

SERVICE NO.

d ABB

NAME 2nd Congregational Church

STREET 383 Route 28

VILLAGE

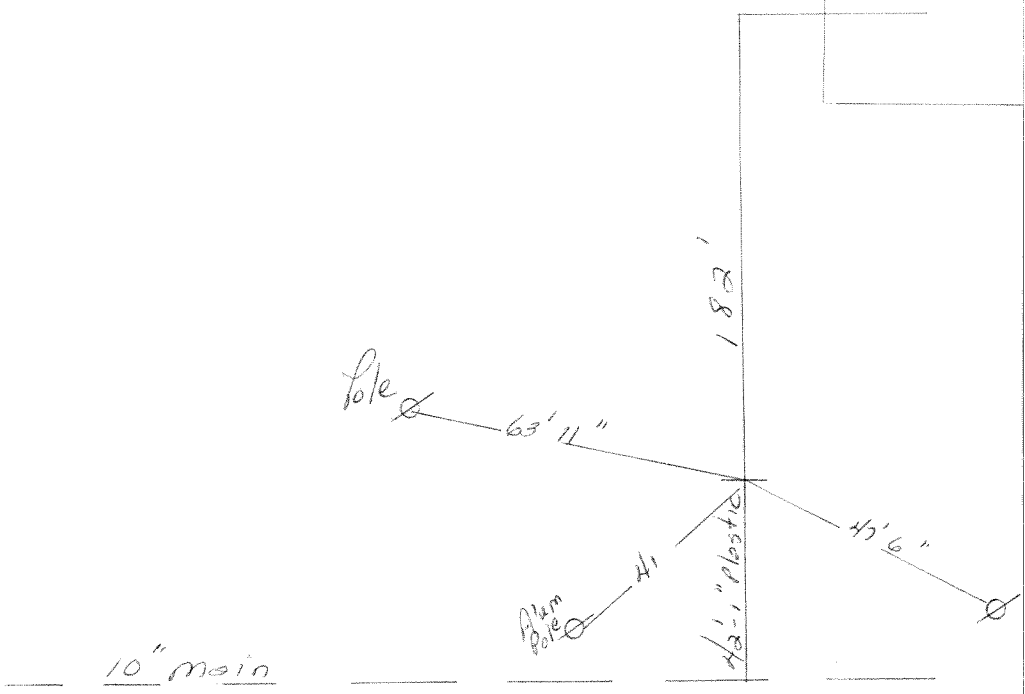
Pad # 5231024144

1032080l 5/8" ABB 8-2500

METER NO. ~~3488 5890 3185 7346 RC 5/8 2-2389~~

Service renewed from main to CC
12/15/87

NEXT TO faucet front
Rt. wing



Route 28

3504-30

ARB 3-12-75

3504-33

NAME Joseph J. Sousa
1-13-95 (Cape Printing & Litho Works)

Is 3 Route 28

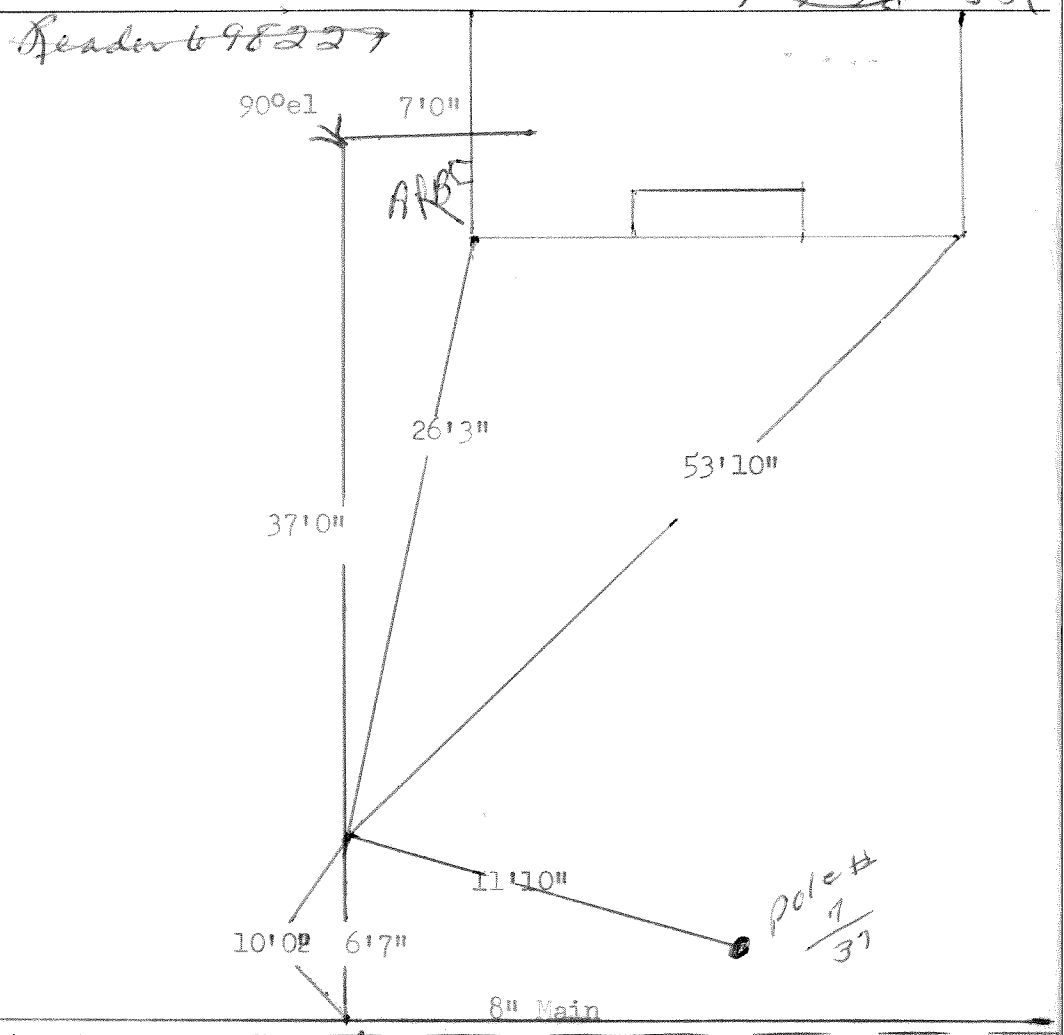
STREET 3 E'ST MAIN STREET ← AKA

VILLAGE WEST YARMOUTH

SERVICE NO. 3504-30

METER NO. ~~3627-6562~~ ~~8936 426~~ 4268890 8-6-96 4-2-28 ST

Reader 698227



EAST MAIN STREET

3601-3233 ABB

SERVICE NO.

3601
Ragini, L.L.C.

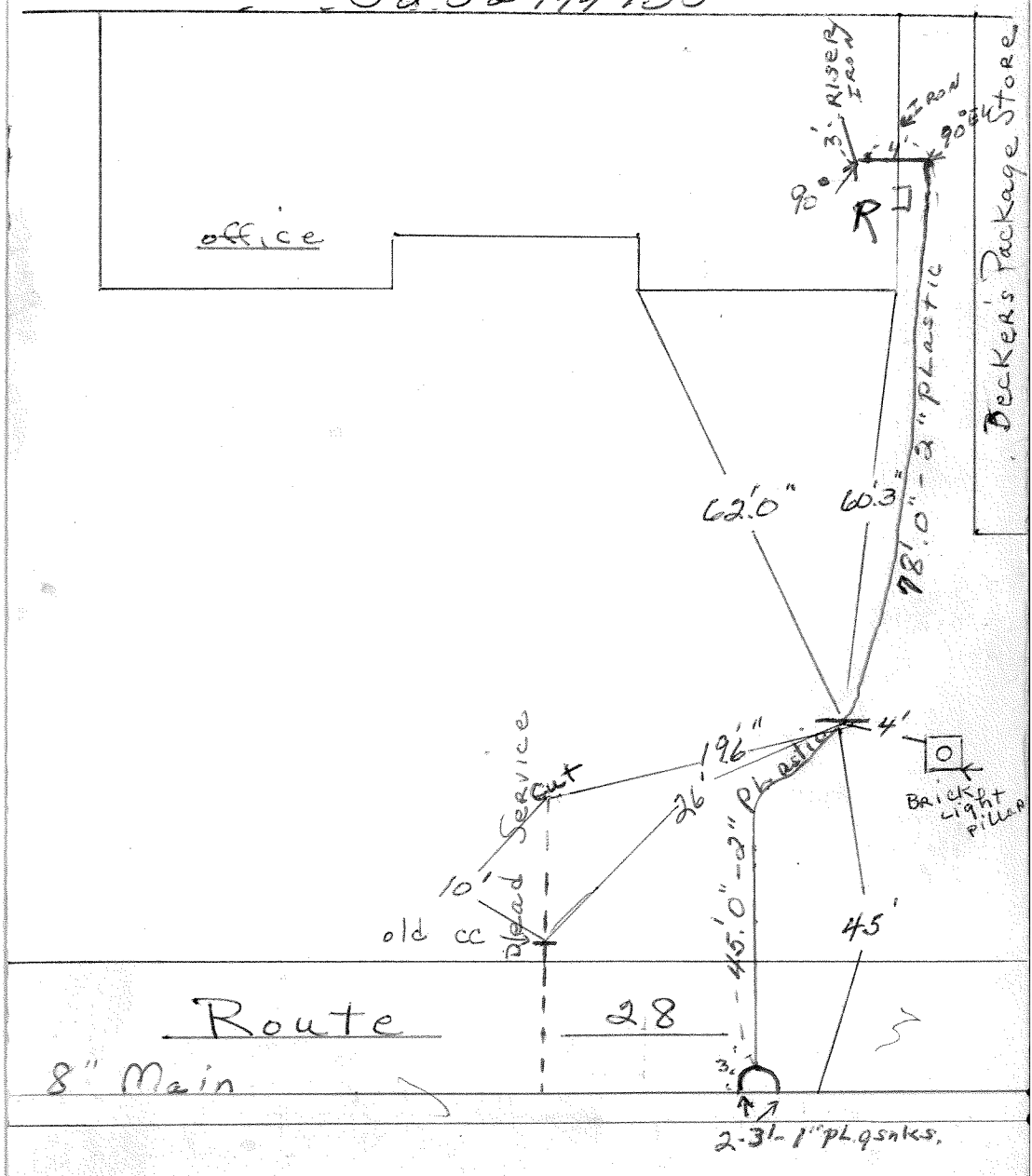
NAME Snu ...eL (Myles Franklin Jr

STREET 48 Route 28 (East Main St.)

VILLAGE West Yarmouth

METER NO. 10402702

FD# 52321449.33



3602-42 PRO

SERVICE NO.

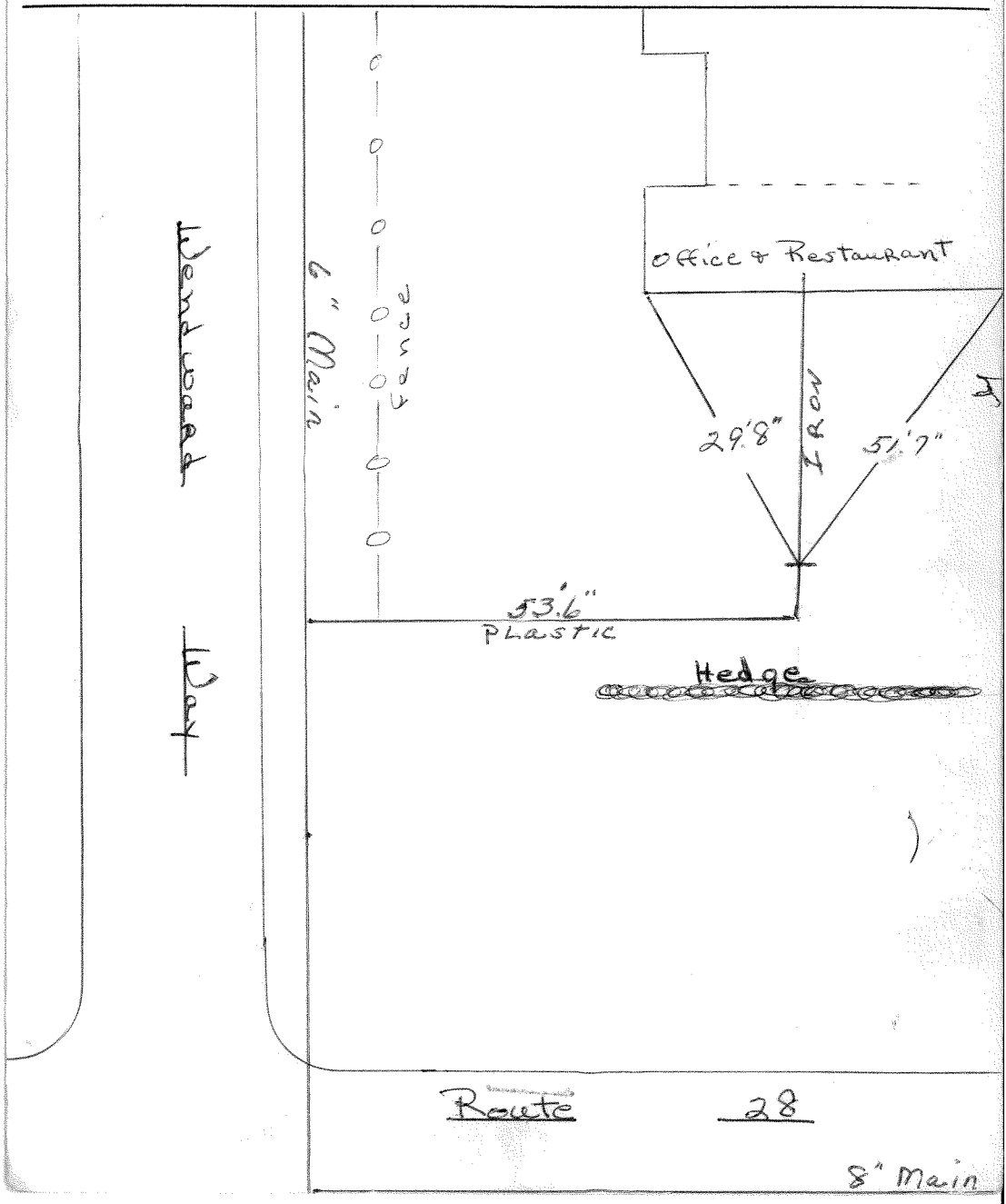
3602
W. YARMOUTH LODGINGS

NAME

STREET 77 ~~62~~ East Main St.

VILLAGE West Yarmouth

METER NO. 45134348 5/8" Pro 2-12-99
~~1971 0149~~ - ~~RH~~ 5/8" Pad R/side



dcc
PRO

SERVICE NO. 3610-30

NAME Ace Quick Oil Change

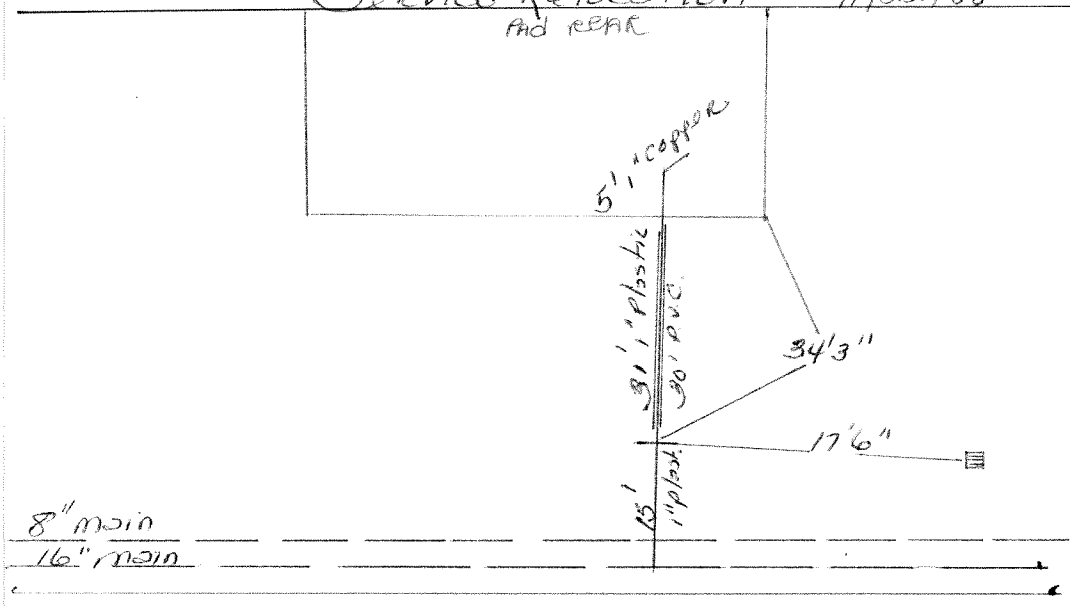
STREET 84 Route 28

VILLAGE West Yarmouth

4473 9/03 5/8 5/8" 12-17-98

METER NO. ~~3992 1190~~ 5/8" 12-27-88 RC

Service Relocation 11/22/88



Route 28

Possible fire line here.

PRO

SERVICE NO. 3616-33

NAME 3616 W. YARMOUTH LODGINGS Family Trust

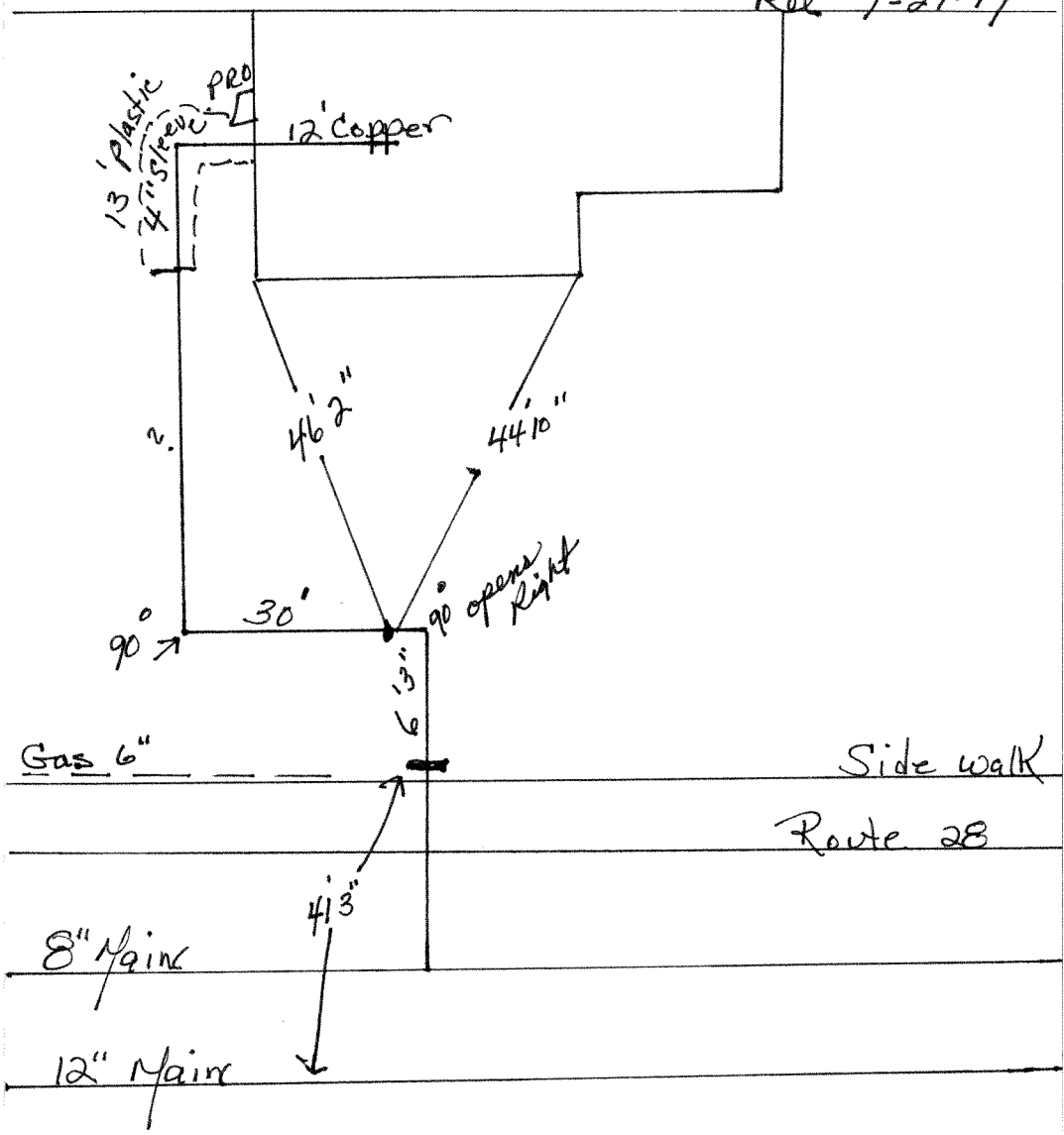
STREET 85 Route 28

VILLAGE West Yarmouth

METER NO. 43199508 12-9-97

Pro L/side By window

Rel 7-27-99



FIRE Line PRO

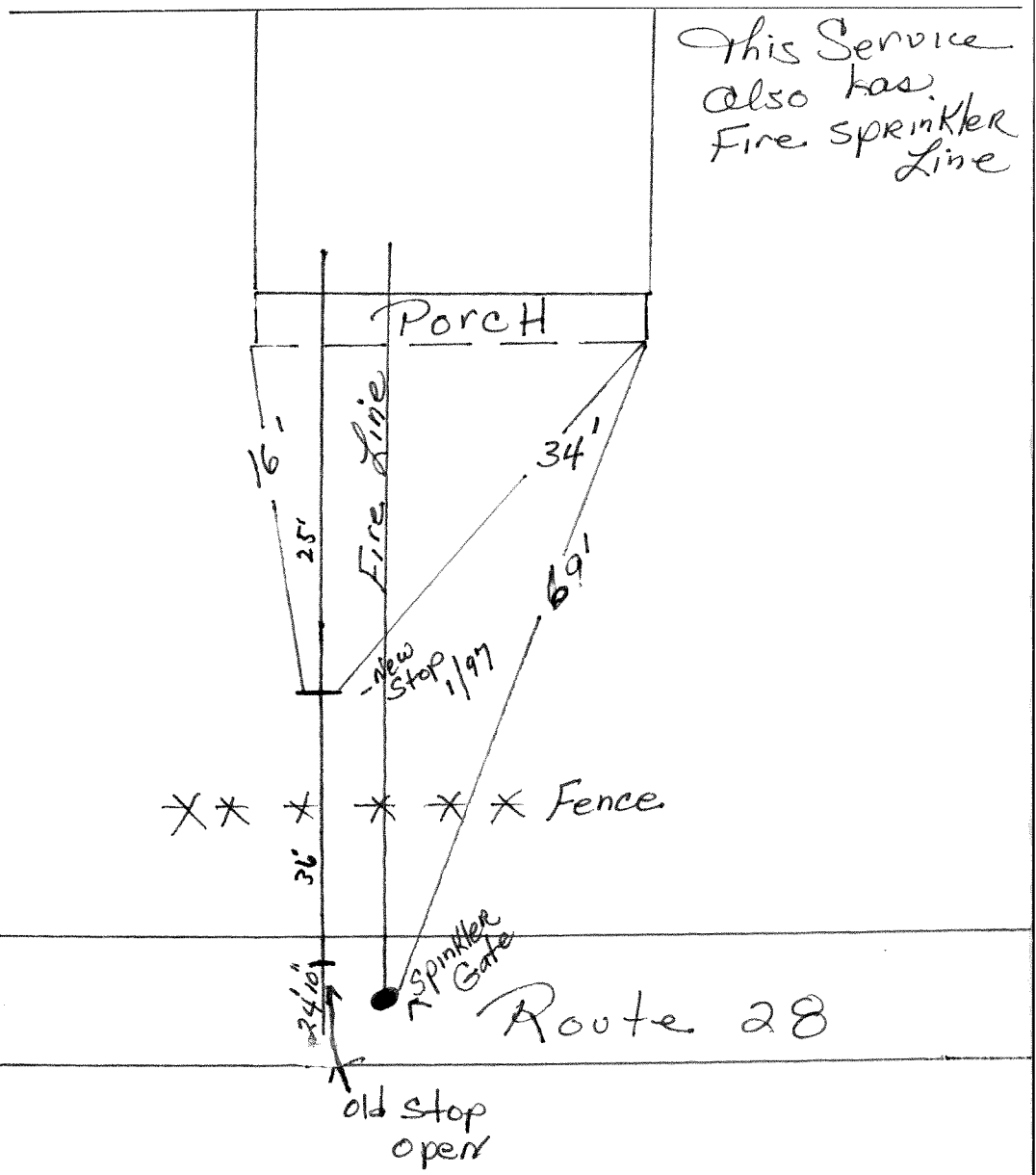
SERVICE NO. 3631- # 60,065

NAME Drive-O-Rama Inc. Mill Store

STREET 33 Route 28

VILLAGE West Yarmouth

METER NO. 42117403 1/9/97 No Remote



3634

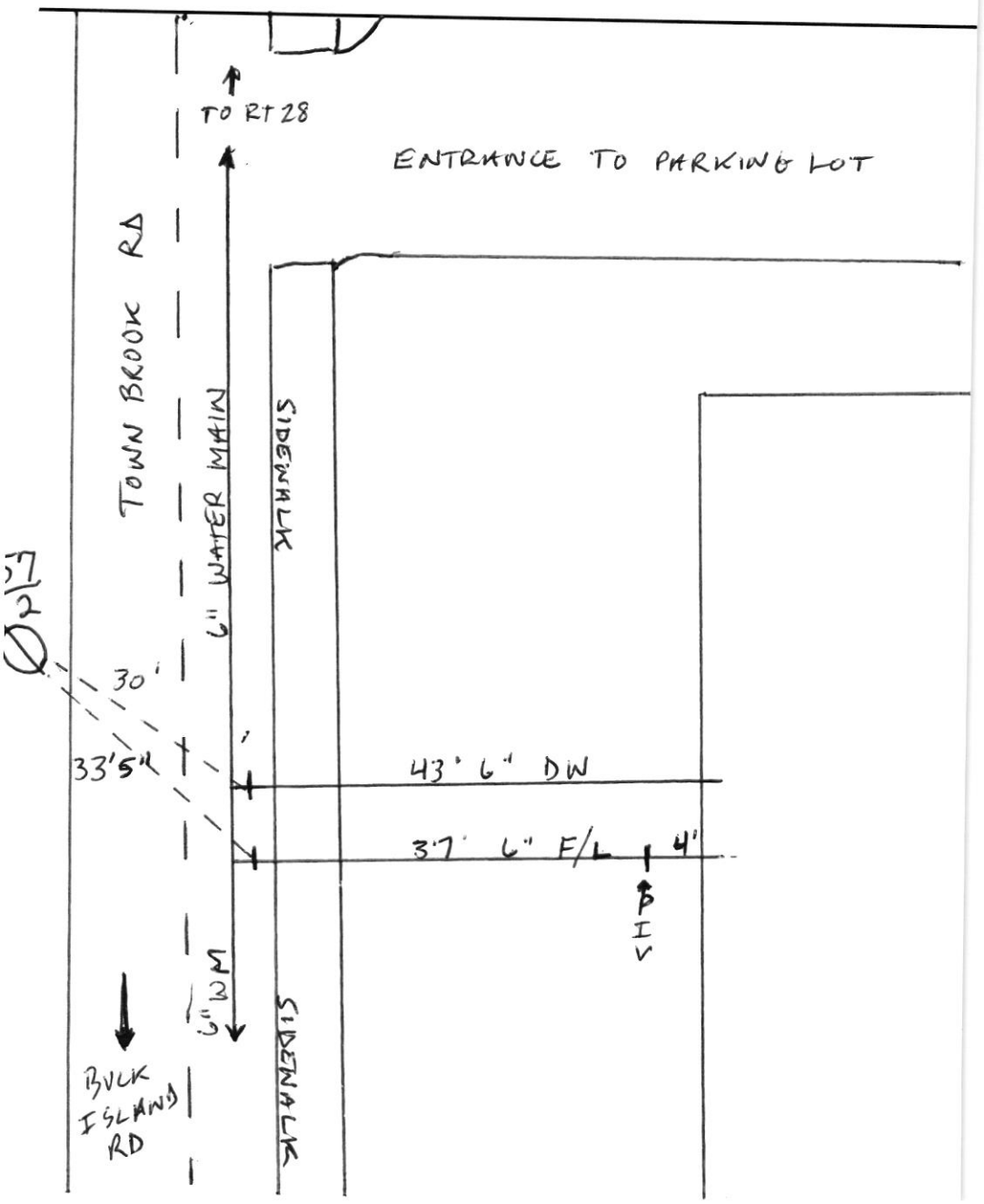
SERVICE NO.

NAME RESIDENCE AT MILL HILL

STREET 164 RT 28

VILLAGE W. YARMOUTH

METER NO.



3625 ABB

SERVICE NO.

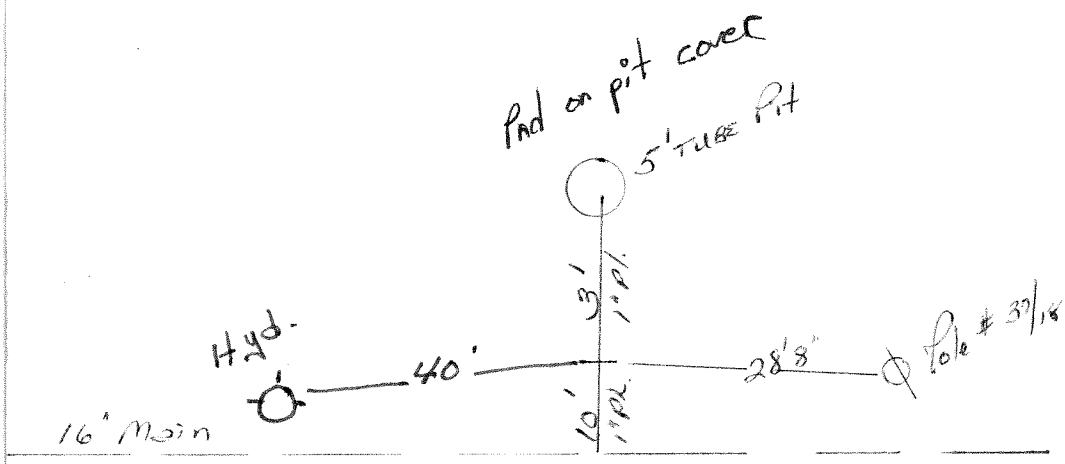
NAME Steven R. Fedele, MINI-GOLF THUNDER FALLS

STREET 37 Route 28

VILLAGE West Yarmouth

METER NO. 11393082 4421020880 5/8" 1-24-89

5/15/89



Rte 28

3644-30

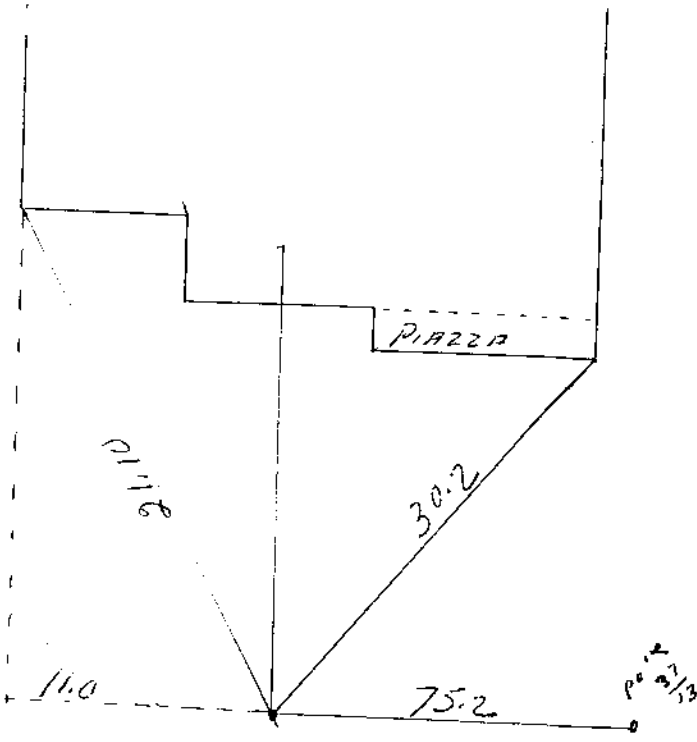
NAME Dan Sullivan
3644-30 5/23/79

STREET 29 Eastman St ← AKA 15 29 Route 28

VILLAGE GW

SERVICE NO. 3644-30

METER NO. 44739027 ; 5/8" 12-9-98
PAL Left side of bldg. 3-2-90



3647

SERVICE NO.

3647-33
Joseph J Sousa
11-9-92

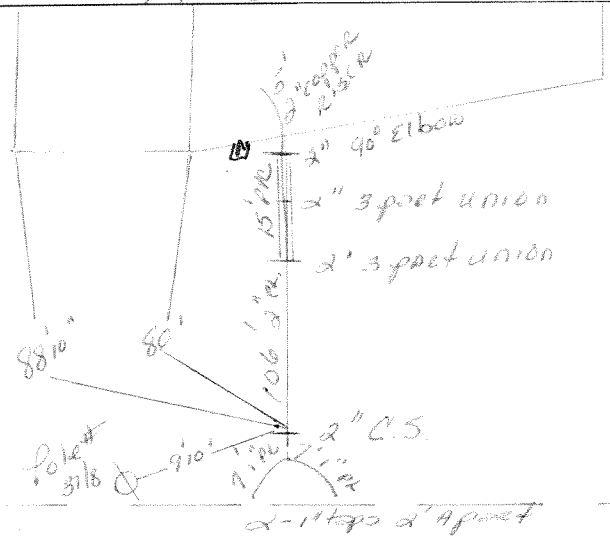
NAME 10 East [illegible] Lot

STREET AKA 10 10 Route 28 10 East Main St AKA Lot 65

VILLAGE West Yarmouth

METER NO. 39099264

140' 2" Plastic 11/28/89



East Main Street

3670-30

FIRE Line
#60,064

3670-
Cape Cod Hospital
11/96

NAME The Cape Cod Hospital

STREET 69 Eastman St "NOTE: This Services

VILLAGE W-1 Also Has Fire Sprinkler

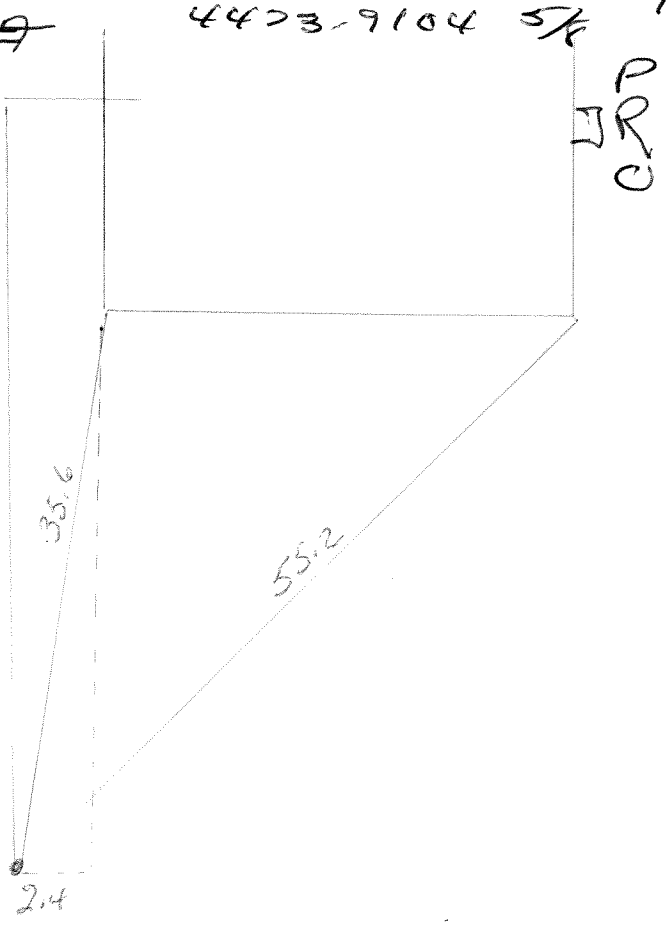
SERVICE NO. 3670-30 Line"

~~2" 6/12/96~~ ROCKWELL 396

METER NO. ~~[illegible]~~ 11-19-69

~~Converted 5/8"~~

~~R-35829~~ 4423-9104 S/E 12-17-96



SP 3731

PIO

3731
Kishor K Patel
8/26/99

NAME

STREET ~~36-34~~ 45 (Rt 28) East Main

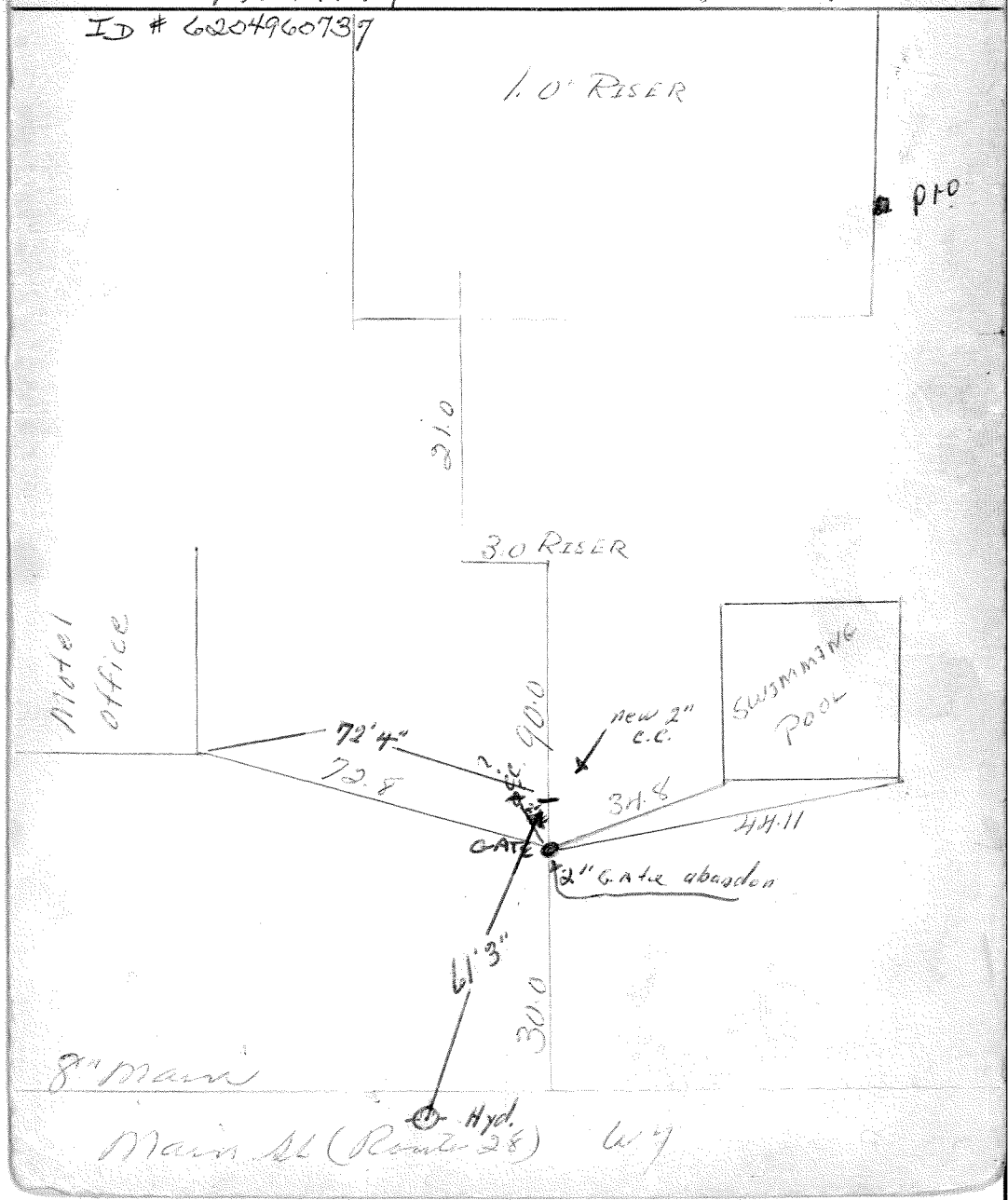
VILLAGE West Yarmouth 1" MAGTEK

SERVICE NO. 3731-30 5-1-63 2" Gate

4727594?

METER NO. ~~18447184~~ ROW ~~49~~

ID # 6204960737



3748-33

Cape Sojourn Motel

3748-33
Peter H Ward
12-21-94

NAME Leon[illegible]ard

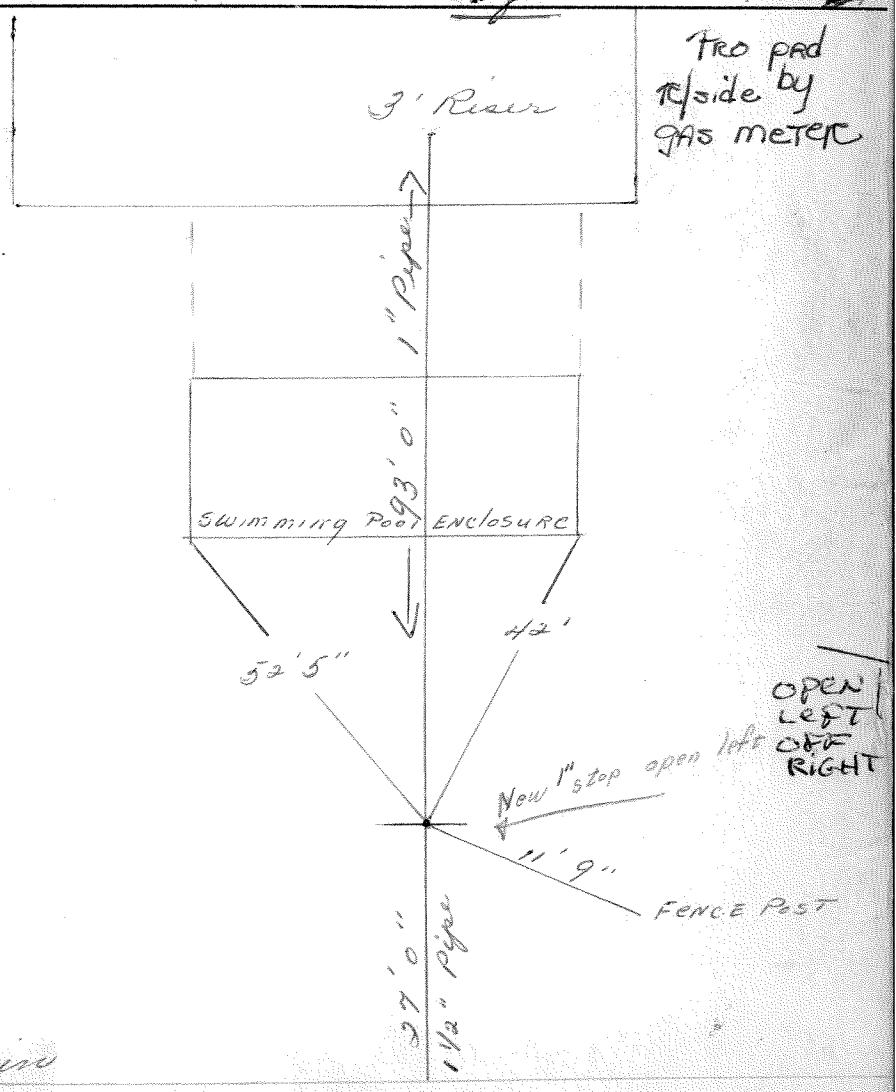
STREET ~~Rte~~ 151 Route 28

VILLAGE N.Y.

SERVICE NO. 3748 - 30 5/25/63

48016107 Pad-221499025 1-6-00

METER NO. ~~4814 7183~~ 1" [illegible] Raw



Route 28

SERVICE NO. 3753-36A

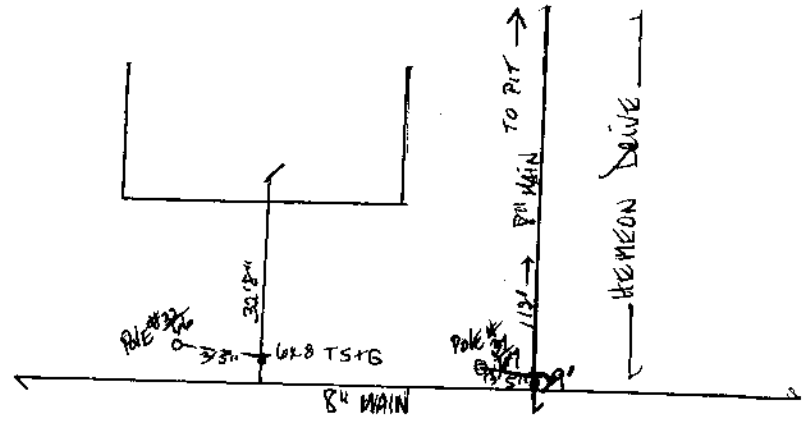
NAME D & L HOUSE OF LEATHER

STREET 350 RT. 28

VILLAGE WEST YARMOUTH

METER NO. 1" 20899903 63

FIRELINE # 60071



ROUTE 28

SERVICE NO. 3833 ARB

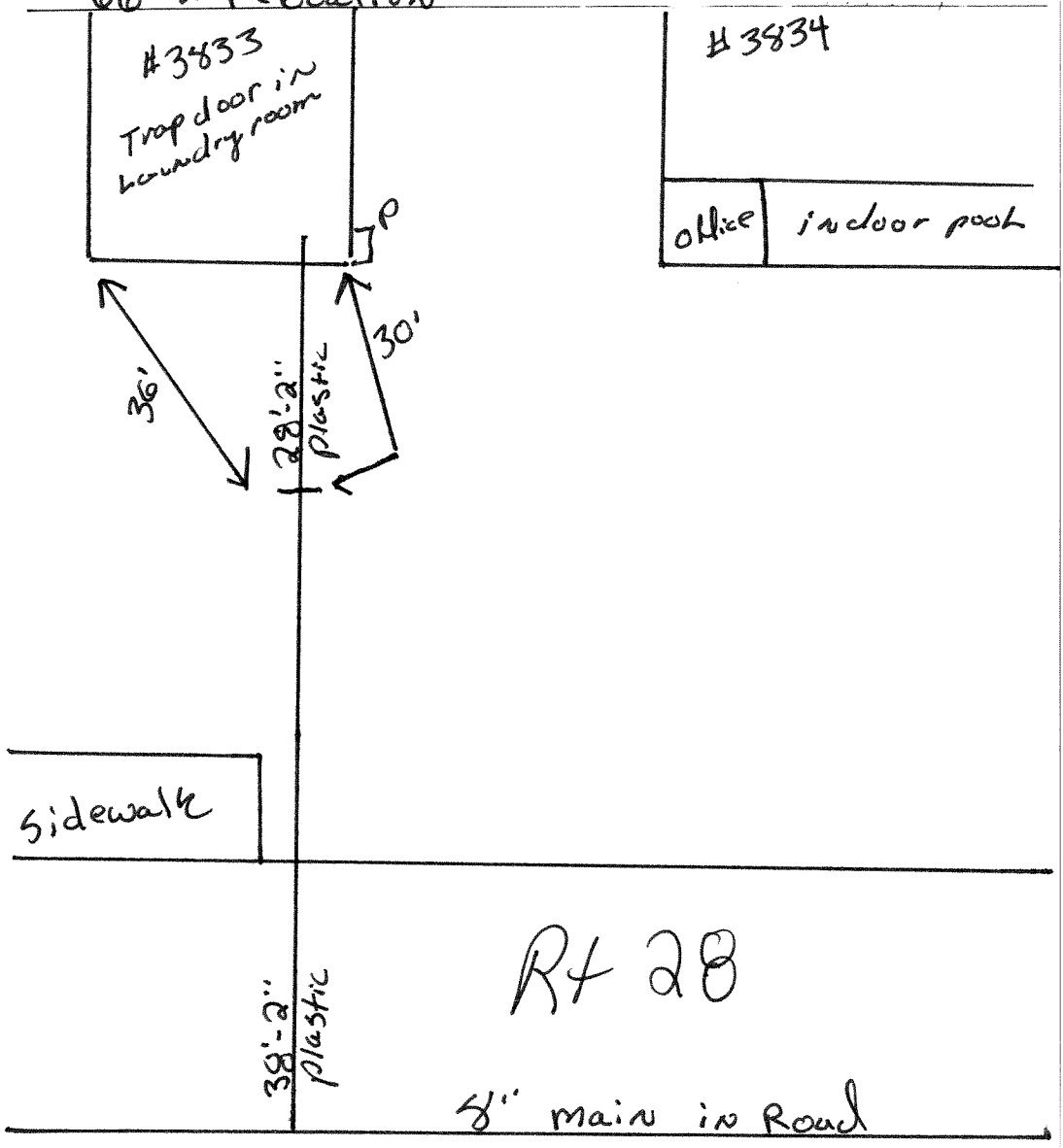
NAME Meshwa Corp Kirti Kumar Patel

STREET 69 Rt 28

VILLAGE W.y.

METER NO. 47016177 12-28-95 East wing

66'-2" relocation



SERVICE NO. 3834 ARB

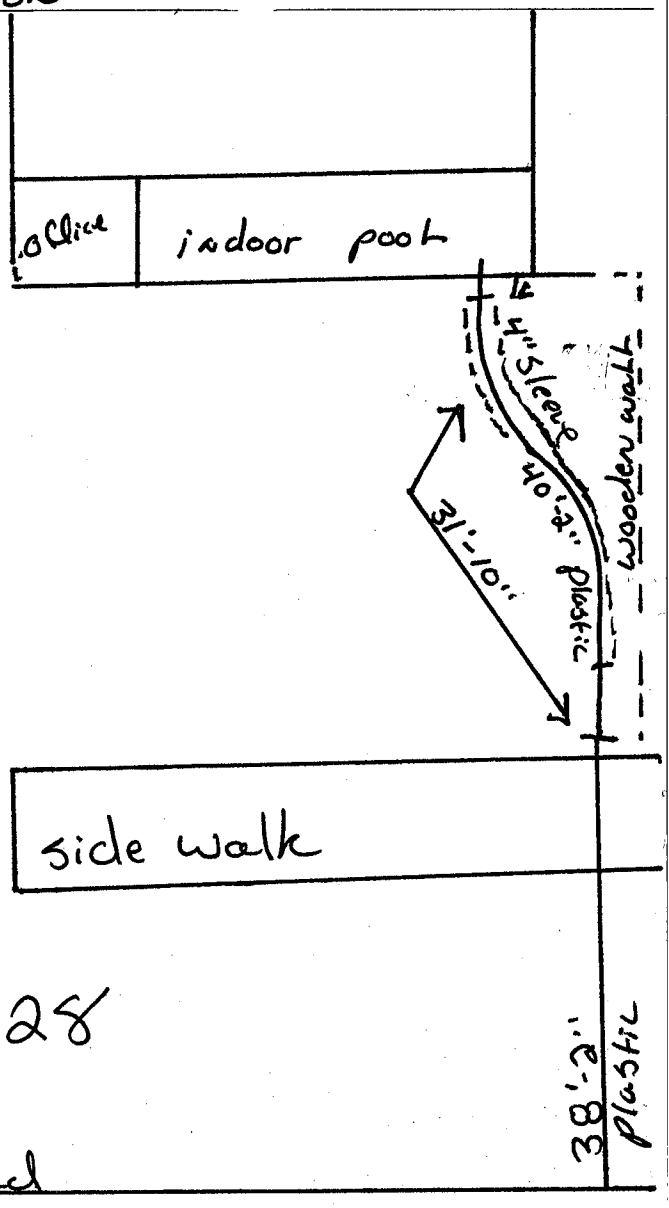
NAME Meshwa Corp Kirti Kumar Patel

STREET 69 Rt 28

VILLAGE W.Y.

METER NO. 47016198 12-28-95 Westwing

78'-2" relocation



8" main in road

3876-~~37~~ 39A

ABR

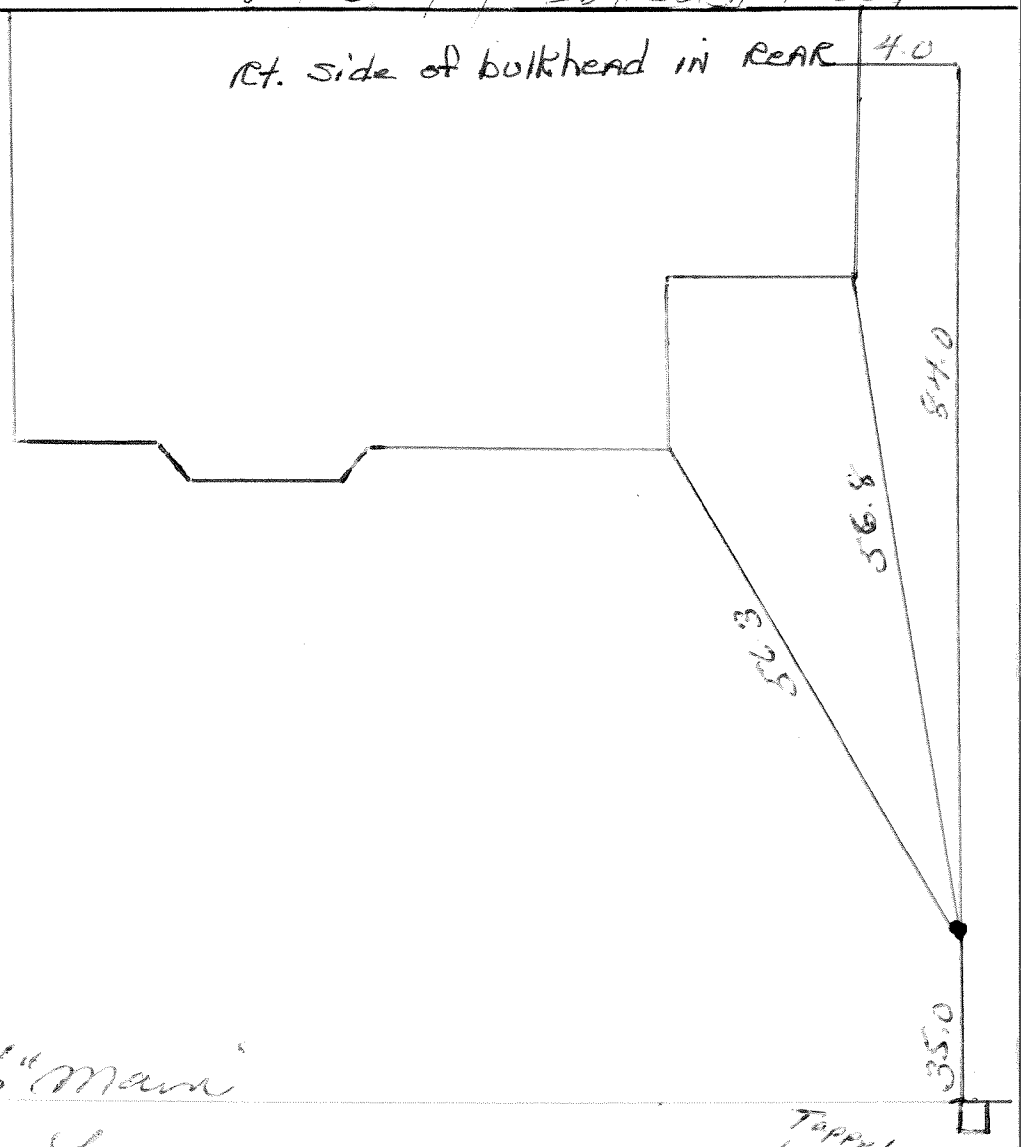
NAME West Yarmouth Library

SVCE ~~88~~ STREET Lewis Road 391 Route 28

VILLAGE West Yarmouth

SERVICE NO. 3876-~~39~~ -39 5/8"

METER NO. 10380106 11/30/00 ID#5231140351



EC

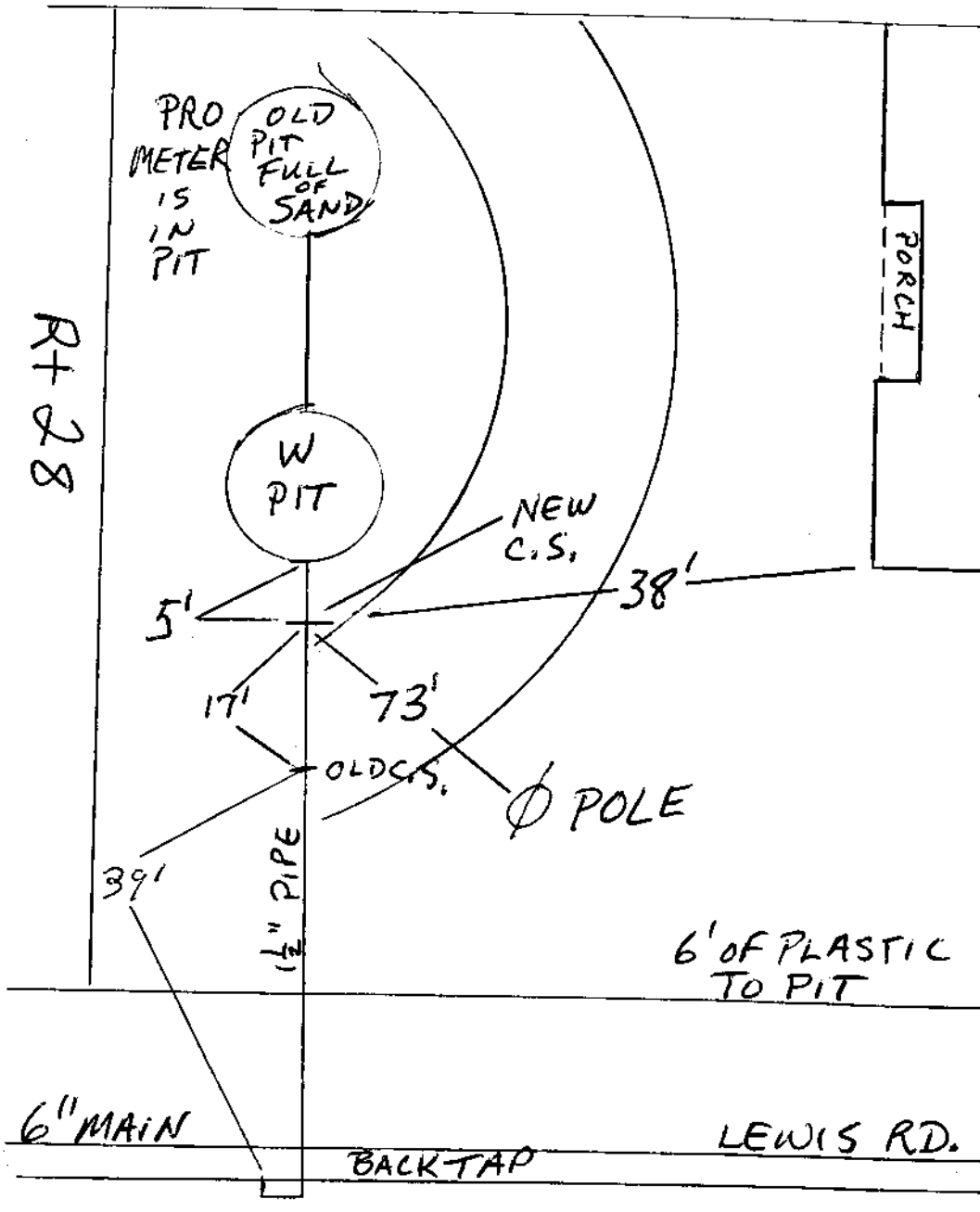
SERVICE NO. 3955-6

NAME W. YARMOUTH LIBRARY

STREET 391 Rt 28

VILLAGE W. Y.

METER NO. 42031437 7-18-05 1 1/2



3960-36

4703
PRO

NAME Robert Emerson

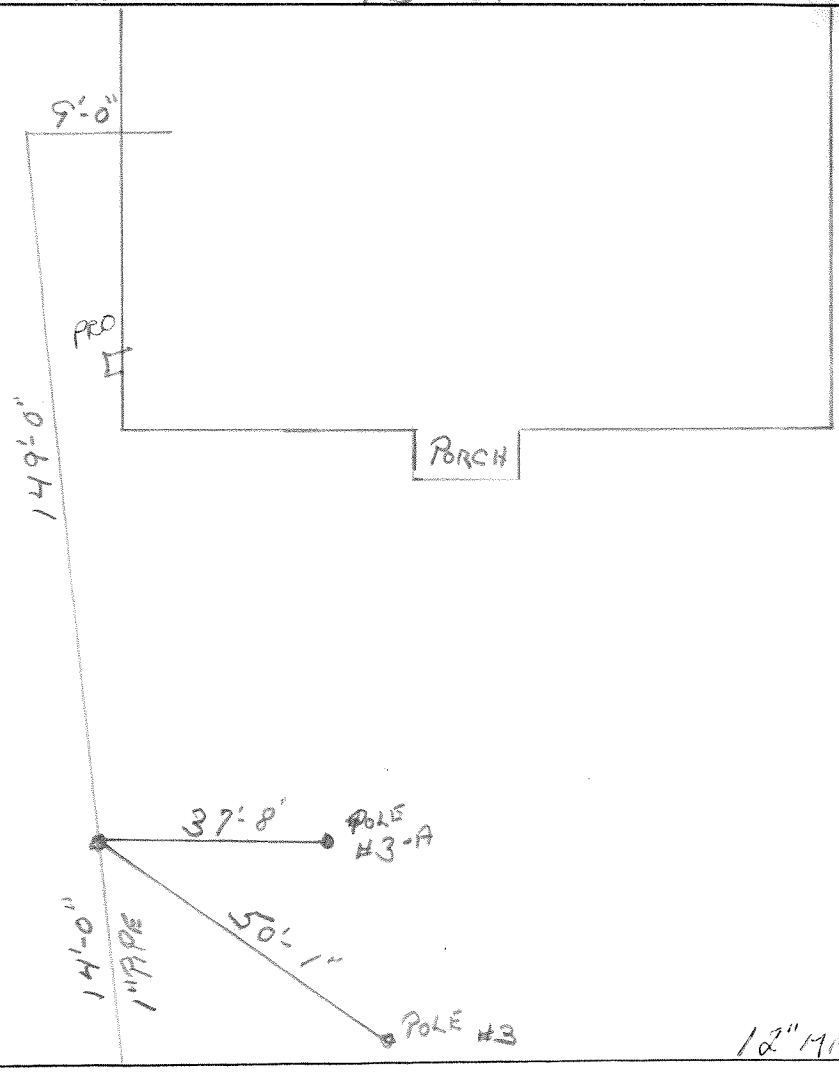
STREET 15- Higgins Crowell Road

VILLAGE West Yarmouth

SERVICE NO. 3960-36

~~4473984~~ 5/8 1-7-98 ~~1988~~ ~~Rock Mag~~ ~~5-11-65~~

METER NO. ~~L8912396~~ ~~R# 67291~~ Left side



Higgins Crowell Road
West Yarmouth

ARB

SERVICE NO. 5053

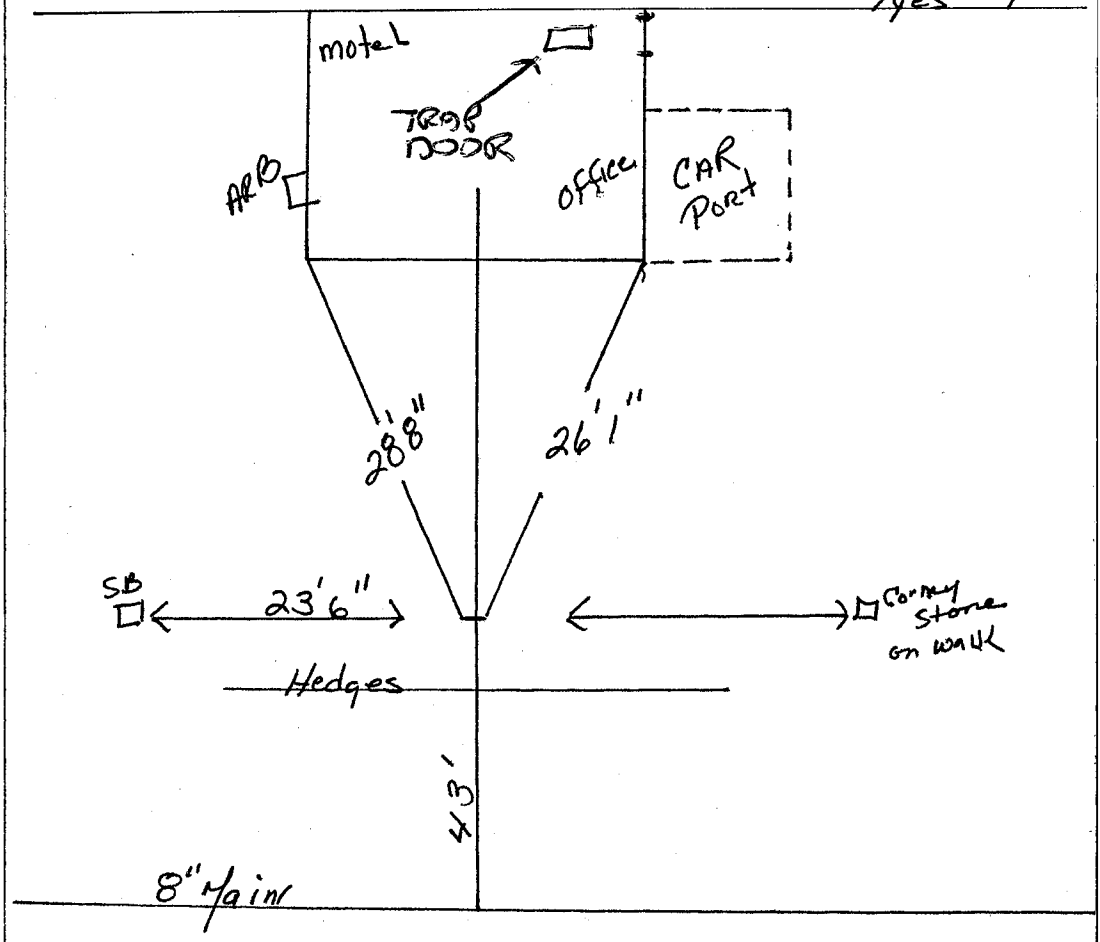
NAME Americana Holiday Motel

STREET 99 Route 28 Office

VILLAGE West Yarmouth 1"

METER NO. 4701 6193

Tyes 3/96



Route 28

5075

SERVICE NO.

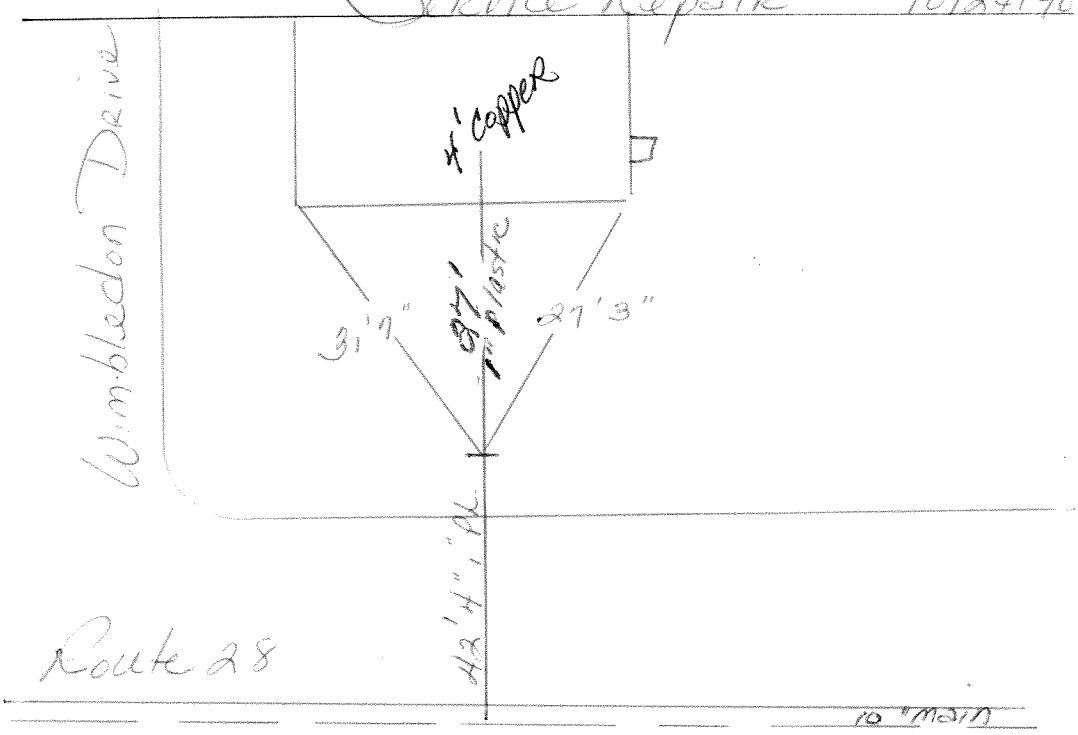
NAME 5075-33
Terri L Noyes
9-23-92

STREET 571 Route 28

VILLAGE West Yarmouth

METER NO. ~~8935847~~ 3002 4782 R# 42918 9/6/81

Service Repair 10/24/90



AR

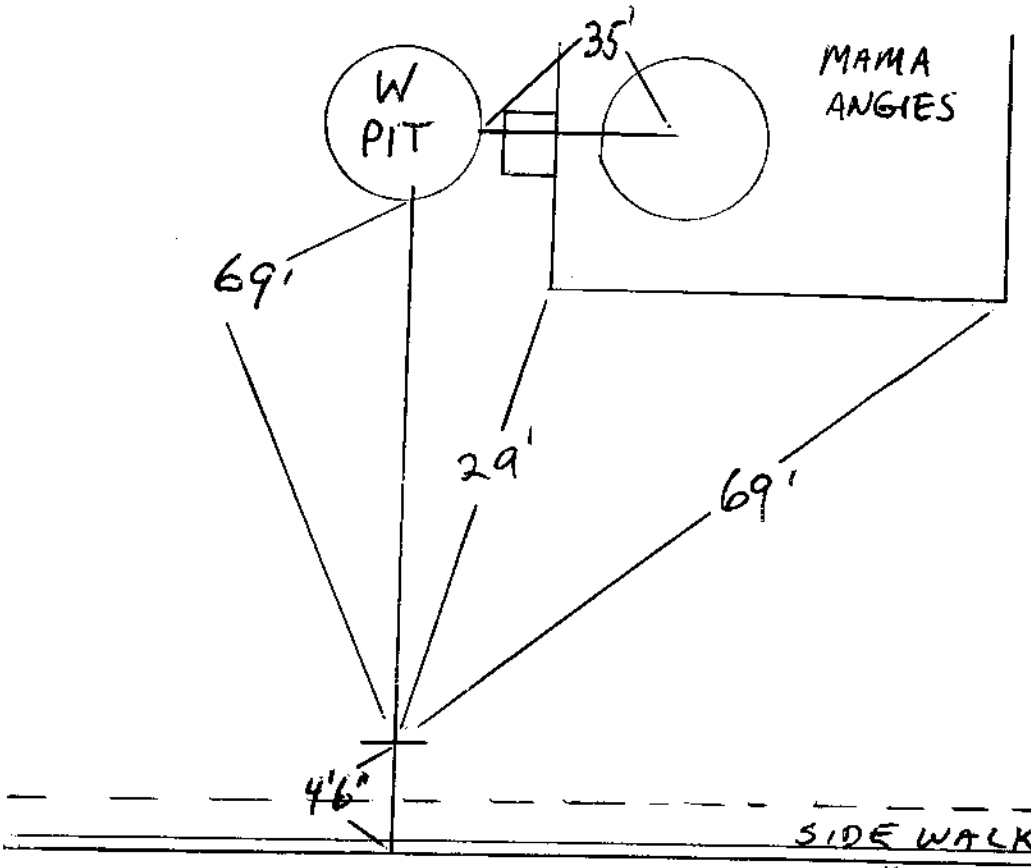
SERVICE NO. 5105-30

NAME MITCHELL E. HART TR MAMA ANGI

STREET 416 MAIN ST. Rt. 28

VILLAGE W.Y.

METER NO. 47016222 10-13-95 1



Rt

NEW TYE 1/10/0

5174-30

Cape Trawler motel

NAME Prince Shiva Babbit

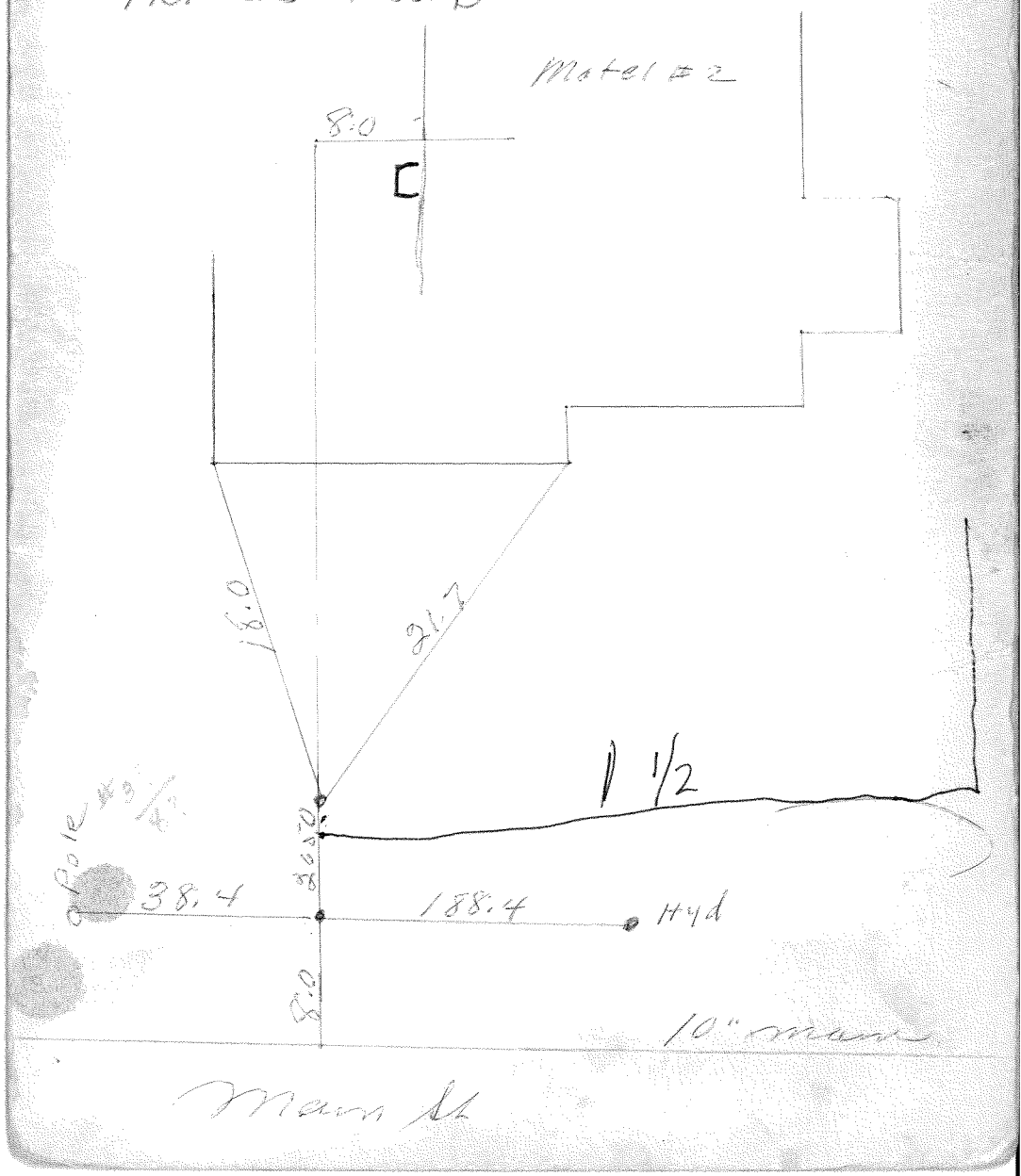
STREET 192 Main St (Motel #2) UNITS 5-10

VILLAGE W.Y.

SERVICE NO. 5174-30

METER NO. ~~18669427~~ ROCKWELL MHR 3-31-65 1"

4701 6215 11-22-95 Row-13



5203-30

~~R~~ R

5203
David Dempsey

NAME ~~[illegible]~~ Olive Crosby

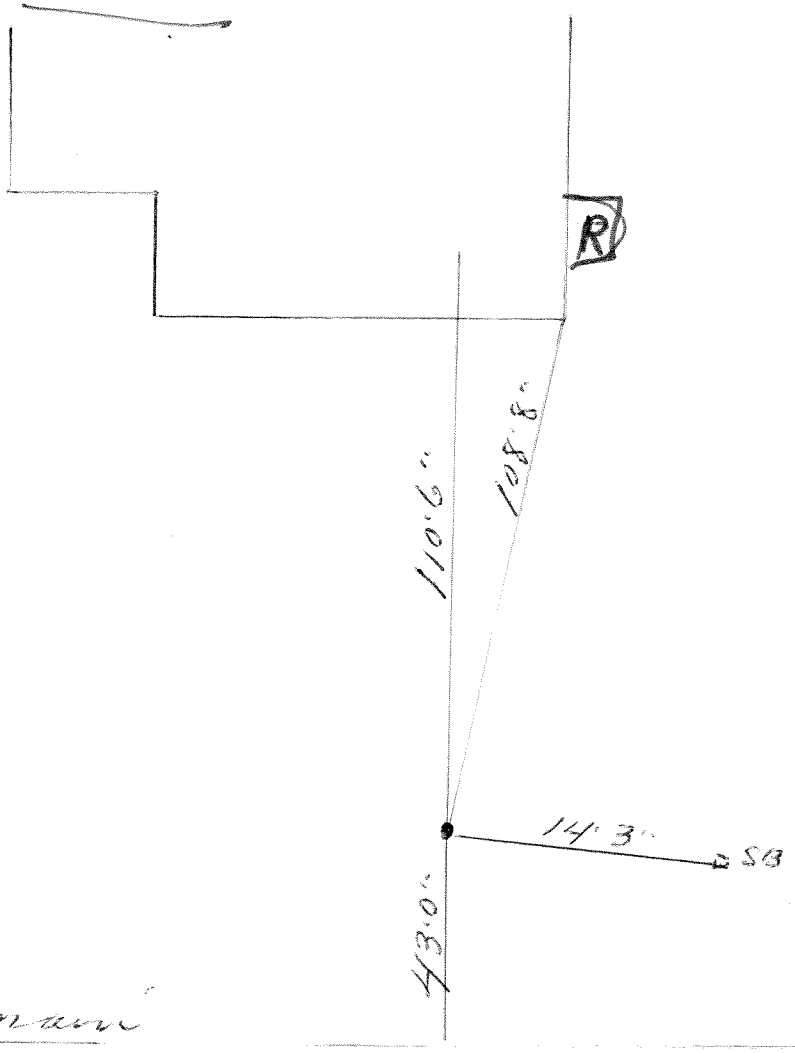
STREET ~~419~~ 415 Main St

VILLAGE WY

SERVICE NO. 5203-30

METER NO. ~~9520733~~ ~~5/8"~~ R 66612

30512425 1" 5-4-83



10" main

Main St WY

5275-30

PRO

NAME Kathleen Lovelette
5275-30 - 7/9/76

STREET 396 Main St.

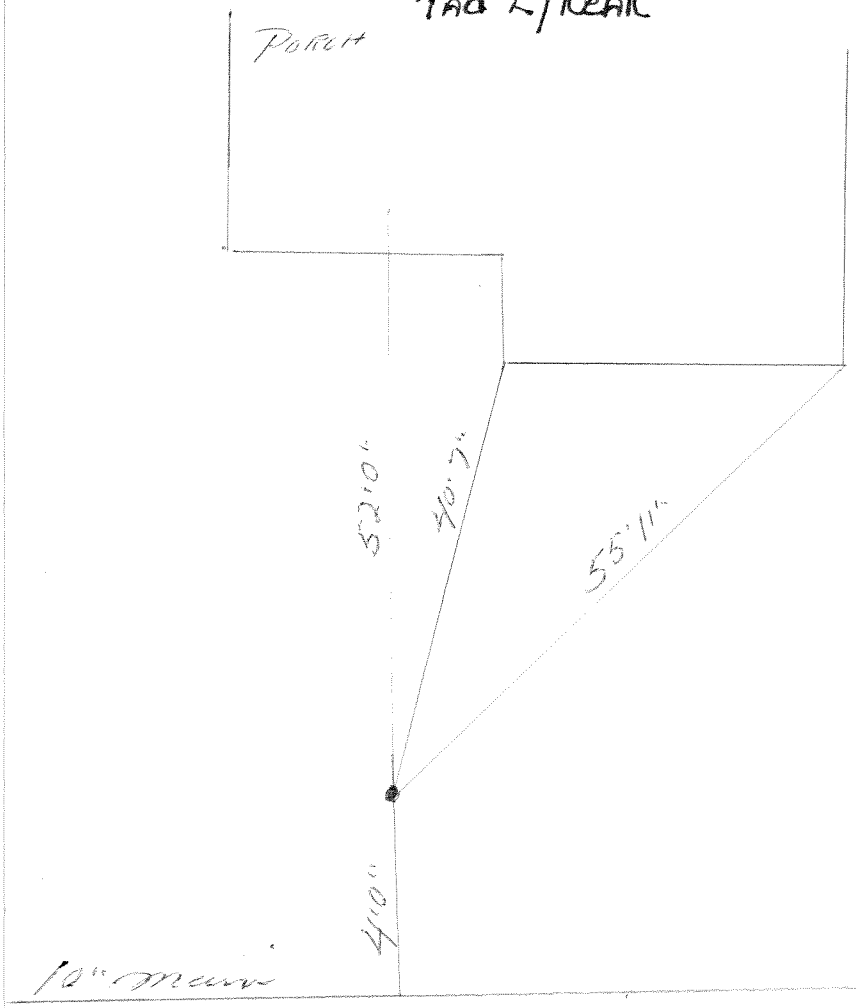
VILLAGE W Y

SERVICE NO. 5275-30 11-23-98

METER NO. ~~9275-99~~ 44738602 5/8" PRO ~~R # 50100~~

BACK of house

PAD L/REAR



Main St W Y

5339-30

SERVICE NO. 5339-30 Pella Window PRO

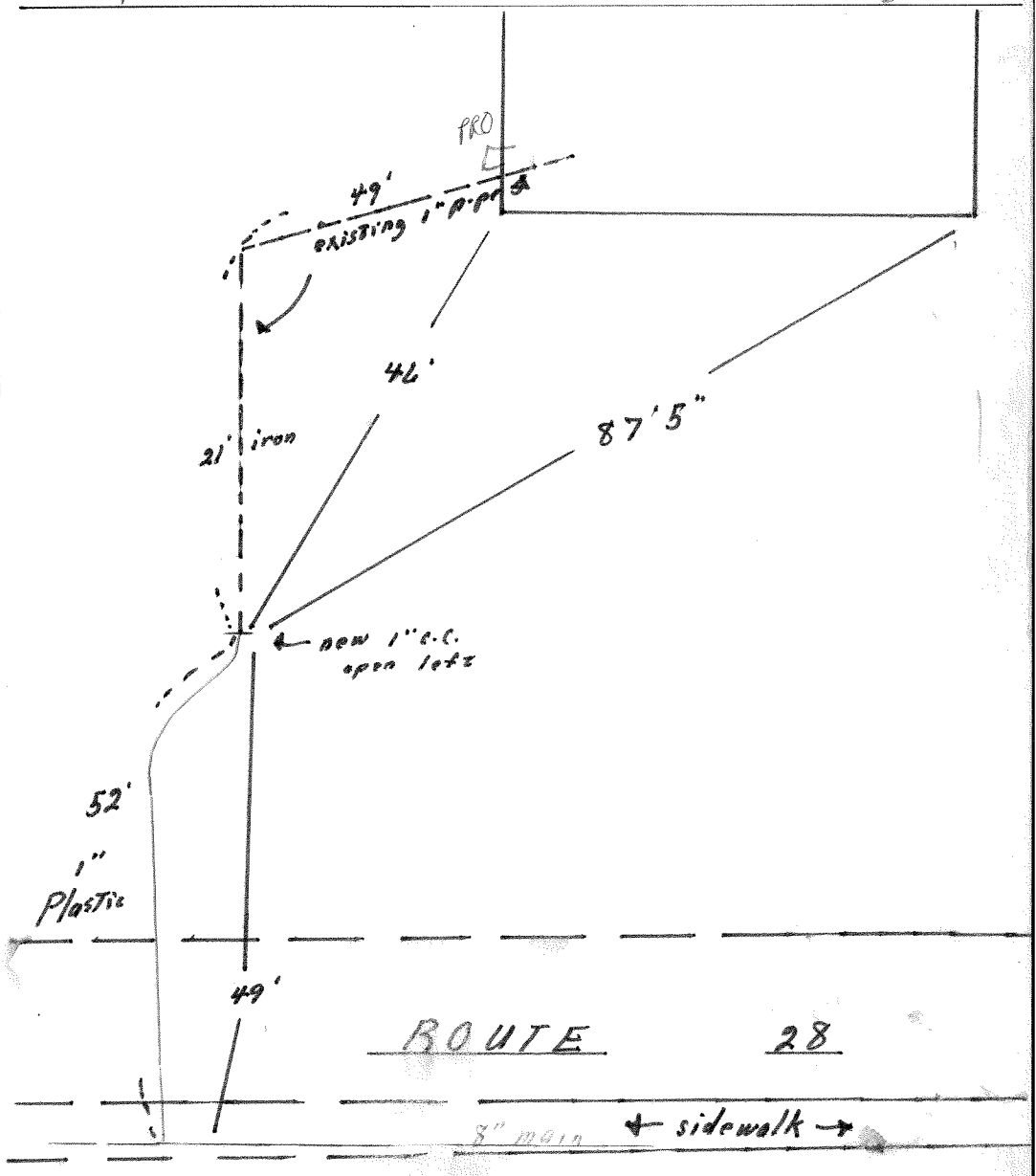
NAME Er 5339 8/6/99 Cape Cod Tobacco Michael P Washo | 5339 8/6/99 Gary Hennessey Michael P Wasko

STREET #1 311 Route 28 (STONE LINEN HOUSE)

VILLAGE West Yar.

METER NO. 44739301 5/8 12-23-98 KOW 33

PRO left side ~~12-29-80~~



5389

SERVICE NO.

PRO

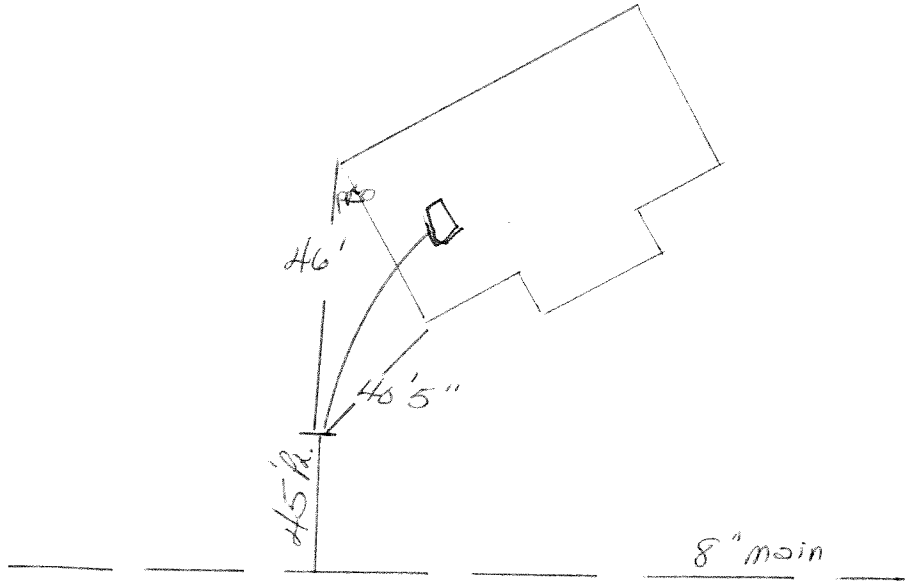
5389-33

NAME Gee Candev Realty Tr. ! (Shell Gas Station)

STREET 327 Route 28

VILLAGE West Yarmouth

METER NO. ~~2299 8852~~ 4738397 5/8 12-22-8



5479-30

PRD

NAME Arnold Petrone
5479-30 12-7-78

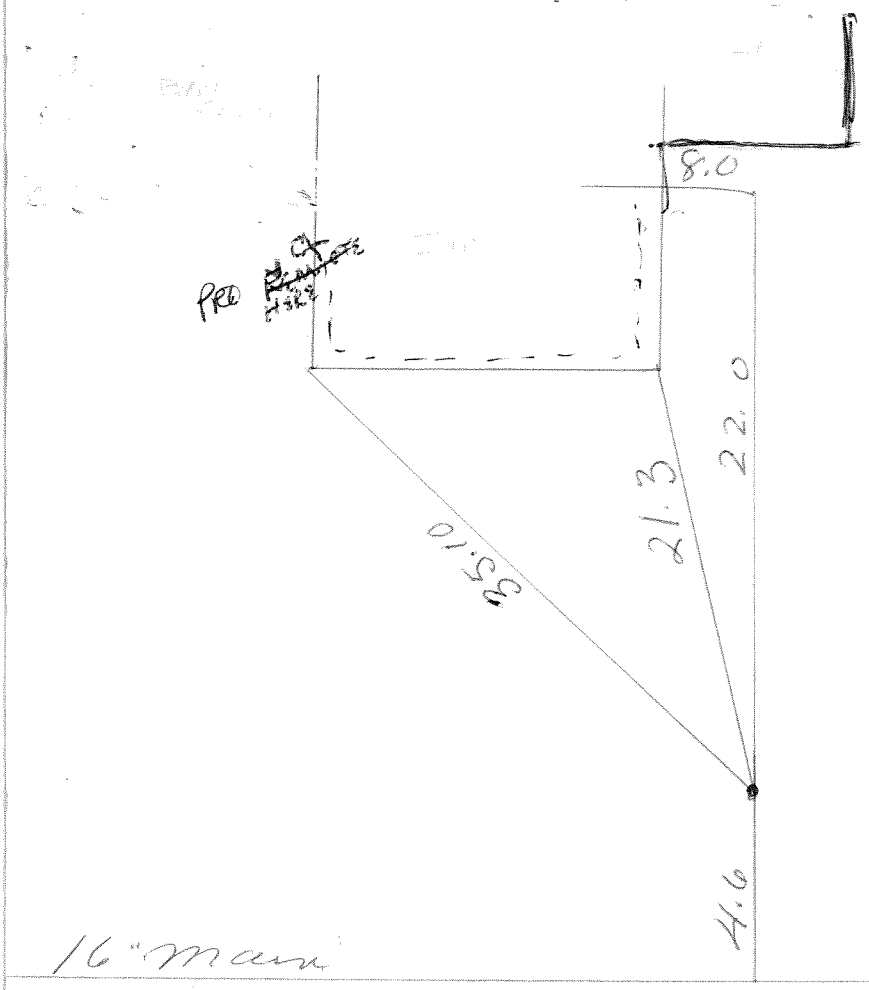
98.10

STREET Main St

VILLAGE WY

SERVICE NO. 5479-30

METER NO. 45133634 5/8 1-22-99



16" Main

Main St Hwy

ABB

5511-30

SERVICE NO.

NAME 5511 JOAN T. SIMPSON Inc

STREET 316 Route 28

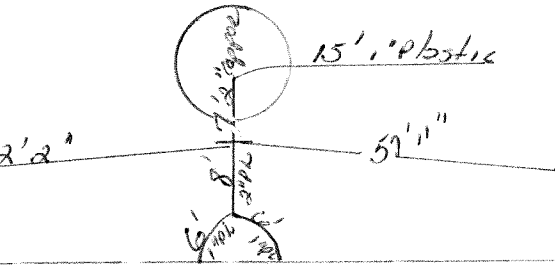
VILLAGE West Yarmouth

METER NO. 10398024 11/17/00 ID# 6142039290

2" meter

27'2" Service Relocation

pad on post NEXT TO PIT



Route 28

5524- 1220

ADB

5524-33 4/14/92
Marmaris Corp
Windrift Motel

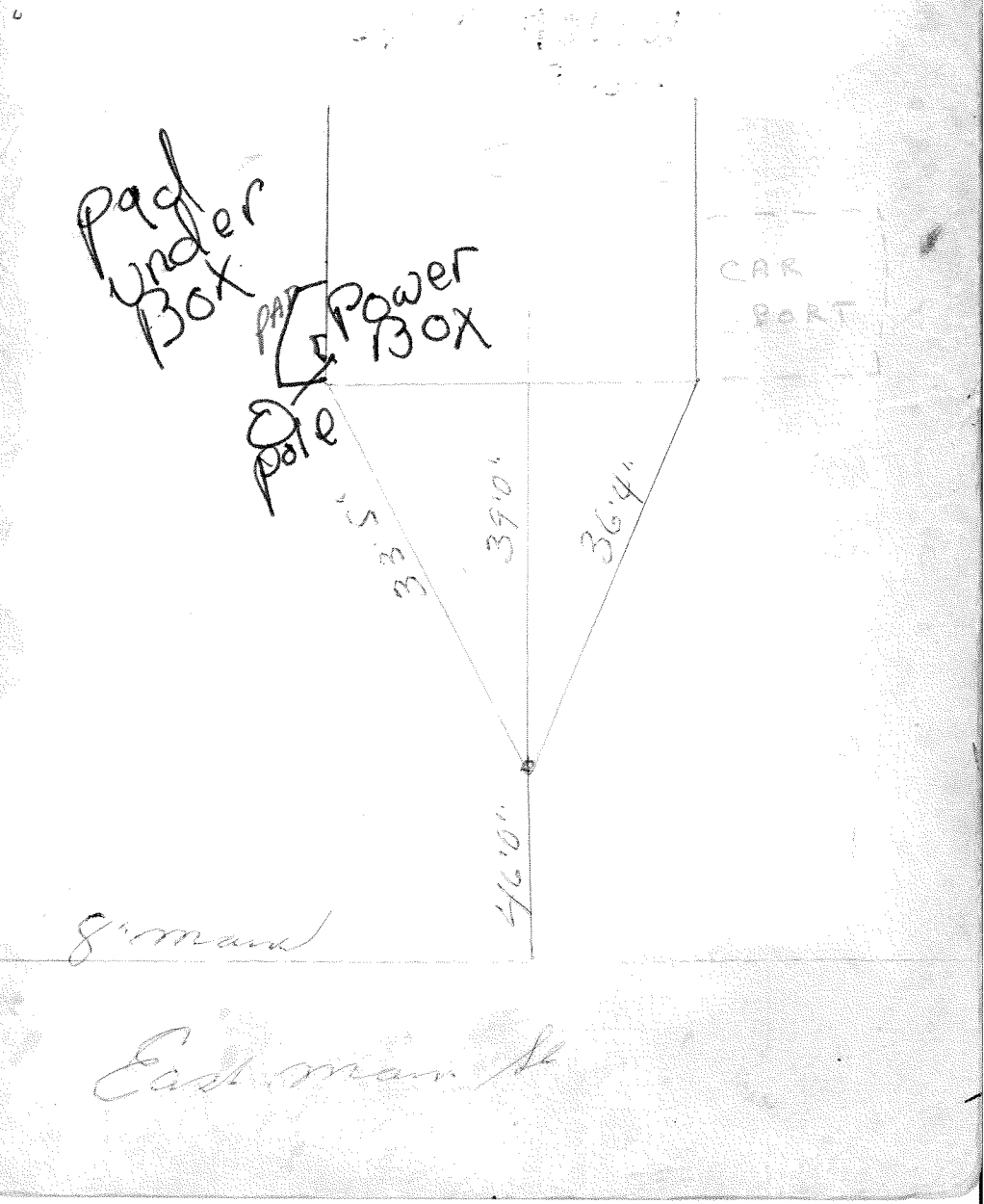
NAME WINDRIFT MOTEL #1

STREET ~~[redacted]~~ Motel #1 OFFICE

VILLAGE W Y

SERVICE NO.

METER NO. 10402672 ID# 5232129615



5525-330 - 120

5525-33 4/14/92
Marmaris Corp
Windrift Motel

NAME

STREET [redacted] 115 & Rt 28 Unit #2

VILLAGE WY

YWD - Pit 4-28-17

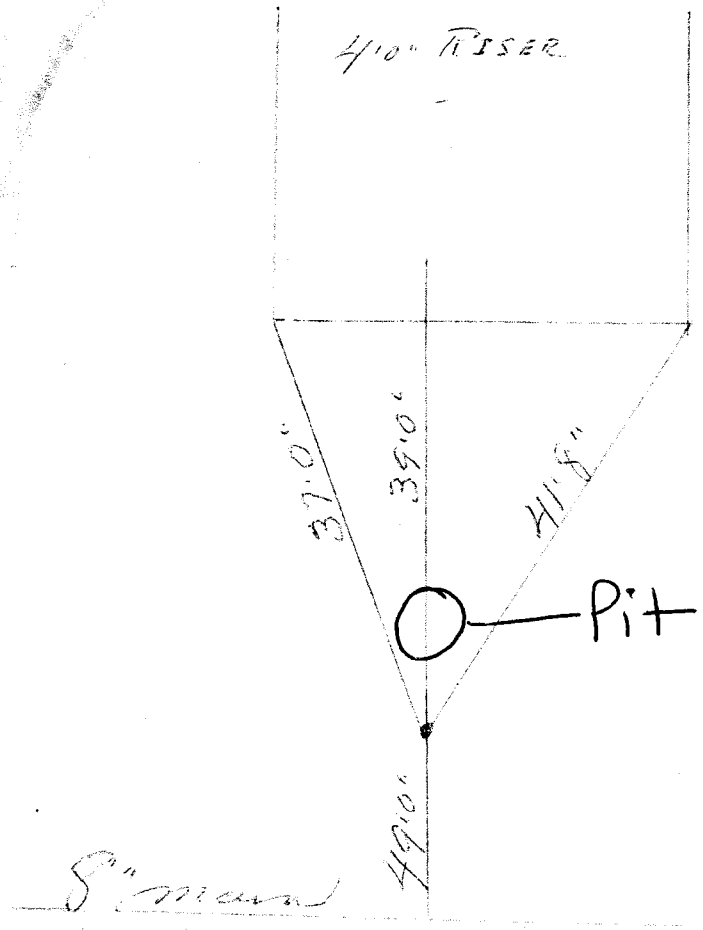
SERVICE NO. 5525-30

ROW 4/13

METER NO. ~~1624 42 FD~~ 2010-4732 1" 11-16-83 ID # 925525

Front under bow window

3-1991



5" main

Eastbound Rt

SERVICE NO. 5554-30 PRO

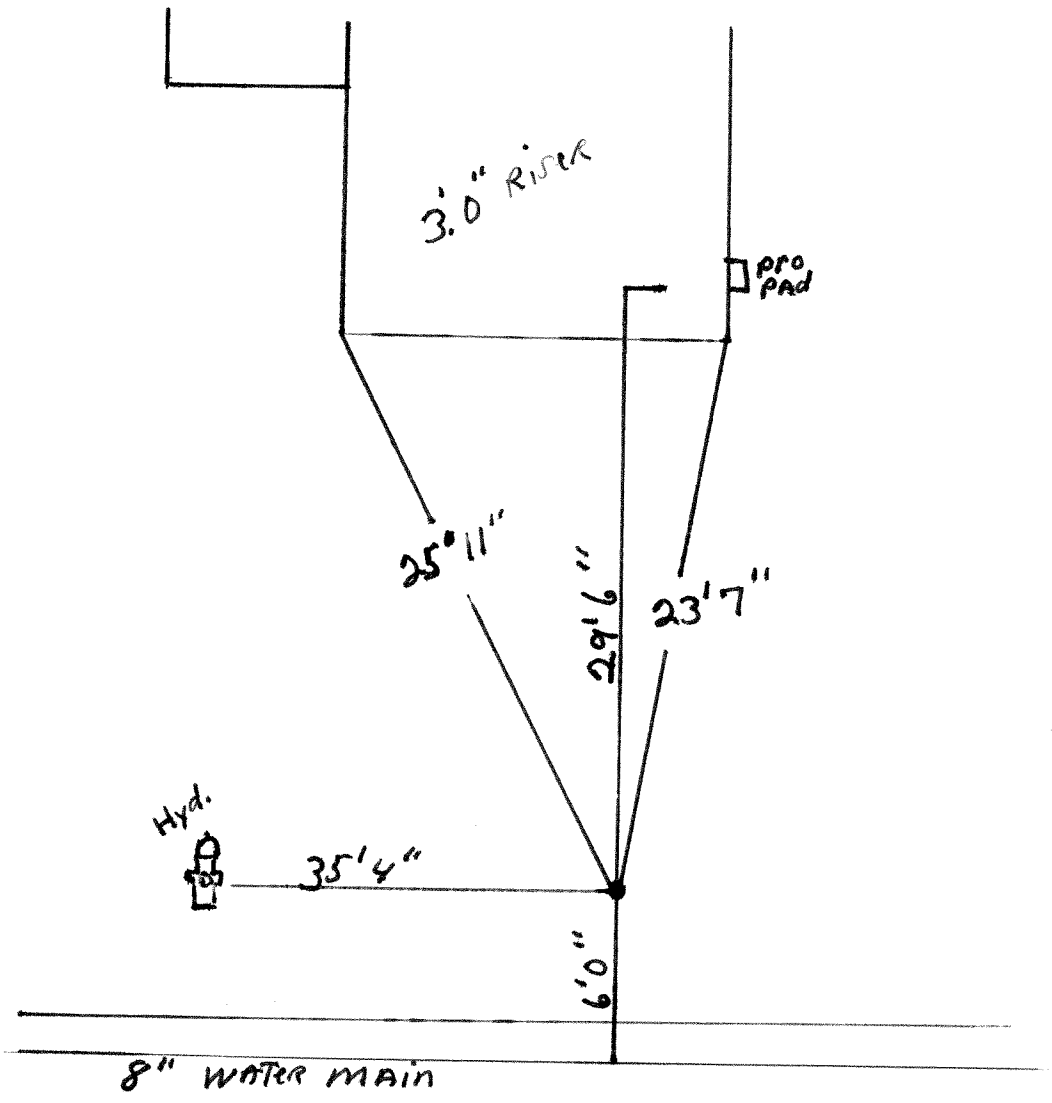
NAME Andreas and Artemis Evangelidis

STREET 194 Main ST Rte 28 West Yarmouth (Store) (Restaurant)

VILLAGE West Yarmouth

METER NO. 4473-8721 IO# 4473-8721

meter changed out 12-22-98 by Vean



Rte 28 West Yarmouth

5558-42 ABB

NAME 5558 W. YARMOUTH LODGINGS INN

STREET ~~Leonard~~ Wendward Way

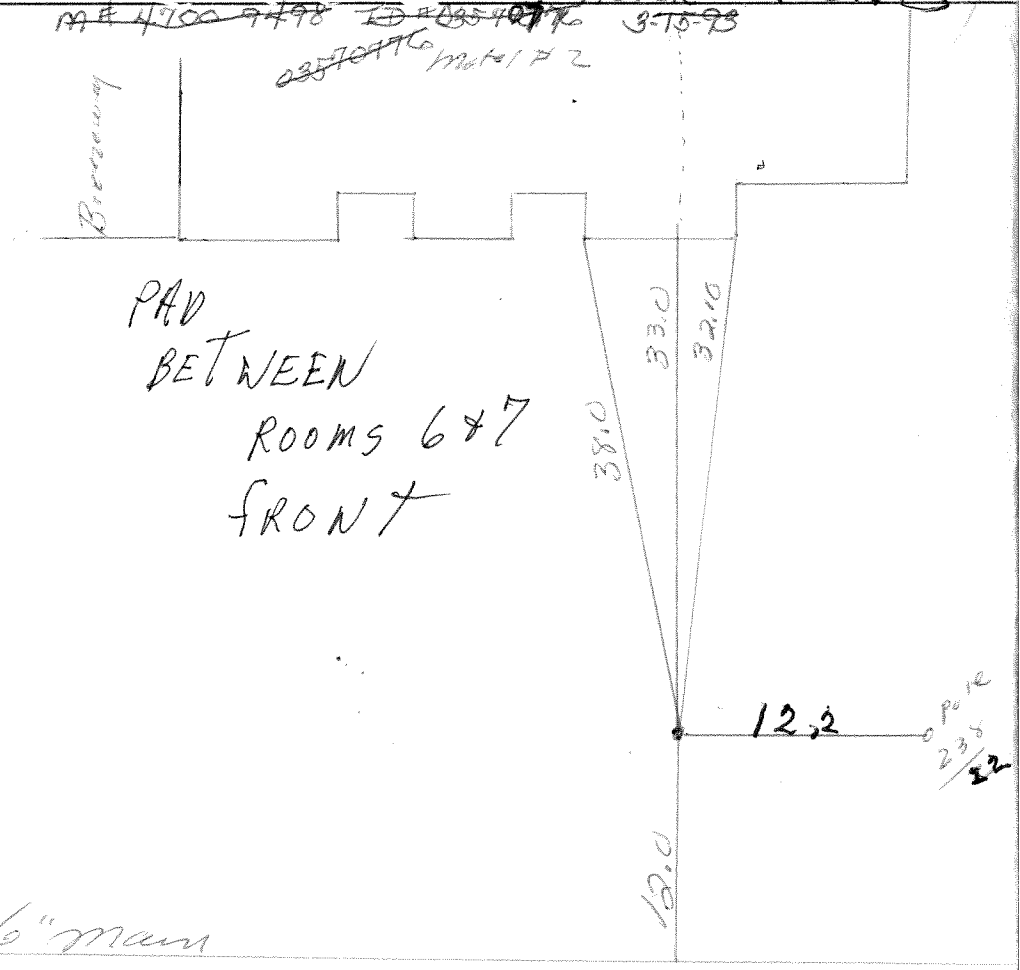
VILLAGE WY

SERVICE NO. 5558-42 V-21-01

METER N. 10402659 5292/300/8 1" METER ROW 13

~~M.E. 4700 9498~~ ~~D=0354077~~ 3-10-93

~~0357077~~ Mete/ # 2



~~Leonard Way~~

WENDWARD WAY

PRO

SERVICE NO. 5559-42

5559
W. YARMOUTH LODGINGS

NAME W[illegible] Hoyt Beach Land motel

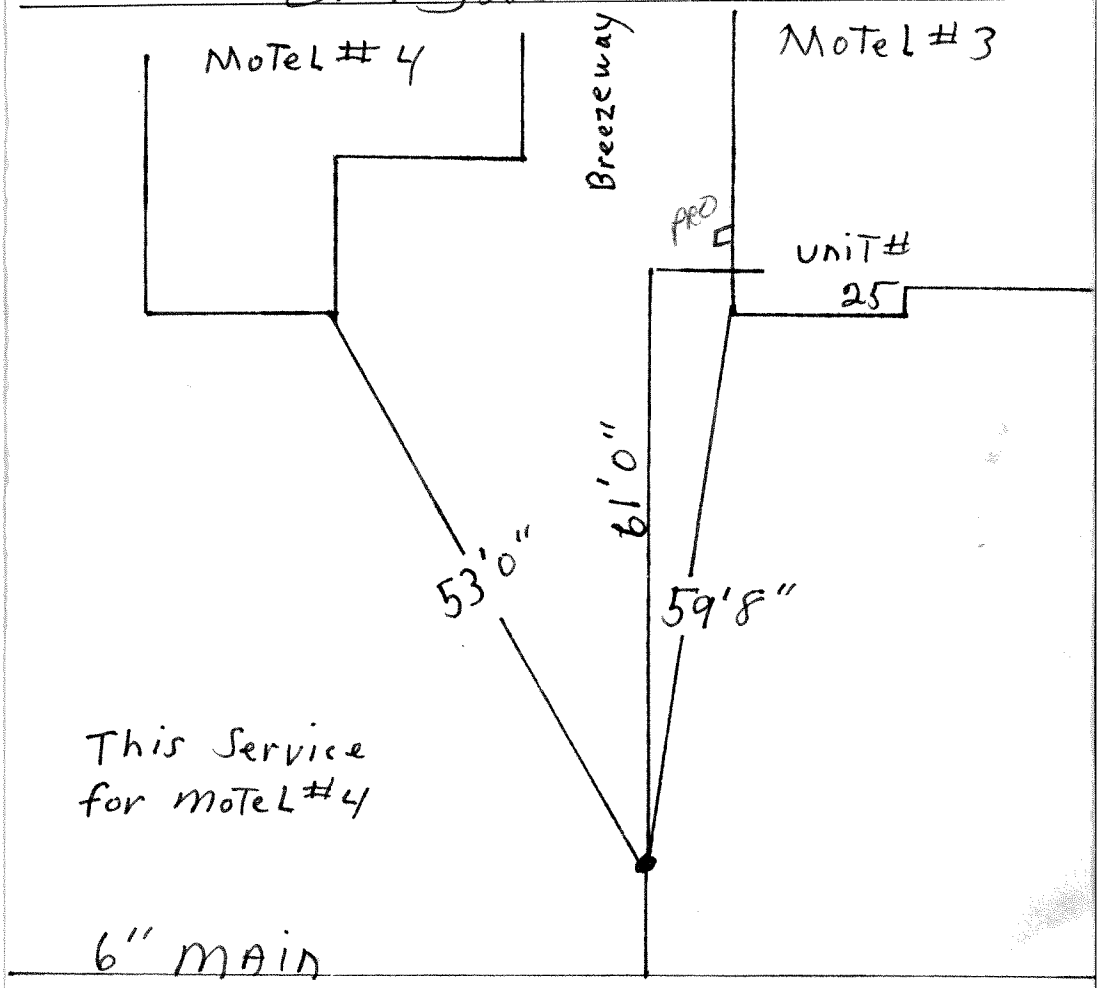
STREET Wendward Way

VILLAGE W. Y.

#7916690 #0877920873 6-1-99

METER NO. ~~2013 2857~~ RM 1" ~~8-16-82~~

units 26-35



Wendward way

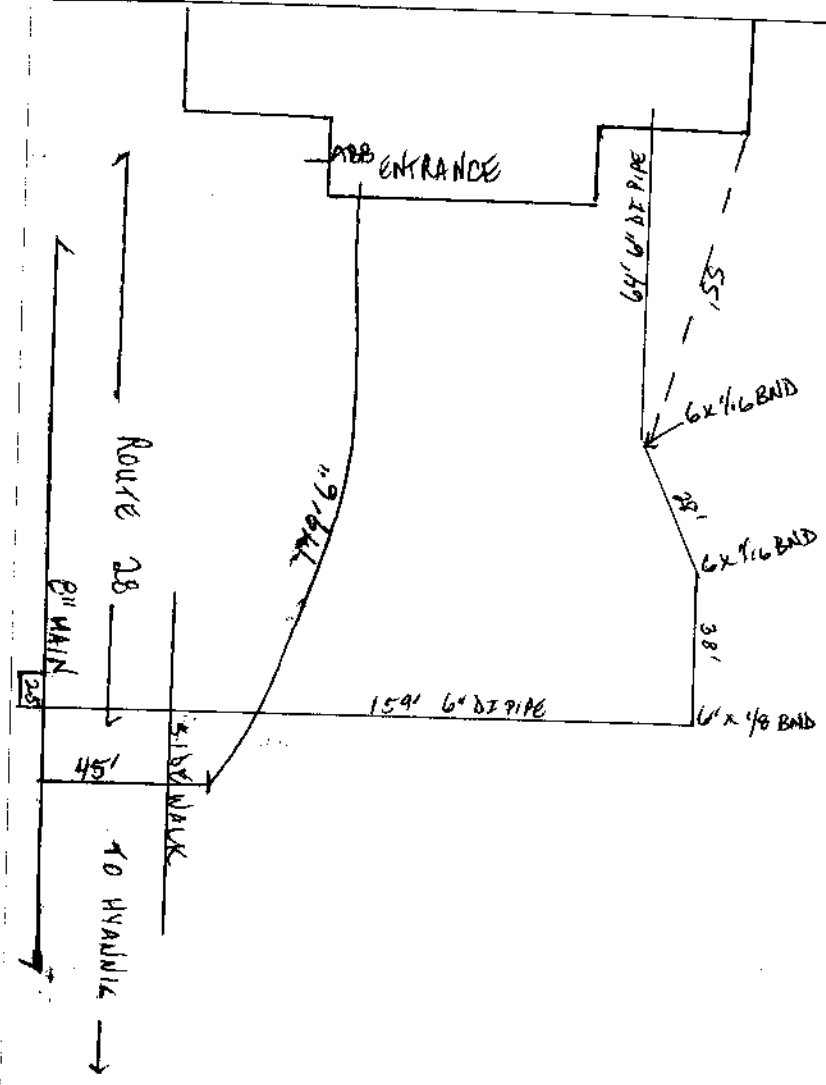
SERVICE NO. 5566-30

NAME 325 ROUTE 28 LAMBERTS

[redacted] WEST YARMOUTH

[redacted]

METER NO. 10402638 12-20-00 I&*5231128632 ABB 1"



ARB

SERVICE NO. 5571-

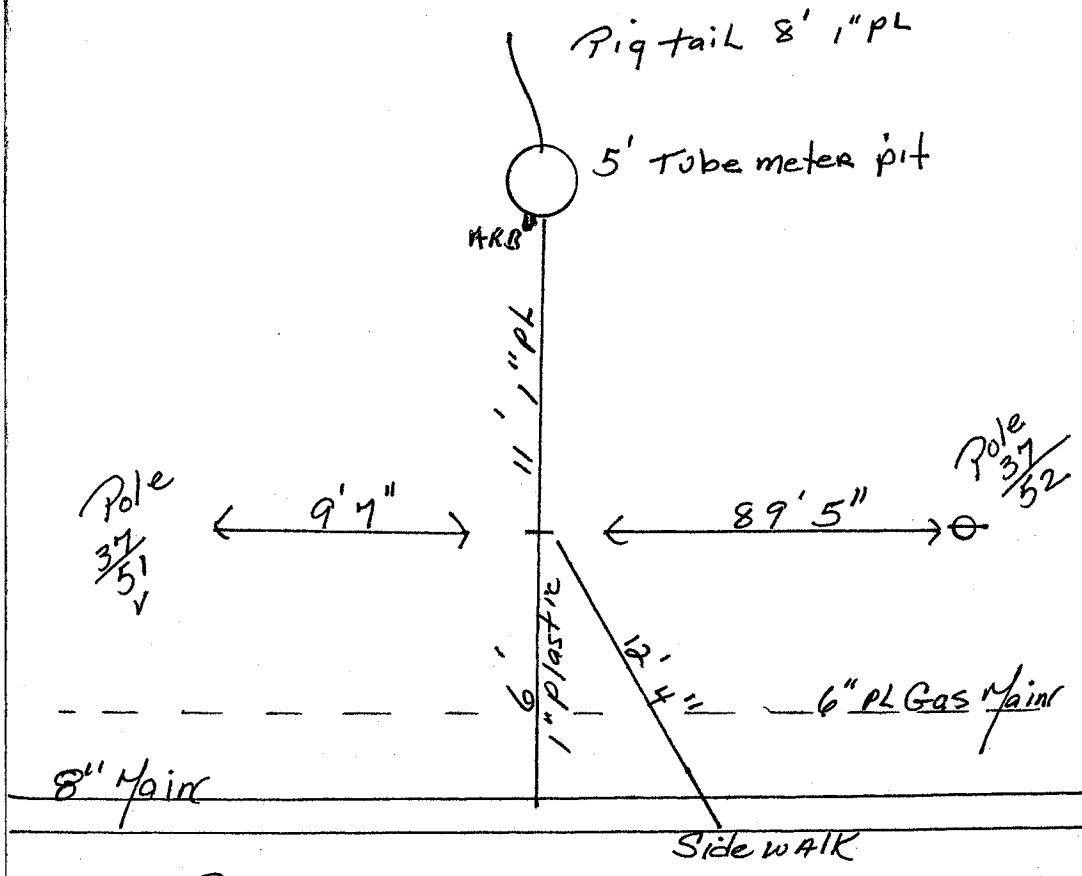
NAME Jump-on-US, Inc. George Elefther

STREET 260 Route 28 Lot I-1

VILLAGE West Yarmouth

METER NO. 40224915 4-30-96

4-12-96
New Service



Route 28

PRO

SERVICE NO. 5616-42

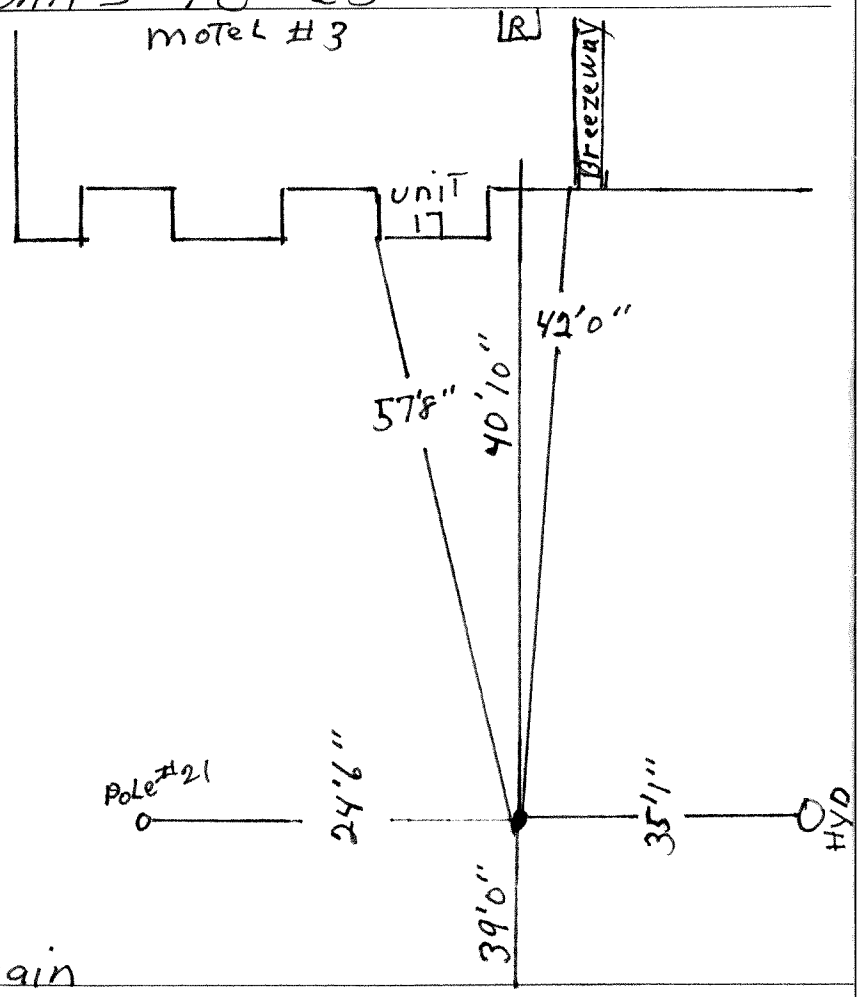
NAME Wi 5616 W. YARMOUTH LODGINGS Hoyt Beach Land motel

STREET Wendward Way AKA 77 Rte 28

VILLAGE W.Y.

METER NO. ~~3075 5035~~ 47275932 ~~5/8~~ 1" 2-12-99 ~~6-59~~. ~~Rx~~ 1" ~~R#60588~~

units 16-25



Wendward Way

5640-30

ABB

5640
CHRISTIN HAYES

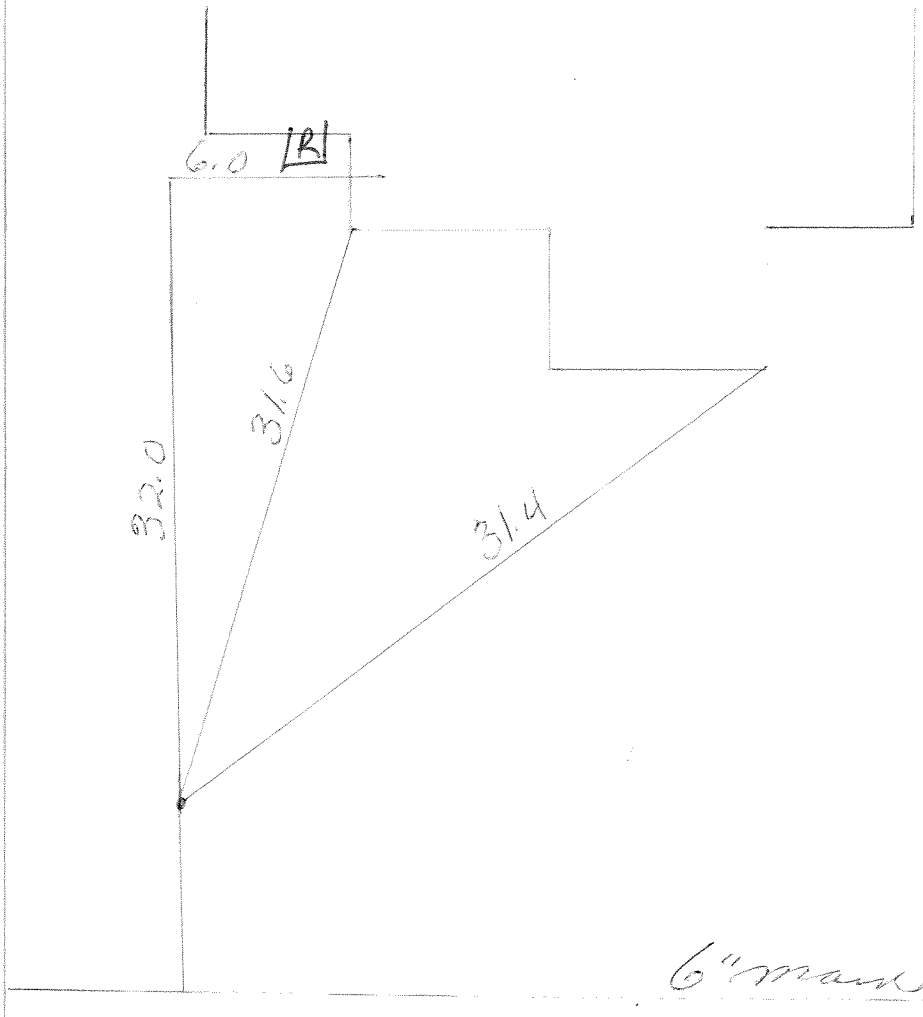
NAME

STREET 374 Cor main St & North Rd

VILLAGE WY

SERVICE NO. 5640-30 5/8"

METER NO. 10386531 12/23/00 ID#5232145761



Cor North & main St

ABB

5647-30

SERVICE NO.

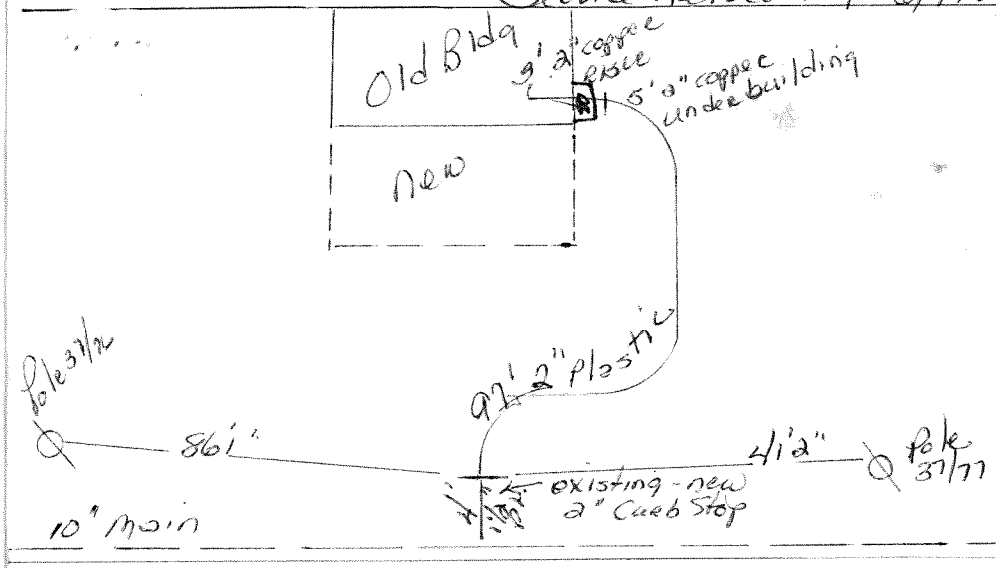
NAME Holly Tree Trust

STREET 4/2 Route 28

VILLAGE West Yarmouth

METER NO. 12075268 614107736 6 2" 1-2502

Service Relocation 6/9/89



28

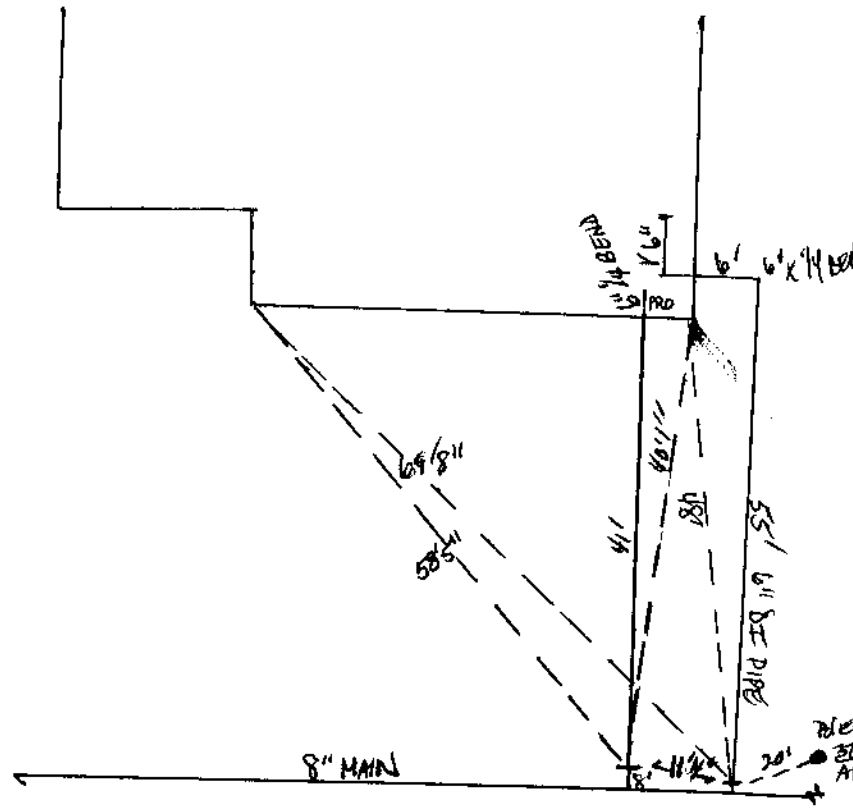
SERVICE NO. 5884-30 PRO

NAME KIM WOODBURY

STREET 204 ROUTE 28

VILLAGE WEST YARMOUTH

METER NO. 43199450 ID# 0043199450 5/8"



TO HYANNIS ROUTE 28

ARB

SERVICE NO. 5943 –

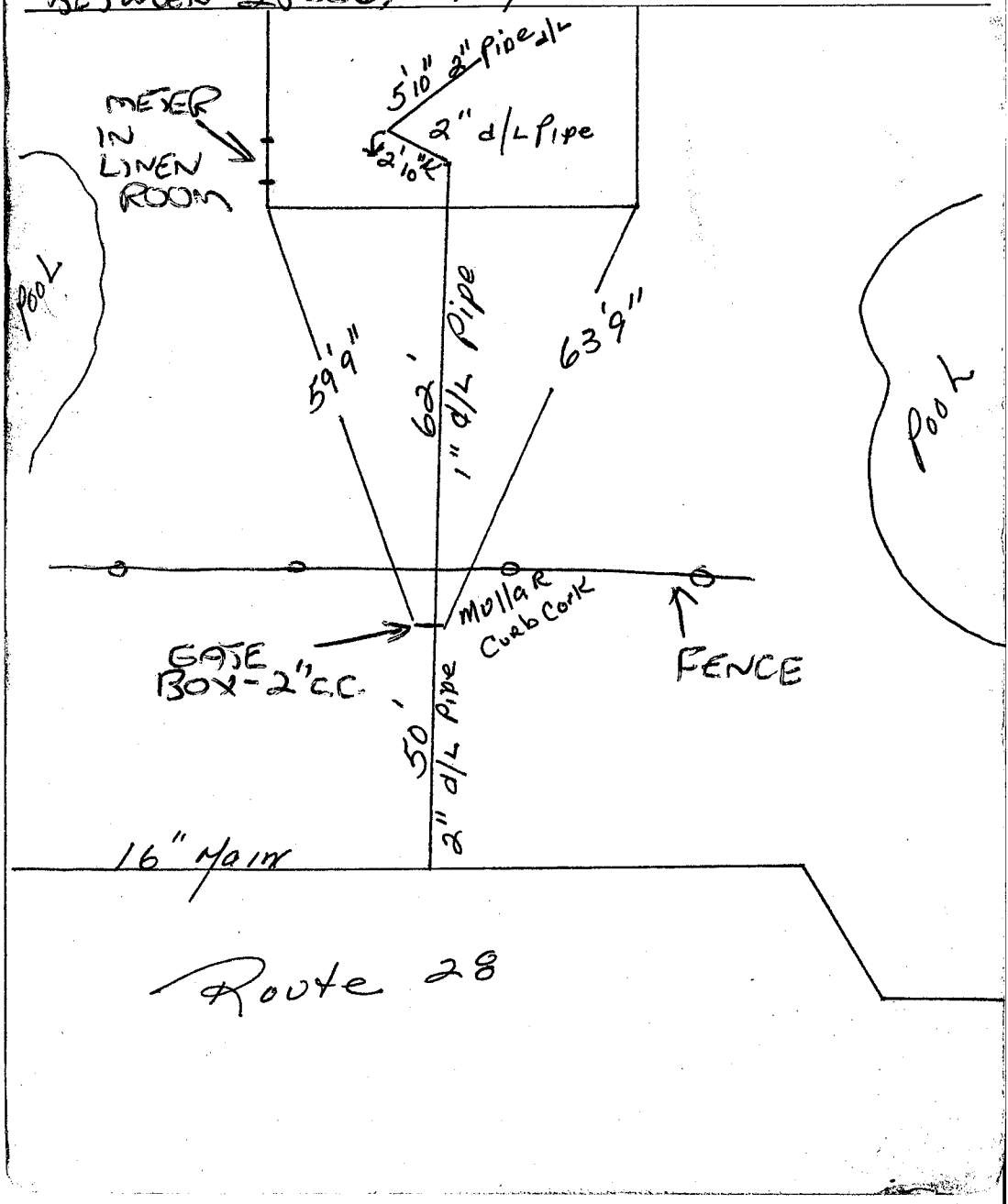
NAME ~~Americana~~ Holiday

STREET 99 Route 28

VILLAGE West Yarmouth

METER NO. 47016194 11-6-95

BUILDING BETWEEN 2 POOLS 1" Meter



P10

SERVICE NO. 5962 - 30

5962-33
NAME Peter H Ward
12-21-94

Leonard Bebro

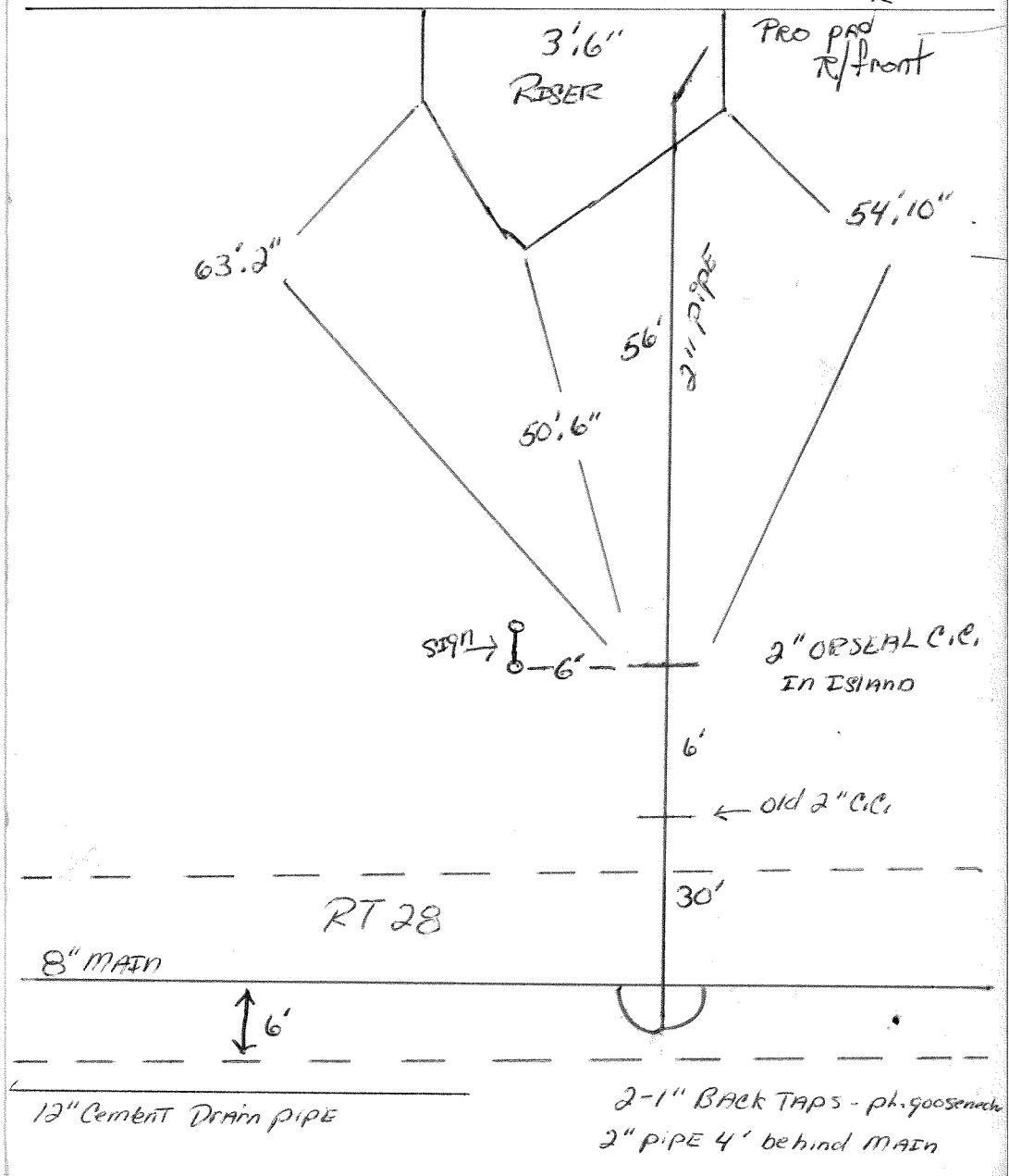
STREET 149 Route 28 MOTEL

Crawl inside OFFICE

VILLAGE West Yarmouth

1"

METER NO. ~~2010727~~ Rockwell MAG. 4/29/69
48016105 2214990040
~~8929 8304~~ ~~ID 00000496~~ 1.6.00Row



ARB

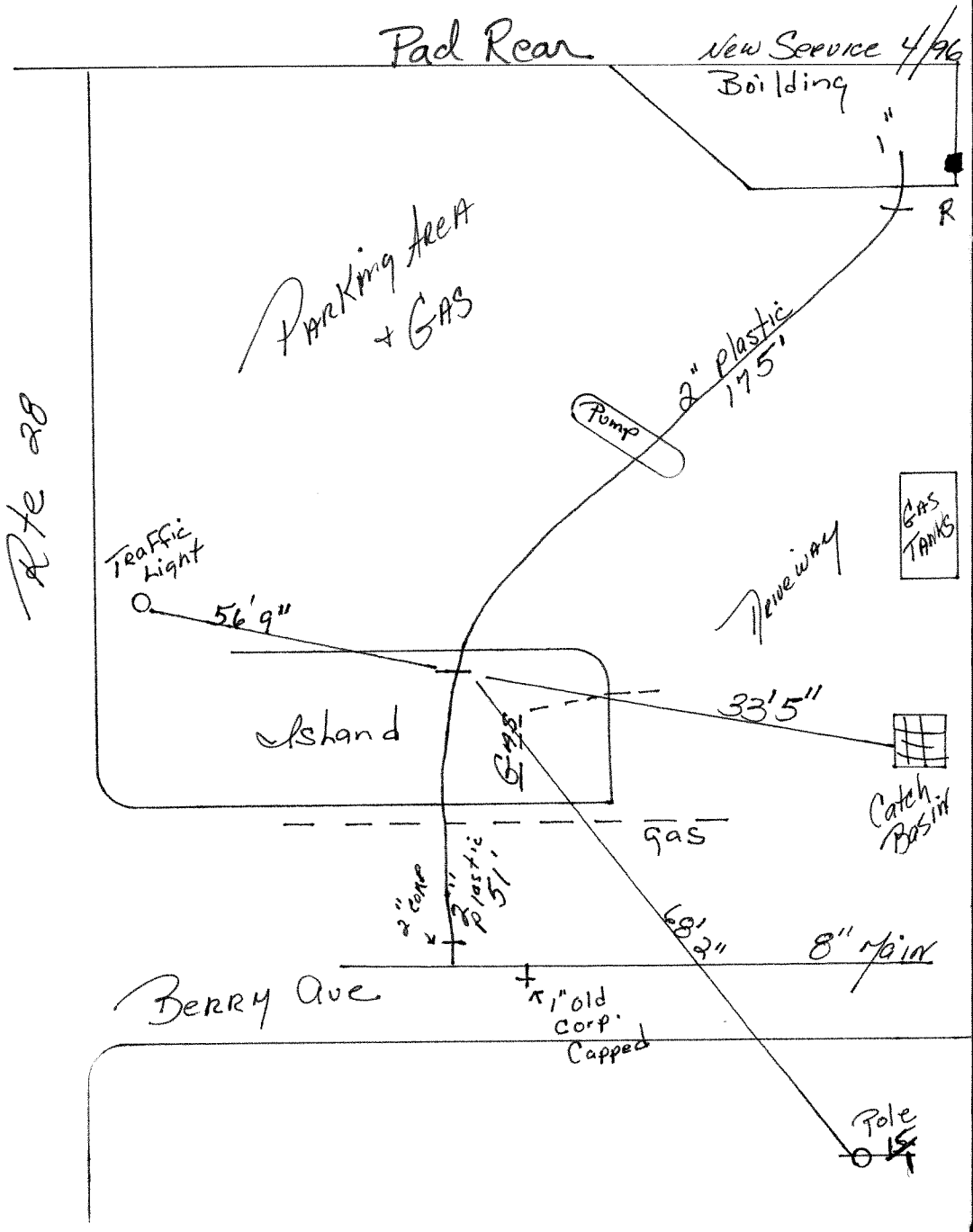
SERVICE NO. 5987-

NAME 5987 INDEPENDENCE PARK ~~by Trust Christy's Market~~

STREET 441 Route 28

VILLAGE West Yarmouth

METER NO. 40225164 4-25-96



7032-36A

PRO

7032

NAME Mark Tasha
Carol Soares

STREEY 5 9 Keno Way
Quail Springs 88 Rd 28

VILLAGE W Y

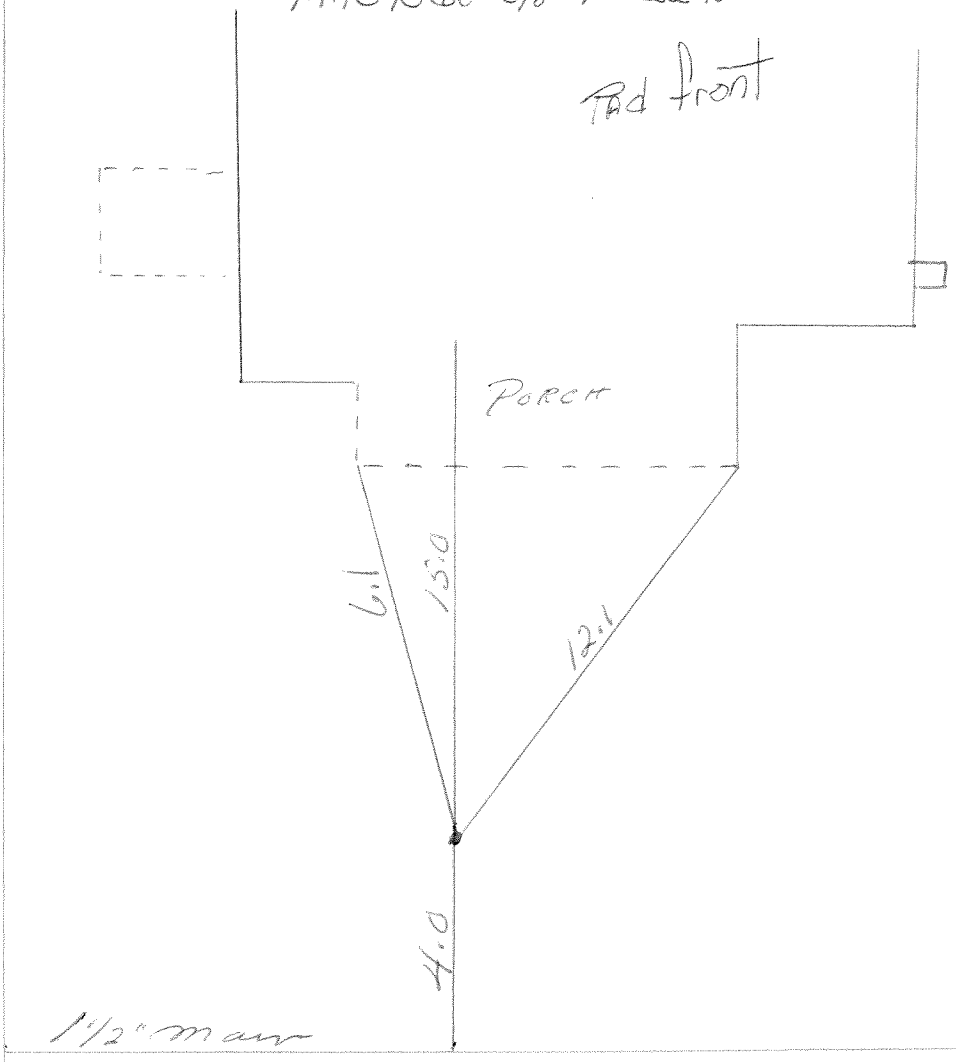
SERVICE NO. 7032-36A

~~1849765~~ ~~R#5036D Rock Wagon~~

METER NO. ~~17842646~~

ROW 3

4473968 5/8 12-22-98



Quail Springs 88 Rd 28 Way

PRO

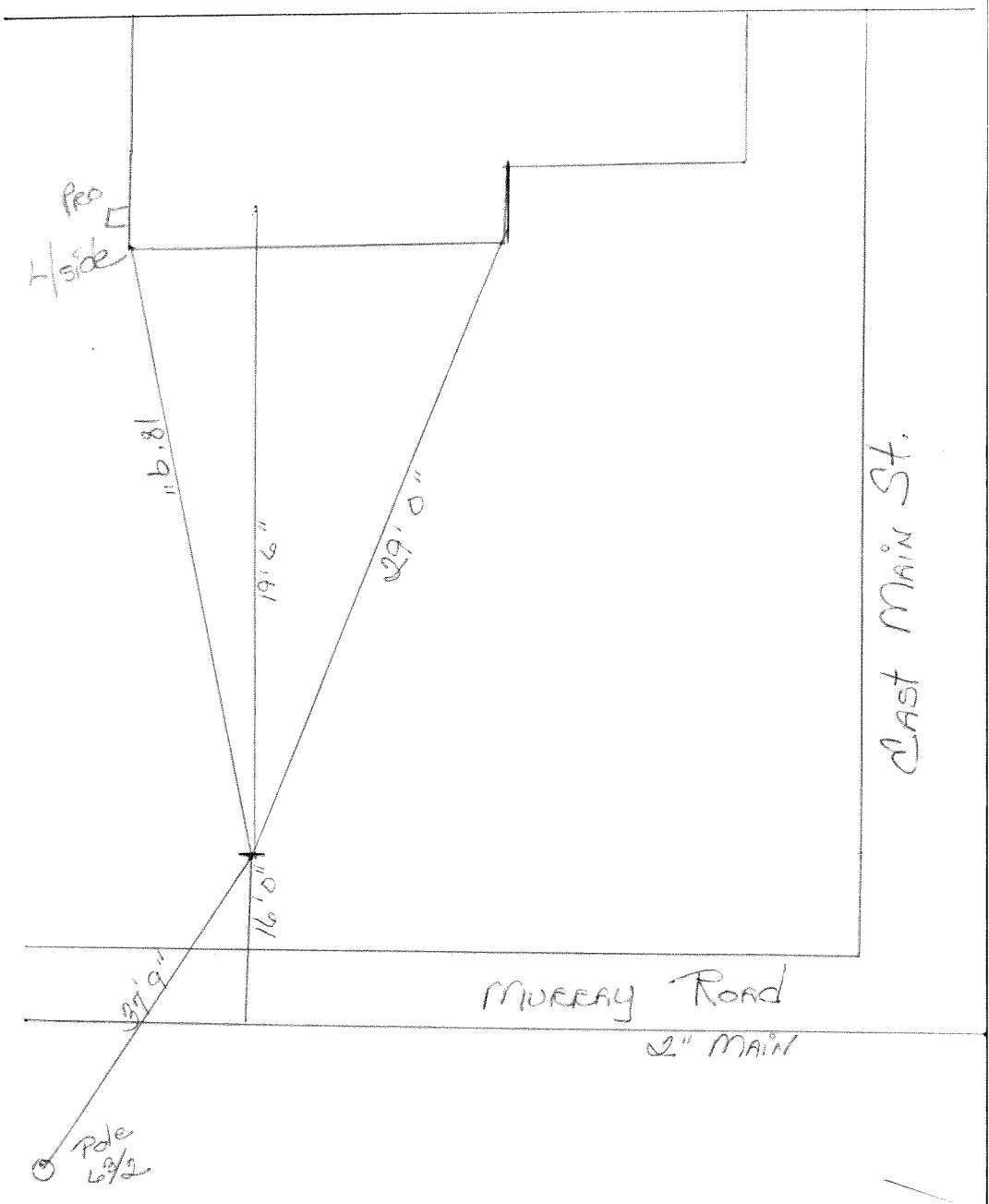
SERVICE NO. 7103

NAME 17 Main St Corp

STREET 17 East Main St.

VILLAGE W. Yarmouth

METER NO. ~~[illegible]~~ 44739974 5/8" PRO 11-17-98



ABB

SERVICE NO. 7116-33-158

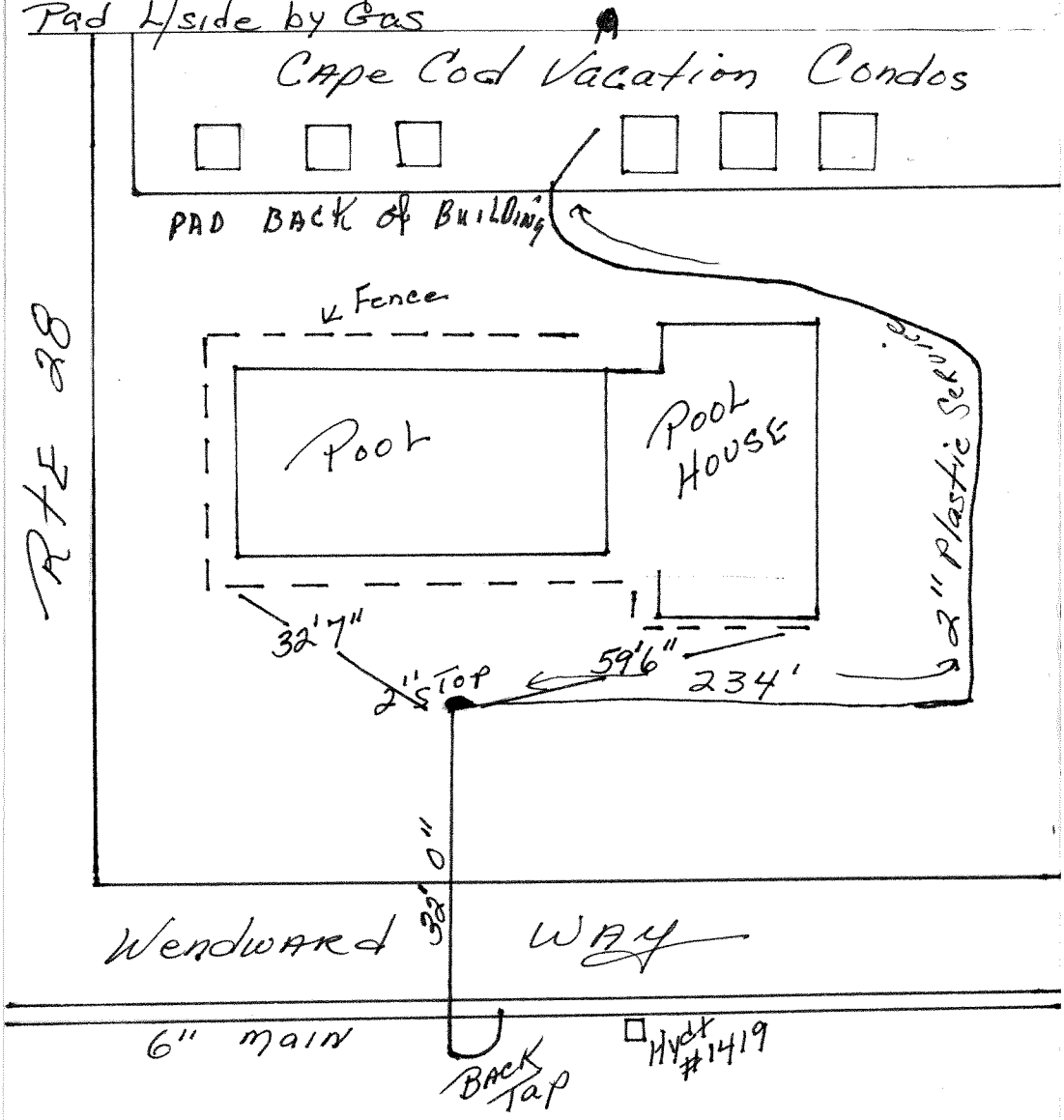
NAME Cape Cod Vacation Condos

STREET 91 Wendward Way - Rt 28

VILLAGE West Yarmouth

METER NO. 10398012 11/28/00 2" meter
ID# 6142039272

Pad L/side by Gas



7168-41 46 Captains House ~~6773~~ PCO

7168-46 4/14/92
Marmaris Corp
Windrift Motel

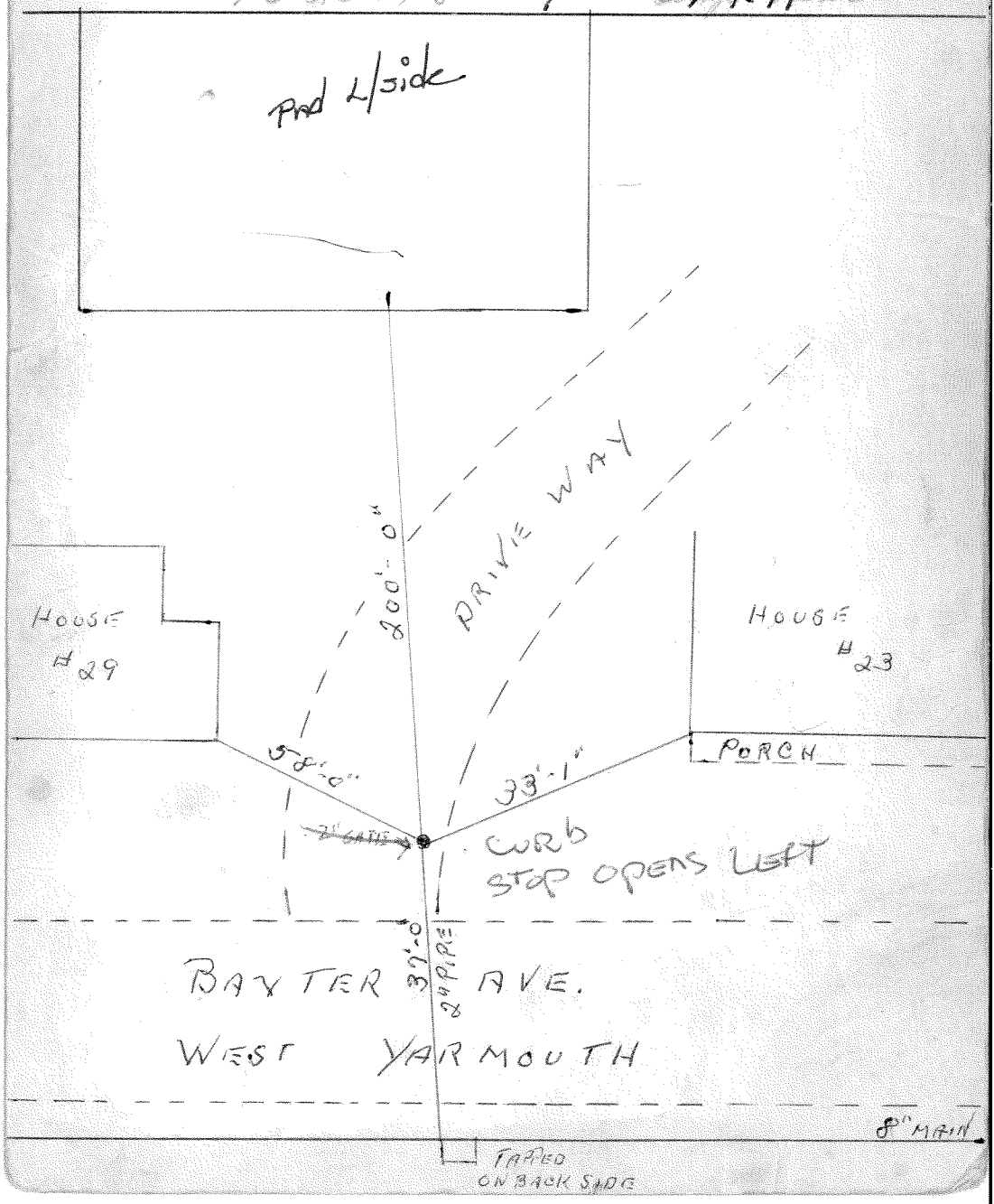
NAME ~~Windrift~~ Quality Tank UNIT #3

STREET off BAXTER AVE. 115 Rte 28

VILLAGE WEST YARMOUTH

SERVICE NO. 7168-41 ROW 55

METER NO. ~~27678663~~ 47884050 ~~T5 25 142~~ 8036993619 1" - 49.99



7172-30

SERVICE NO.

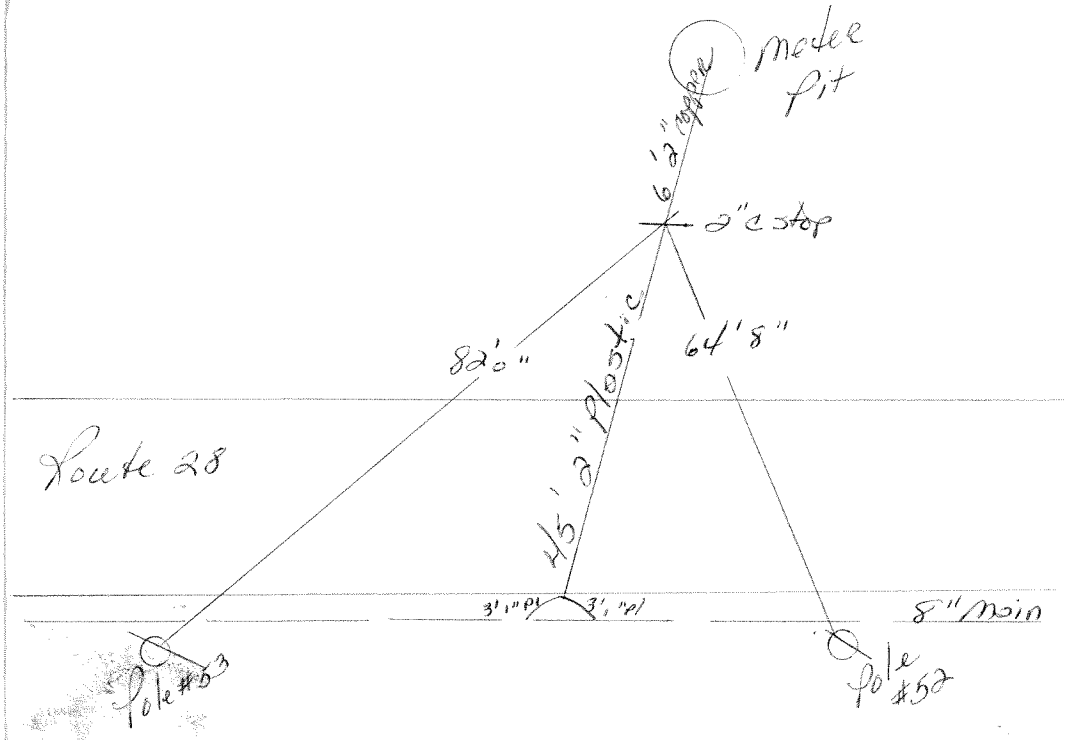
NAME John Barker Jr - Yankee Village Motel

STREET 275 Route 28

VILLAGE West Yarmouth

METER NO. 36989826 ID# 00923982 1" meter CC

Renewed service from main to ~~Stop~~ Pit 3/21/88



7228-36 PRO

7228-33
Robert B. Hunter

NAME

STREET KENS WAY OLOC

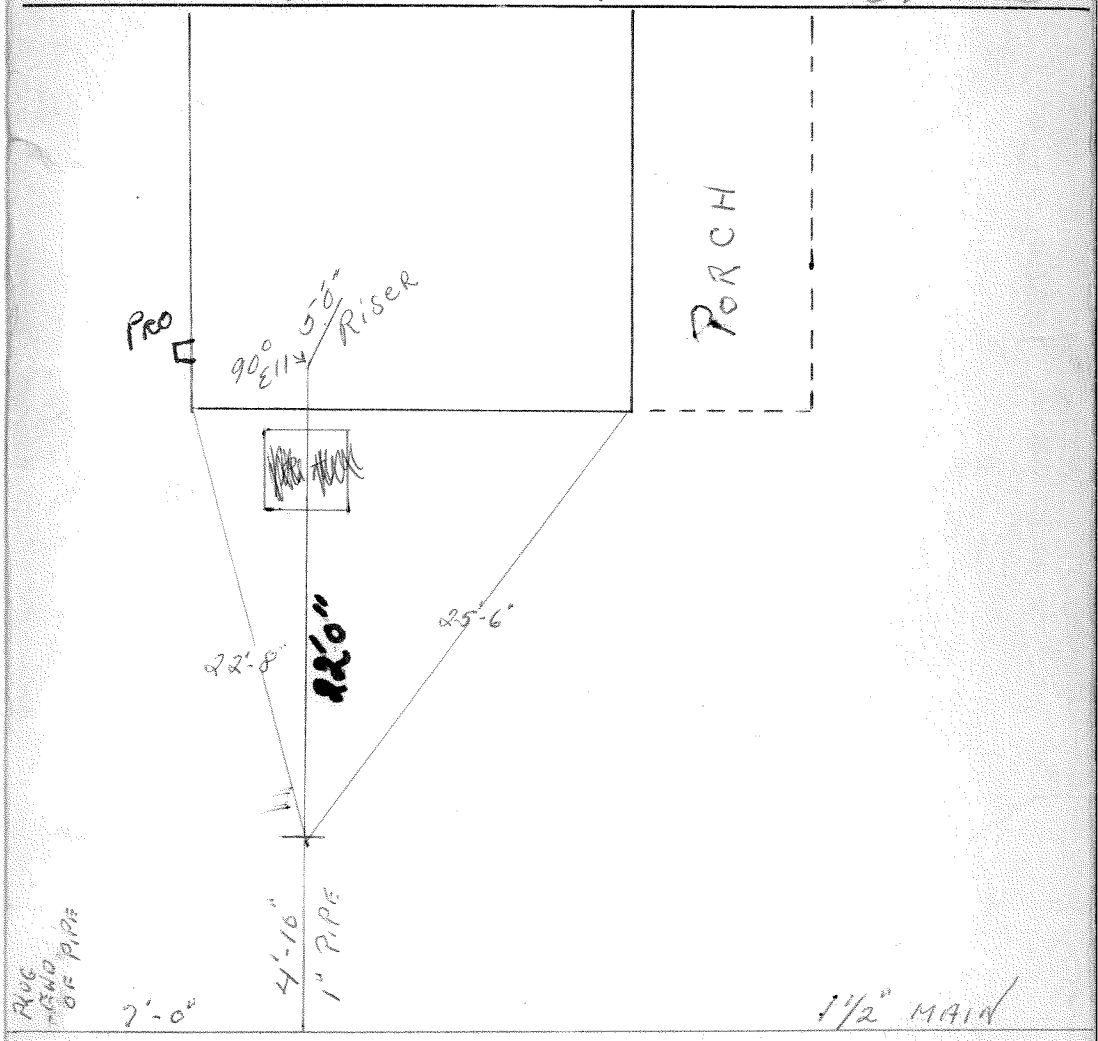
VILLAGE WEST YARMOUTH

KEY MGEPRO

SERVICE NO. 7228 - 36A

44739720 5/8 12-8-98

METER NO. ~~19488571~~ 9-19-66 ROW 58



KENS WAY

WEST YARMOUTH

7376-36A

PRO

NAME Lau[illegible]m

Terry S Walker
7376-36A-(1440)
1=3=86

STREET 21 Kens Way Lot 2

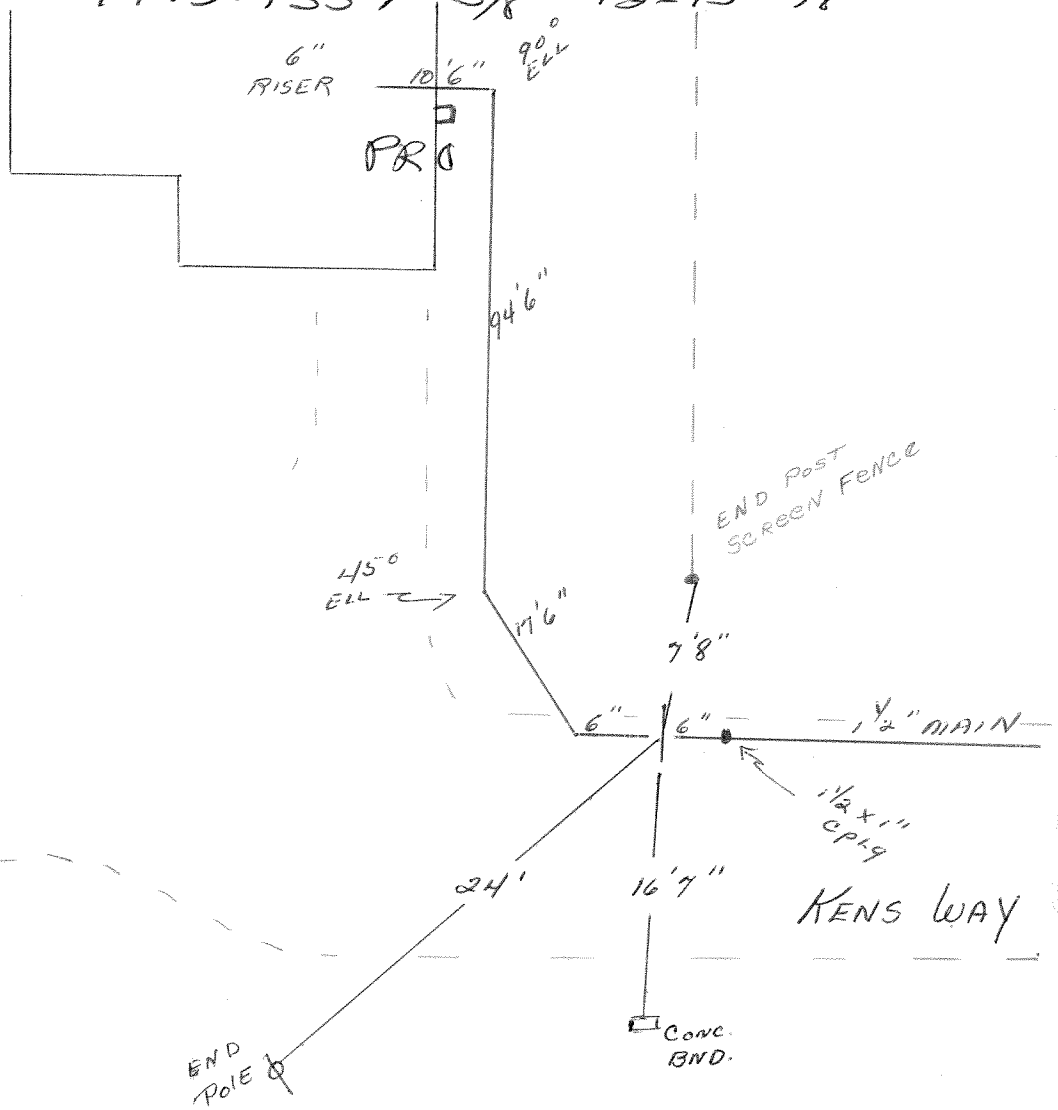
VILLAGE W.Y

SERVICE NO. 7376-36A

~~1B1.0005~~ R ~~1B1.0~~

METER NO. ~~1984 2248~~ 5/8" ~~Rock Maple~~ 10/67

4473.9357 5/8 12-15-98



1967

7398-30

ECR

7398 4/6/01
Ellas Hospitality LLP

NAME

STREET Tidewater Motor Lodge - 131 Main ST

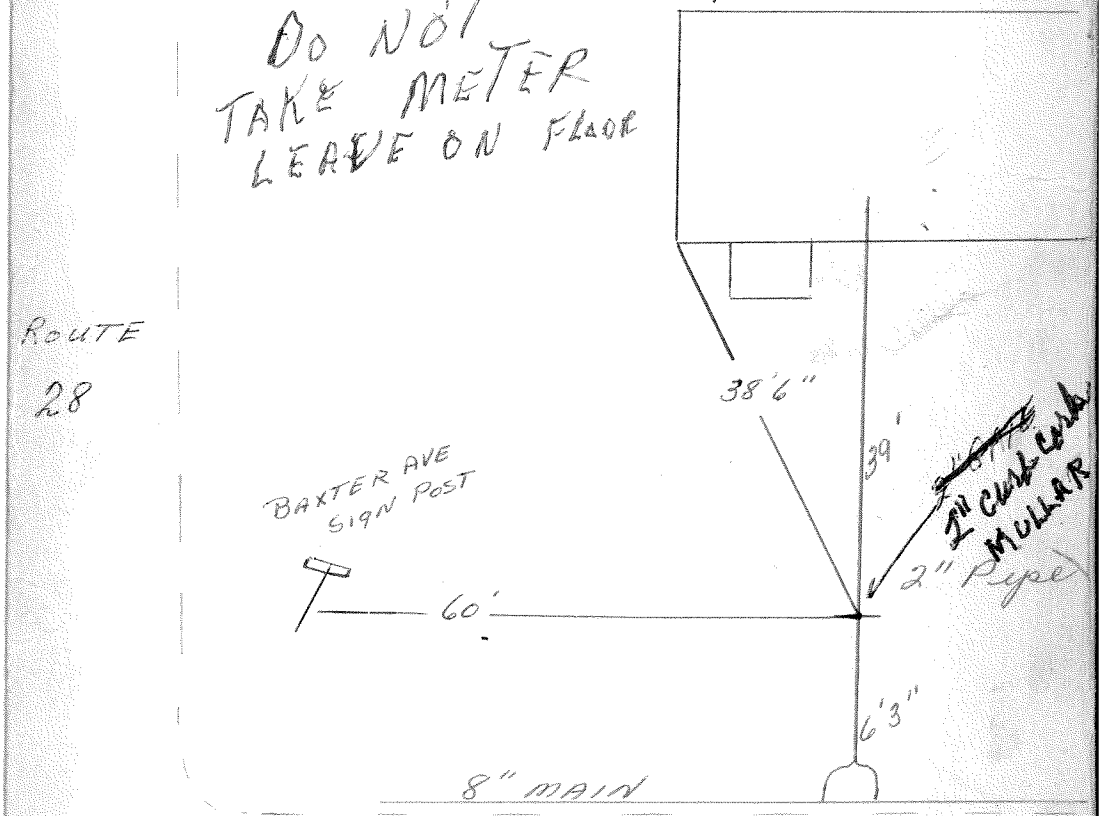
VILLAGE W.Y. West side

SERVICE NO. 7398-30 HE HAS METER 2"

METER NO 20034043 ID# 00749473 2/4/91

PAD RT. SIDE

DO NOT TAKE METER LEAVE ON FLOOR



BAXTER AVENUE

1967

7410-3c

7410

ARB ~~ACR~~

7410 4/6/01
Ellas Hospitality
LLP

NAME

STREET 131 MAIN ST. EAST SIDE

VILLAGE W Y

SERVICE NO. 7410-30

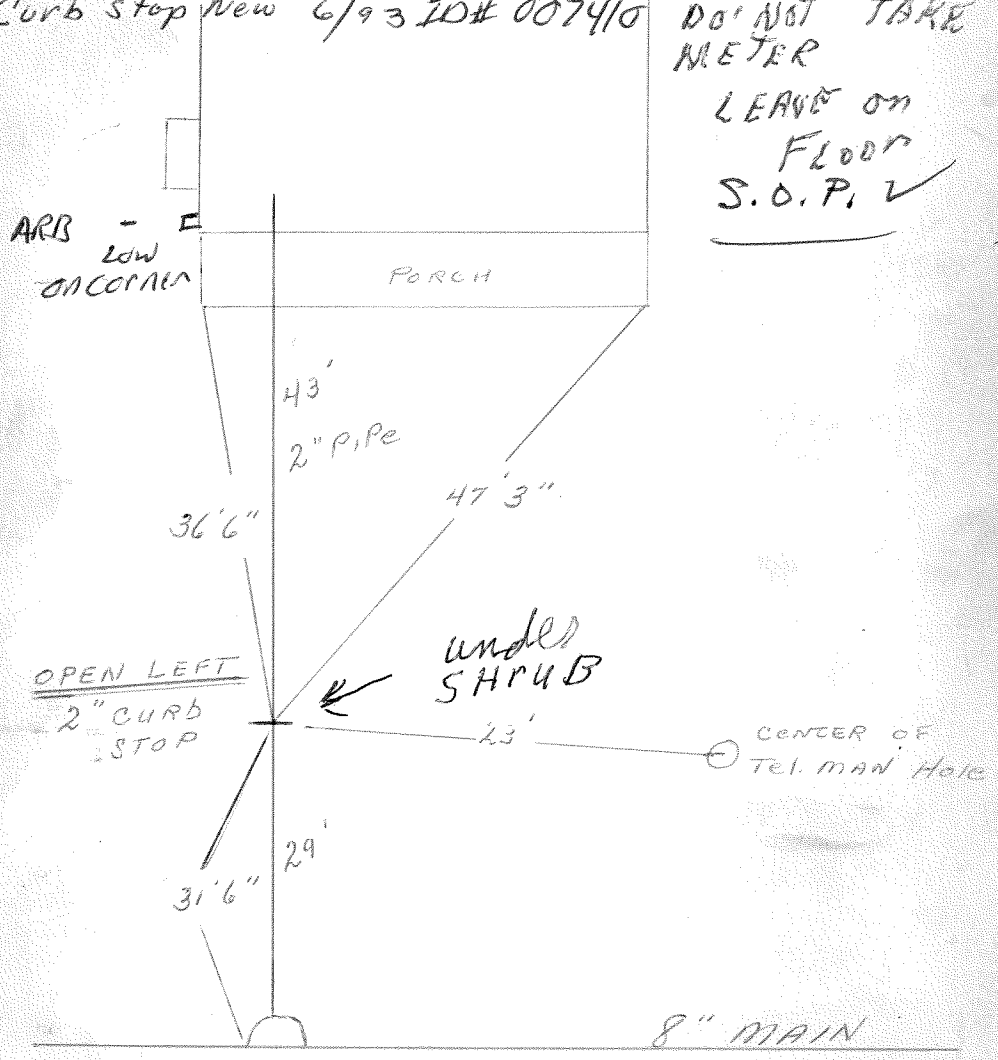
~~ID #00853184~~ Lt side by bolthead

6000337

METER NO. ~~2003 40444~~ 1 1/2" ROCK MAGN

Curb stop new 6/93 ID# 00710

DO NOT TAKE METER
LEAVE on FLOOR
S.O.P. ✓



ROUTE 28

7463-30 O ARB

Golden Bay Rest

NAME ~~Burger Chef~~ Socrates Mitrokostas 3-15-76

STREET ~~"Burger Chef"~~ 80 East main St

LOT 2

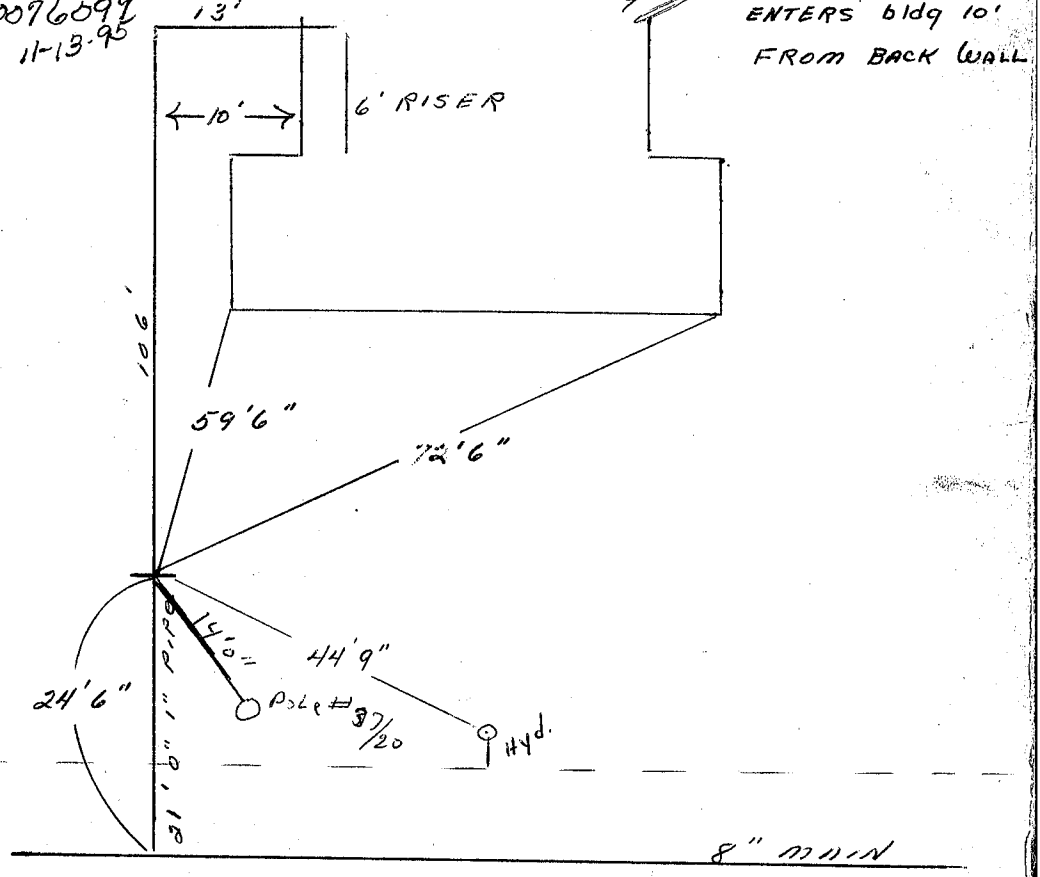
VILLAGE W. Y.

SERVICE NO. 7463-30 R-7

~~#6662705~~ ~~ID #3298255~~ ~~C-21405~~

METER NO. ~~20 1336 46~~ Rock Mayer 5/8"

40076099
11-13-95



Route 28

1968

SERVICE NO. 7894

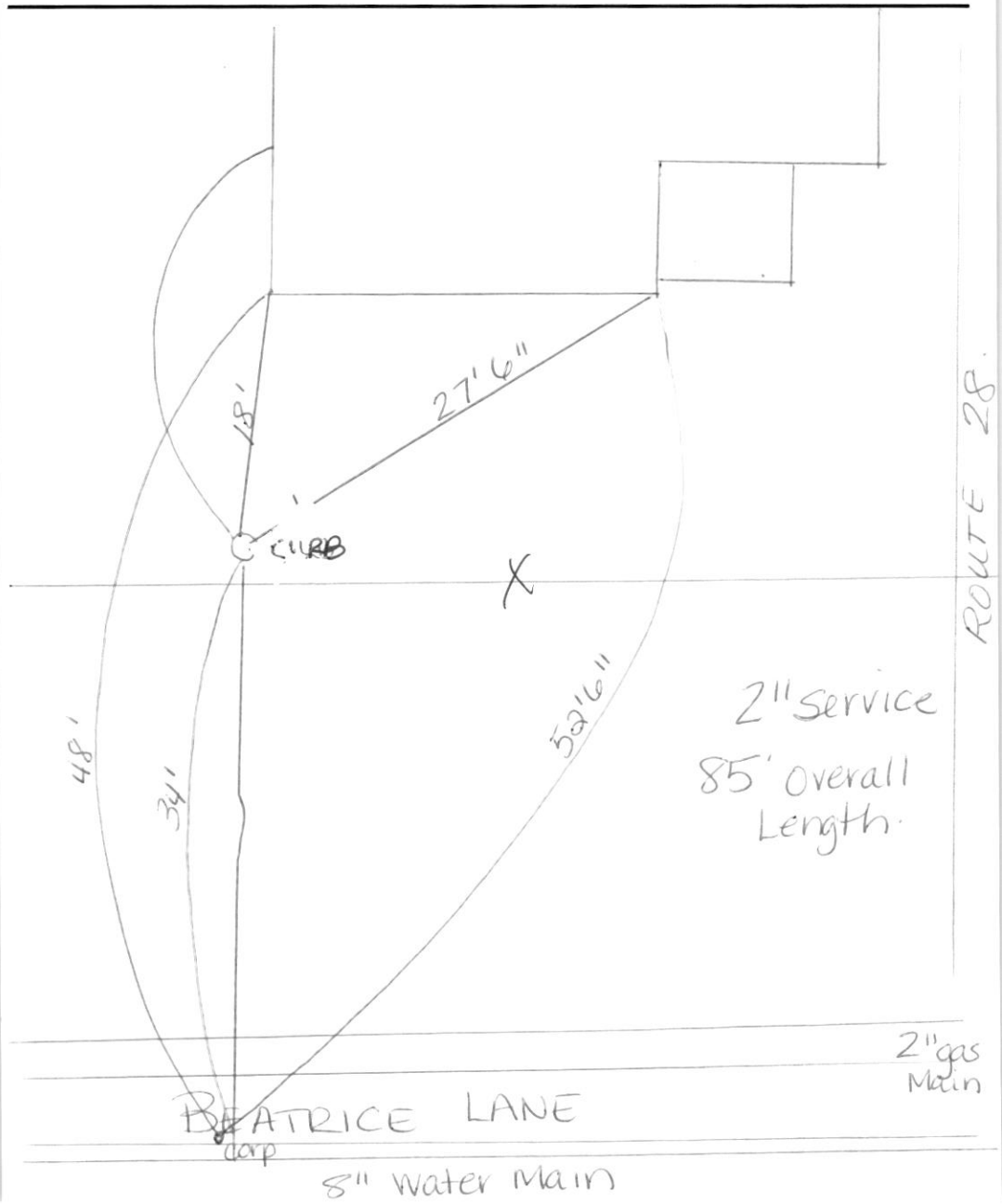
NAME

STREET 237 ROUTE 28

VILLAGE WEST YARMOUTH

METER NO. HOUSE / BOOKSTORE

PKM 8/1/2018



7900

ARB

STREET ROUTE 28 LOT.

Seg. 1900

VILLAGE WEST YARMOUTH

1½" Meter

SERVICE NO. 7900--30

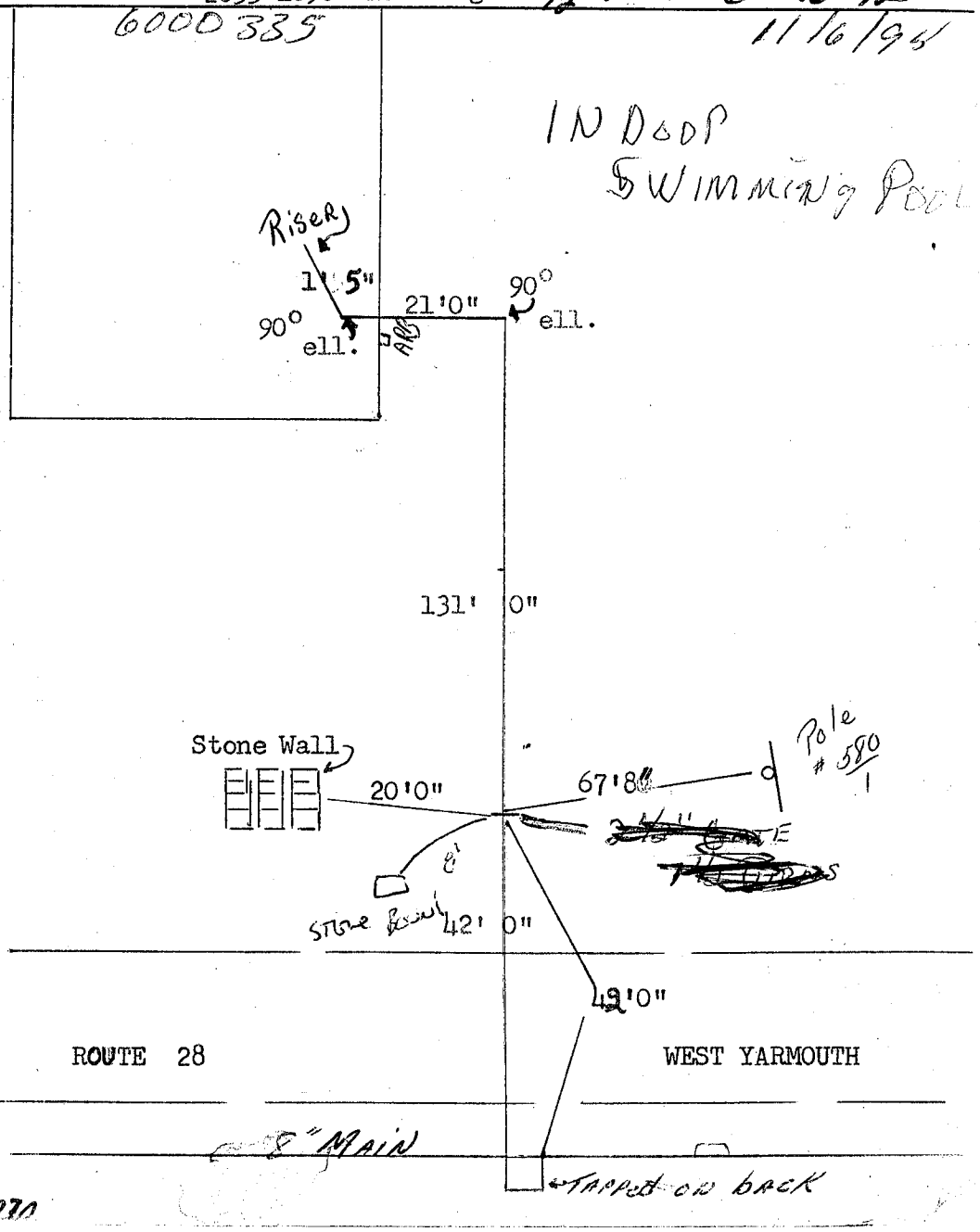
Row 57

METER NO. ~~2053 1690~~ Rock Magn ~~1½" 5-1-70~~ ~~6-26-72~~

6000335

11/6/95

IN DOOR SWIMMING POOL



1970

7929-36A

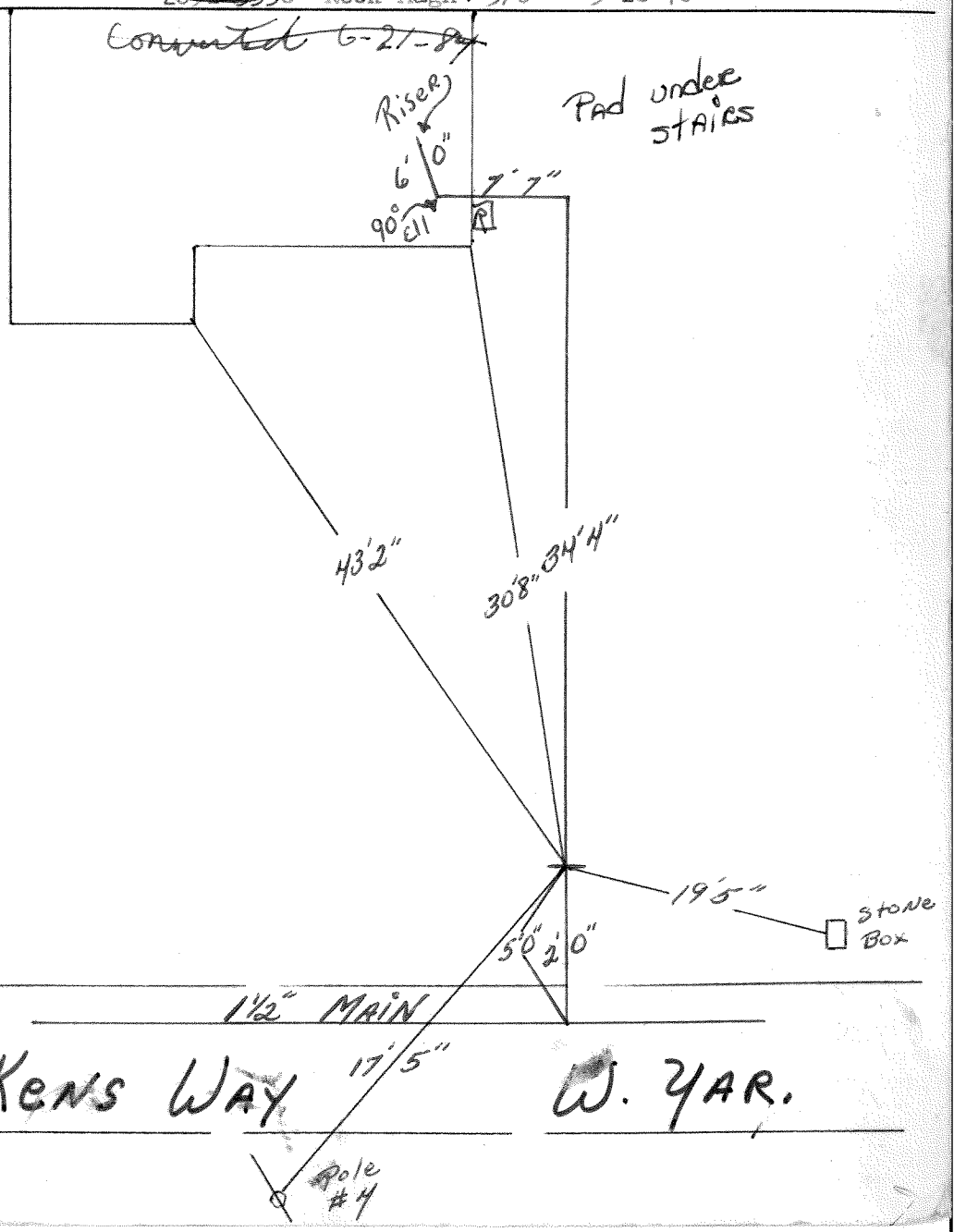
NAME Dr. Robert Platt
7929-36A 7/15/83 Augusta PRO

STREET 17 KENS WAY LOT - None

VILLAGE WEST YARMOUTH

SERVICE NO. 7929--36 A ~~Route # 450746~~
45132397 12-2-81

METER NO. ~~2092 3336~~ ~~Rock Magn.~~ 5/8" ~~5-26-70~~
~~Converted 6-21-84~~



1970

9287-30

PRO

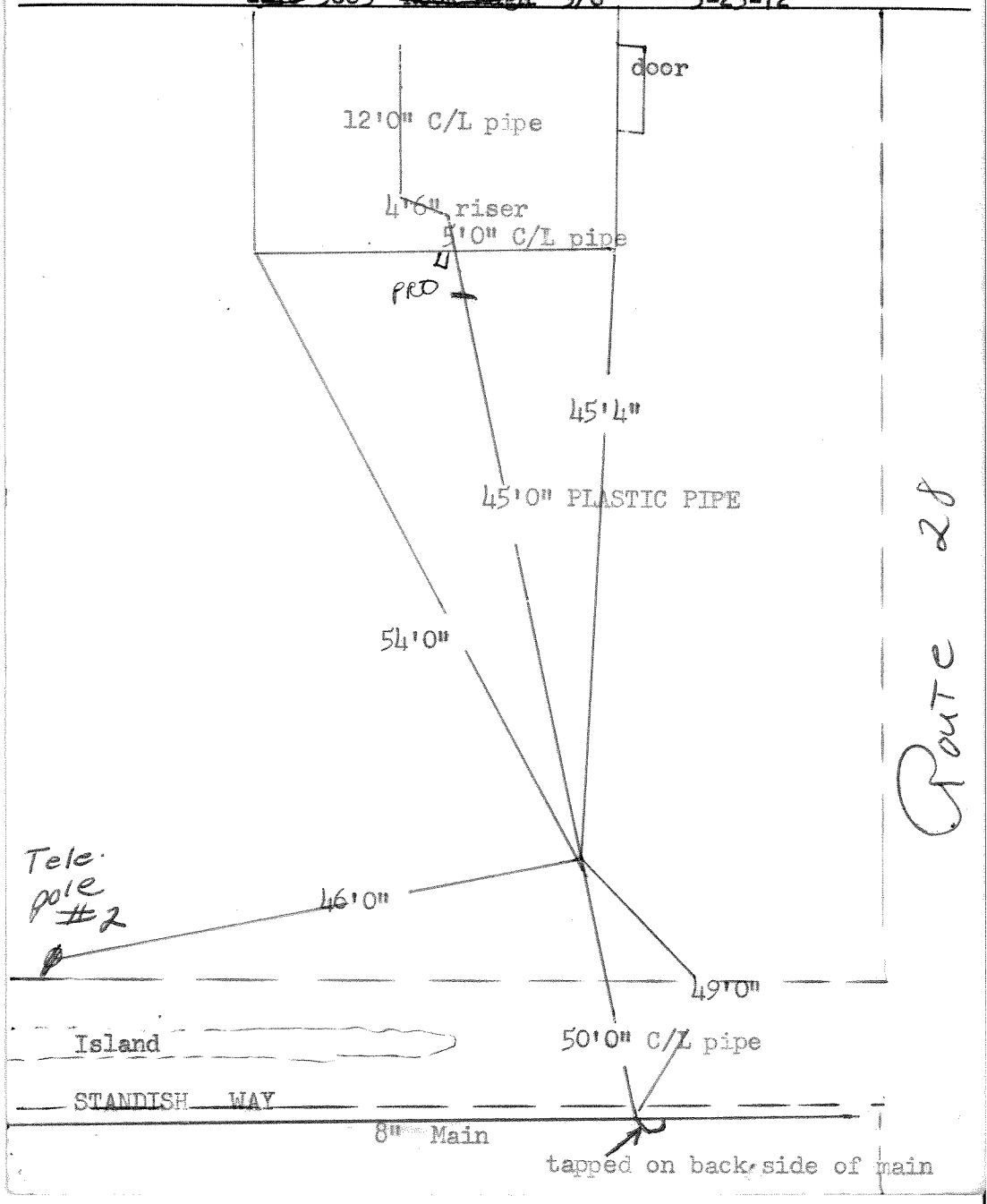
NAME Cape Realty, Inc.
9287-30 4-22-77

STREET corner STANDISH WAY & ROUTE 28 WY

VILLAGE WEST YARM OUTH

SERVICE NO. 9287-30

METER NO. 44739109 5/8 12-1798
~~2170 5663 Rock Maple 5/8" 3-23-72~~



9717-30

SERVICE NO.

ABB

9717 4/6/01

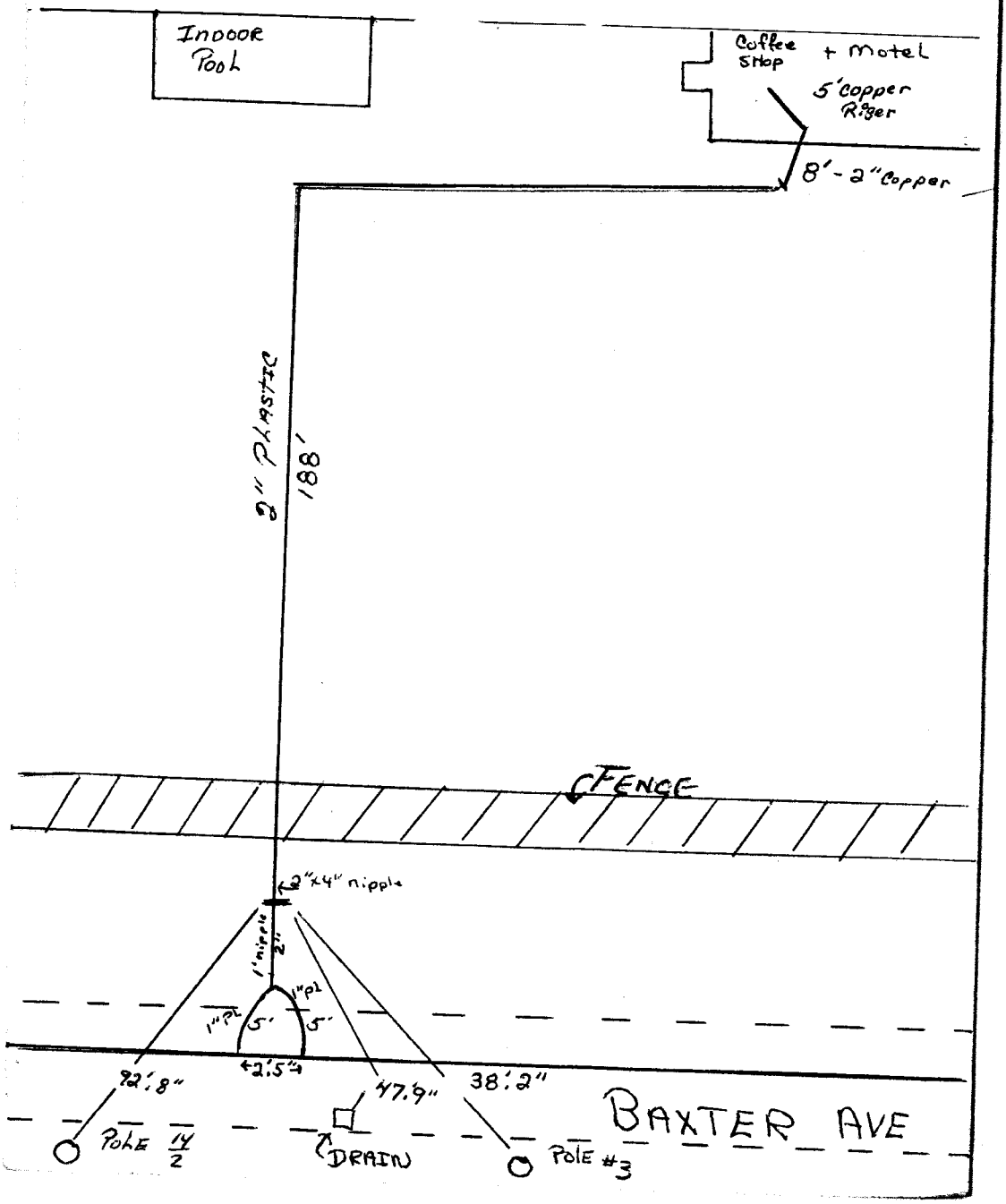
NAME TOE (W) Ellas Hospitality LLP

STREET 135 Main St Rt 28 (Service off Baxter Ave

VILLAGE

2"

METER NO. 10398045 11/1/00 ID#523102388



PRO

SERVICE NO. 9740

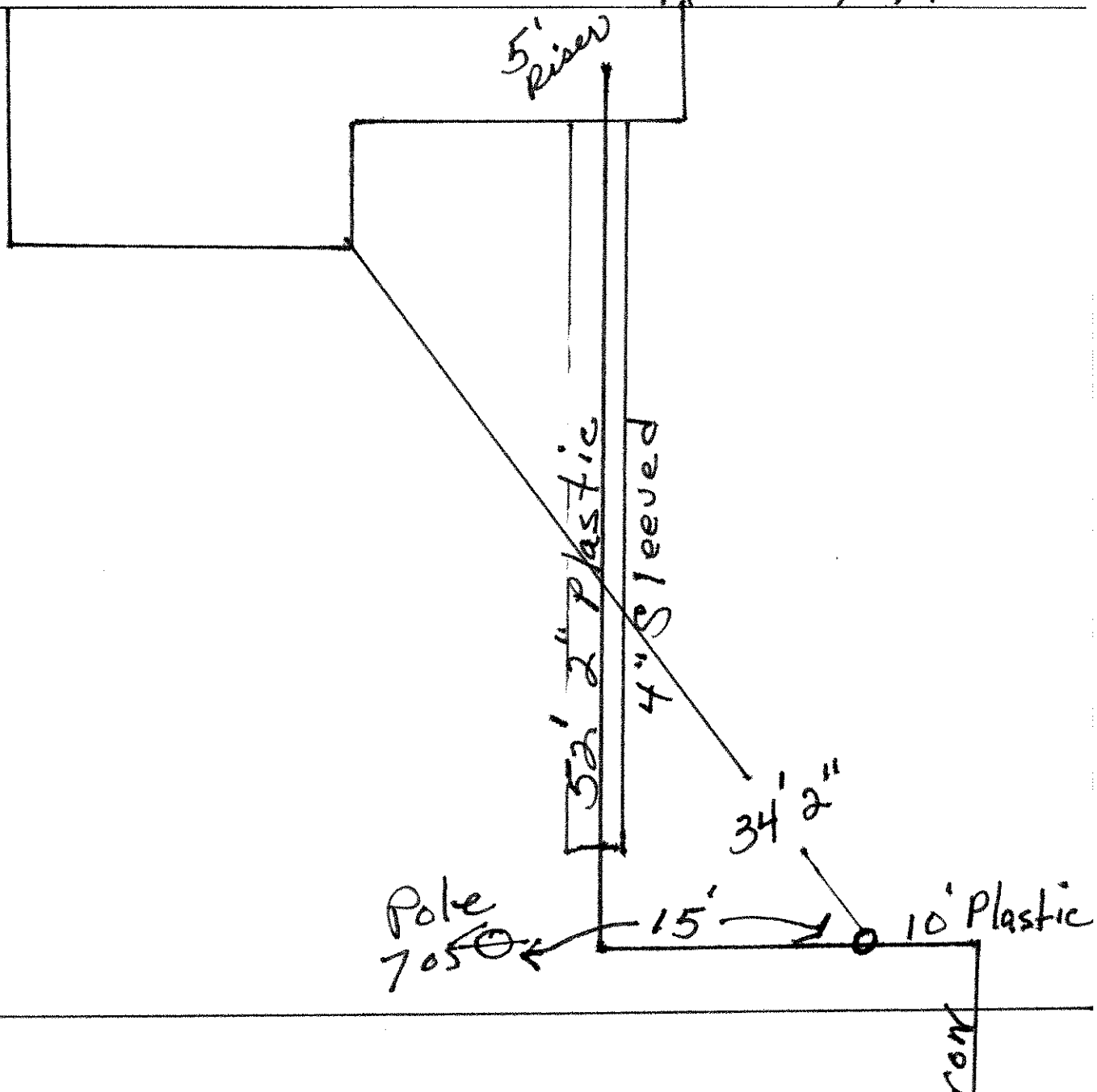
NAME Yarmouth Child Care Center

STREET 367 Route 28

VILLAGE West Yarmouth

METER NO. 47916674 8-2-99

Pro pad Front Rel 7-99



ABB

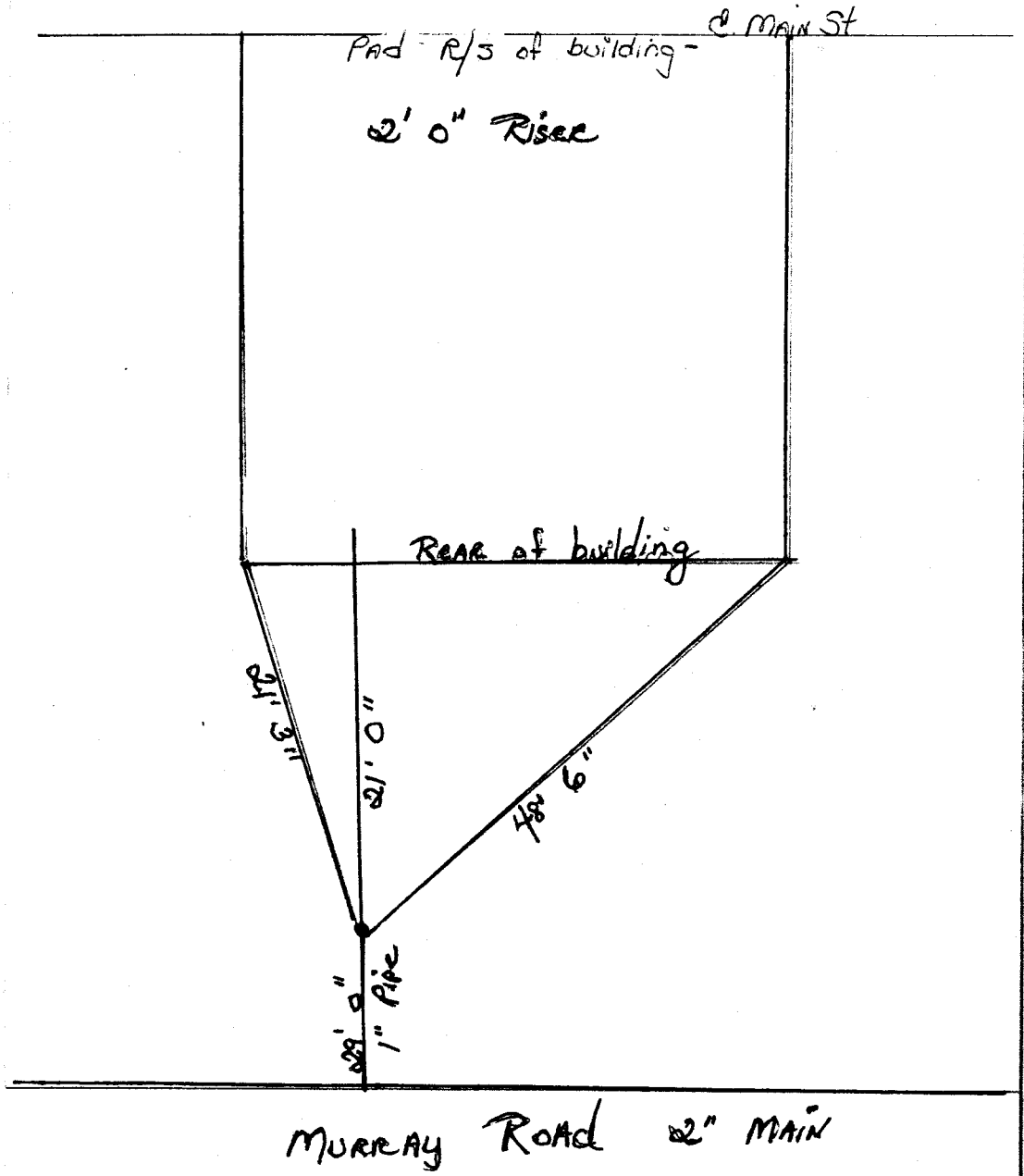
SERVICE NO. 9818

NAME Hayes & Hayes

STREET 23 East Main St W.Y.

VILLAGE W. Yarmouth

METER NO. 11374506 44220081128 5/8" 12-1401



9873
9874
SAME

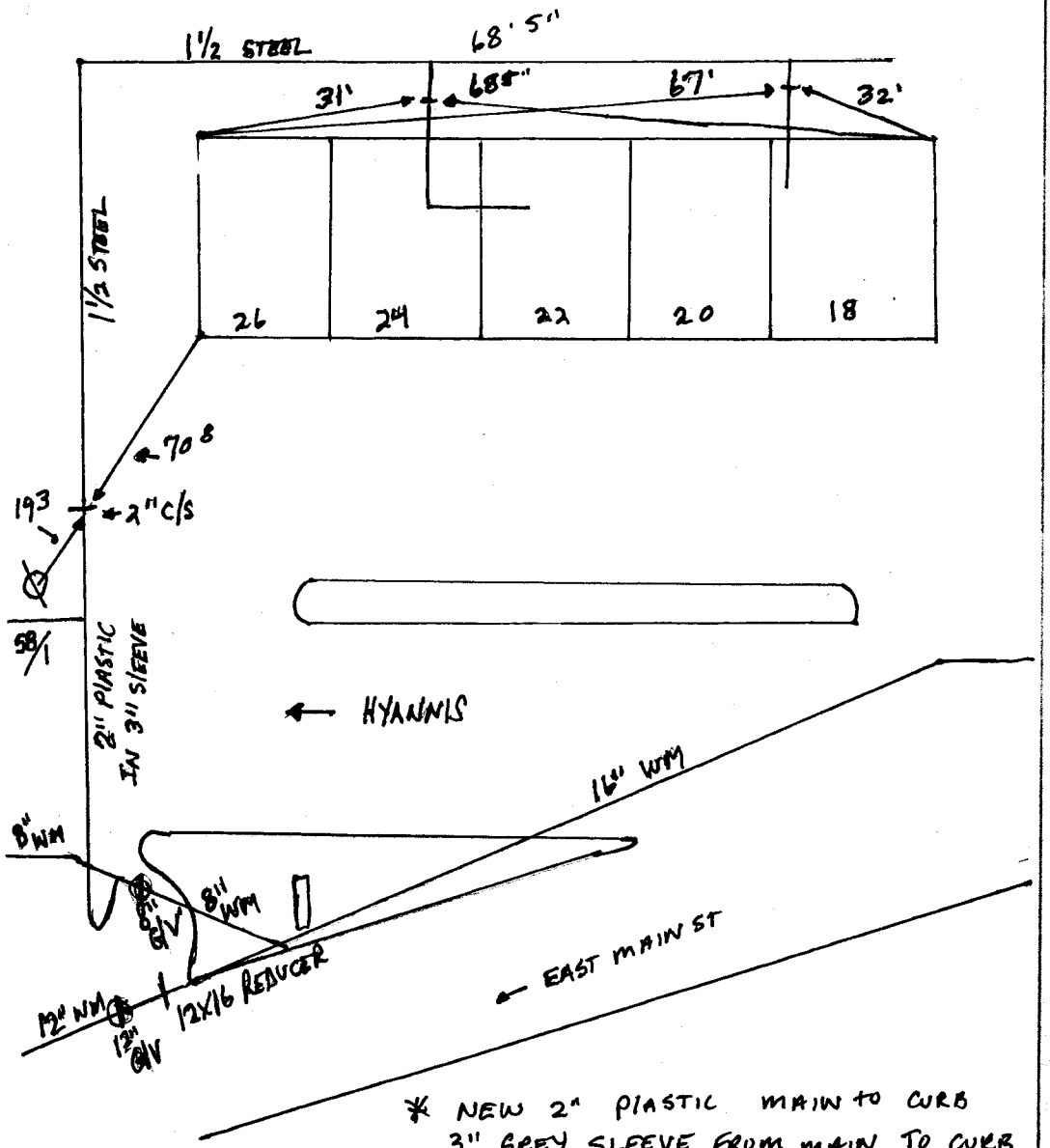
SERVICE NO. 9872

NAME

STREET 18-26 ROUTE 28

VILLAGE W. YARMOUTH

METER NO.



* NEW 2" PLASTIC MAIN TO CURB
3" GREY SLEEVE FROM MAIN TO CURB
06/08/16 B.CI & Y.W.D

9873
9874
SAME

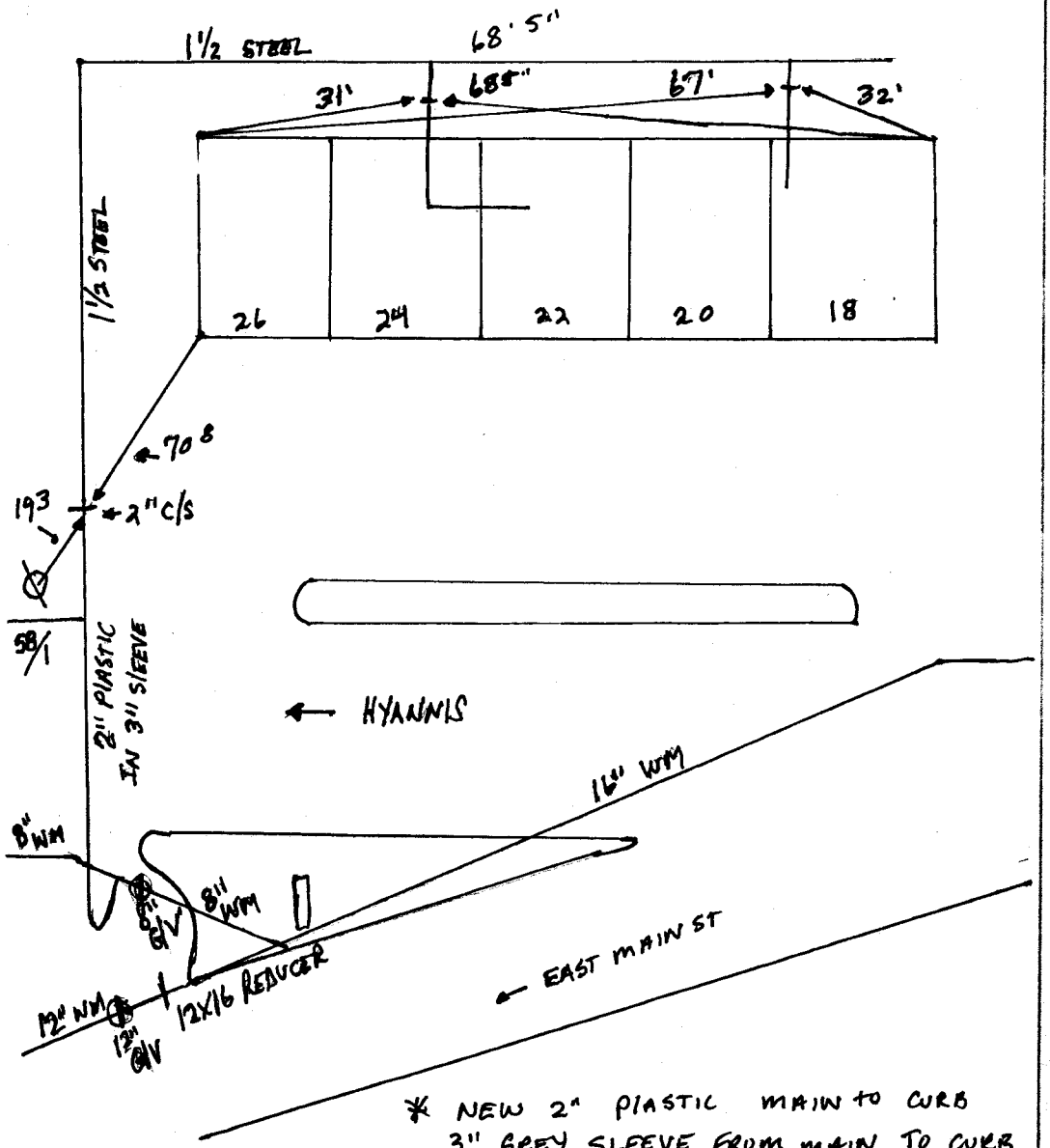
SERVICE NO. 9872

NAME

STREET 18-26 ROUTE 28

VILLAGE W. YARMOUTH

METER NO.



* NEW 2" PLASTIC MAIN TO CURB
3" GREY SLEEVE FROM MAIN TO CURB
06/08/16 B.CI & Y.W.D

9873
9874
SAME

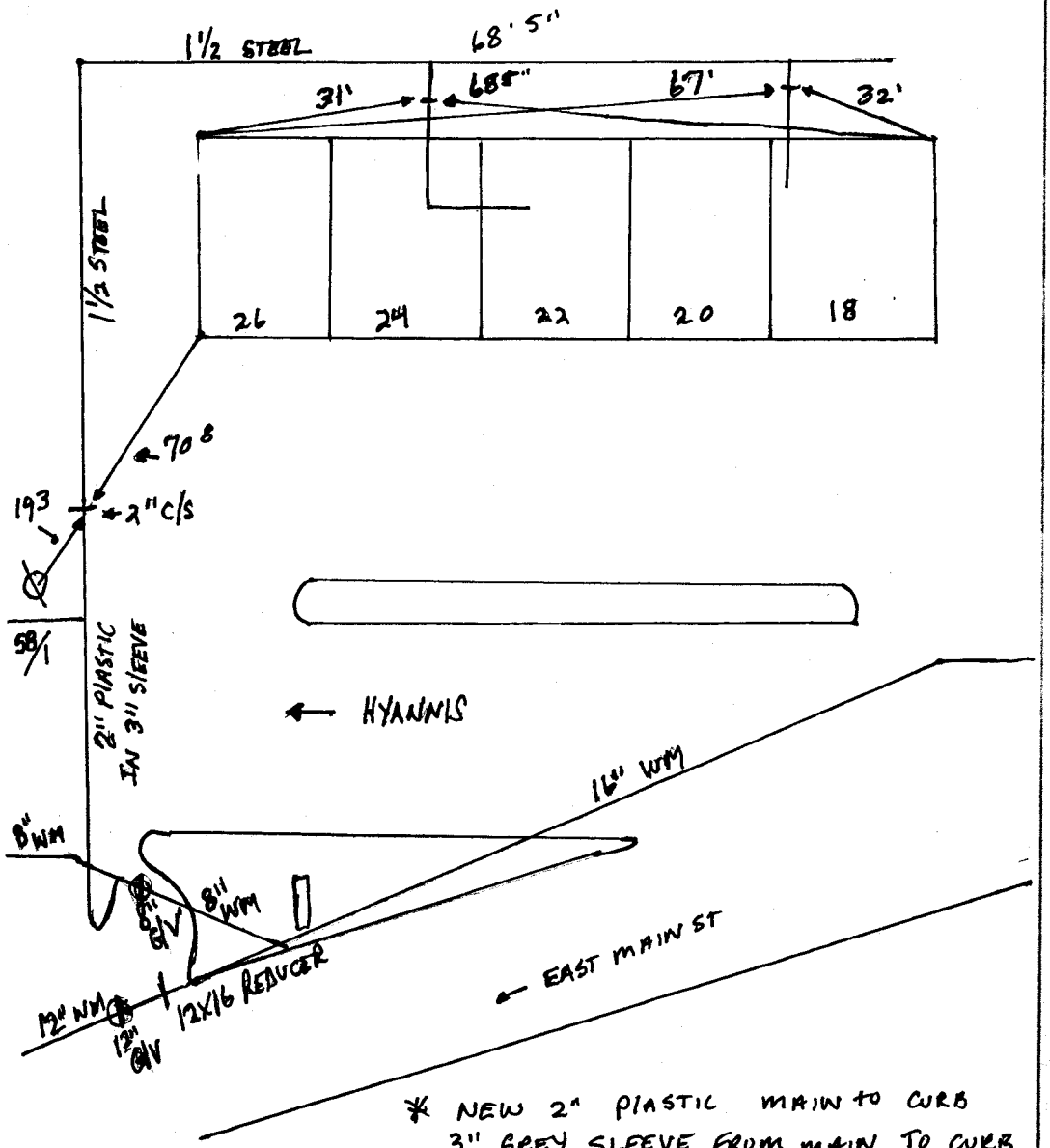
SERVICE NO. 9872

NAME

STREET 18-26 ROUTE 28

VILLAGE W. YARMOUTH

METER NO.



* NEW 2" PLASTIC MAIN TO CURB
3" GREY SLEEVE FROM MAIN TO CURB
06/08/16 B.CI & Y.W.D

ABB

SERVICE NO. 11115

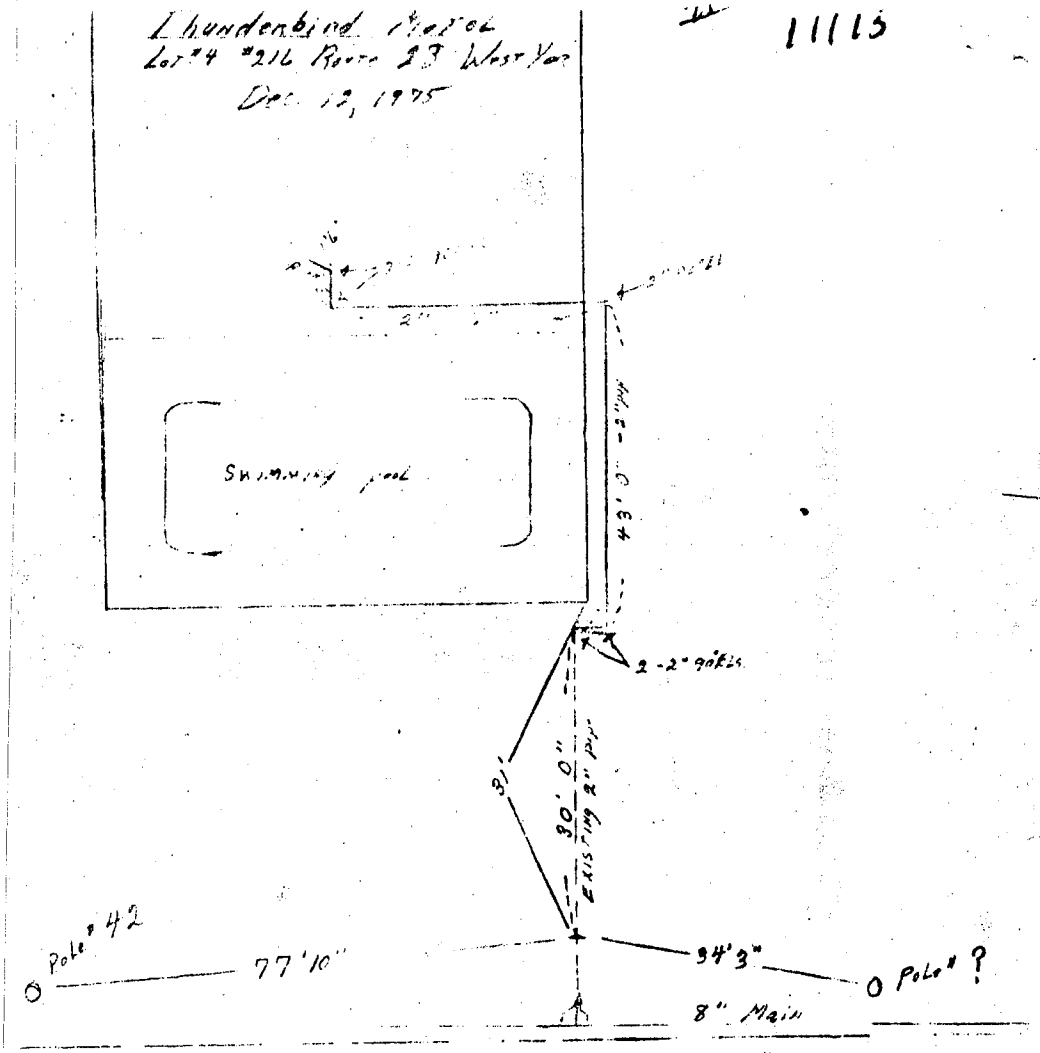
NAME 11115 3/7/03
216 ROUTE 28
THUNDERBIRD MOTEL
Motor Lodge

STREET 216 Route 28

VILLAGE wf #11115 2"

METER NO. 10398052 11/1/00 ID#5231102390

Pool



ROUTE 28

2

11249-6 30 Ever

SERVICE NO.

PRO

NAME Yarmouth Police Station

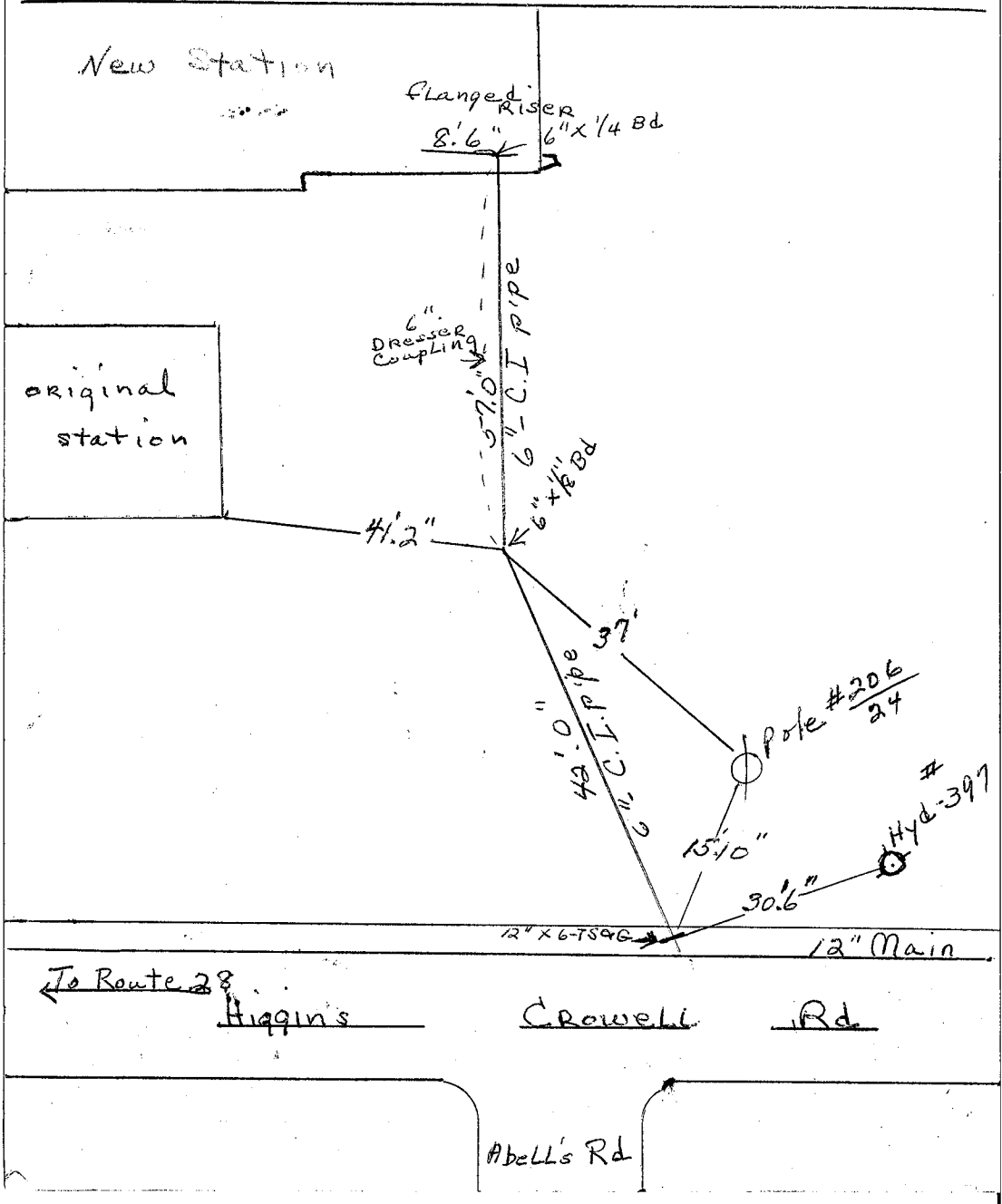
STREET 424 Main Street

Lot V-5

VILLAGE West Yarmouth

7006154 Prod 1194990526 PRO 11-3-99

METER NO. ~~2558-6274~~ - 3" ~~Rockwell~~ Turbine-4-11-77



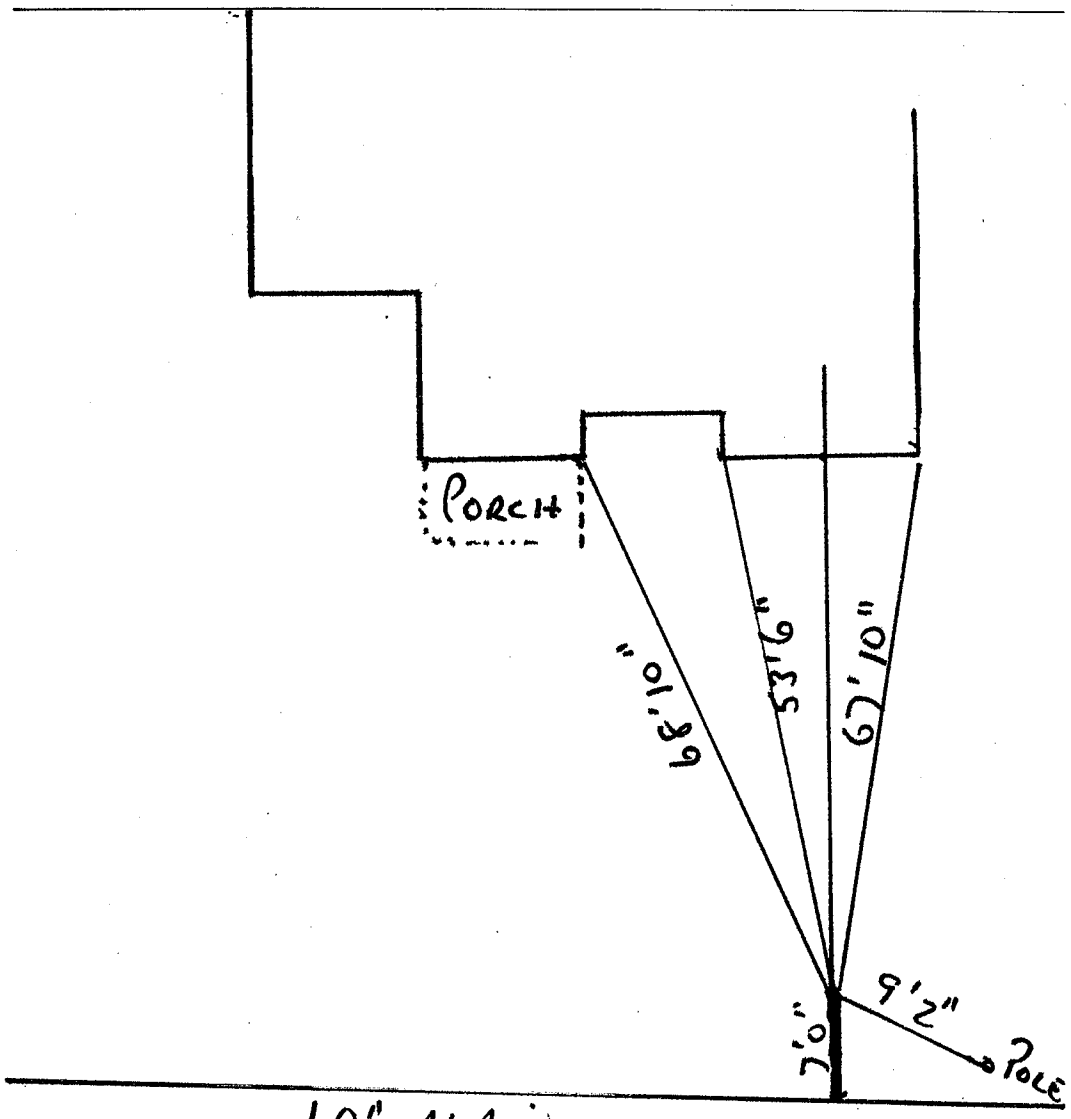
SERVICE NO. 11342-30

NAME ACME LAUNDRY CO. INC.

STREET 280 MAIN ST.

VILLAGE W.Y.

METER NO. 2419-2808 3" 6-4-75



11442-30 ABB

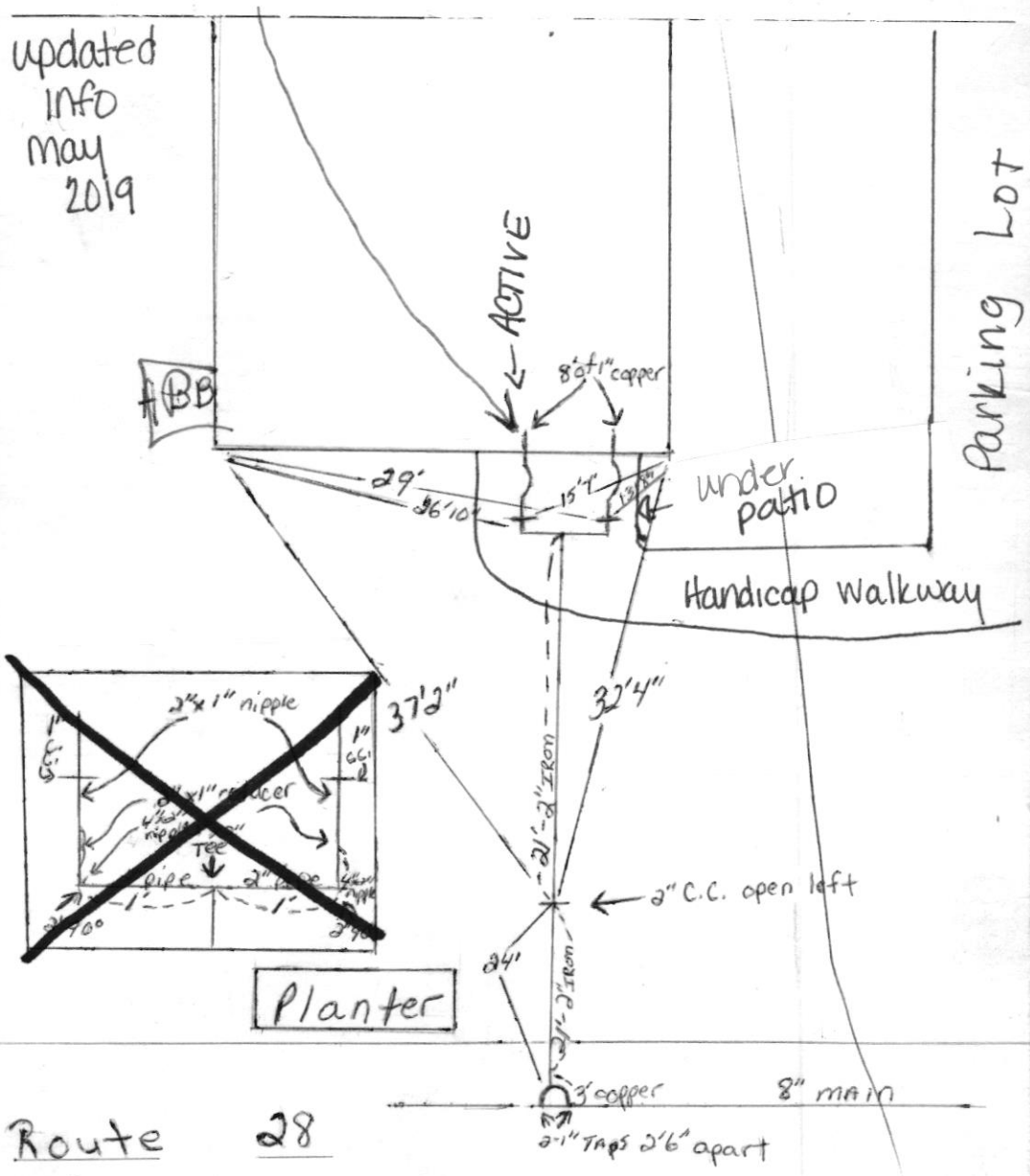
SERVICE NO.

NAME 11442-30-(1000) K. L. Assoc. 57 Steve + Sues

STREET RTE. 28 - ~~Treasure Island Rest.~~

VILLAGE West Yarmouth

METER NO. 10102695 12-5-01" (1") 52312831?



Route 28

5-19-78

11500-30

DCR

SERVICE NO.

11500-33
175 Main Street R/T
Dan Keefe 11/15/90

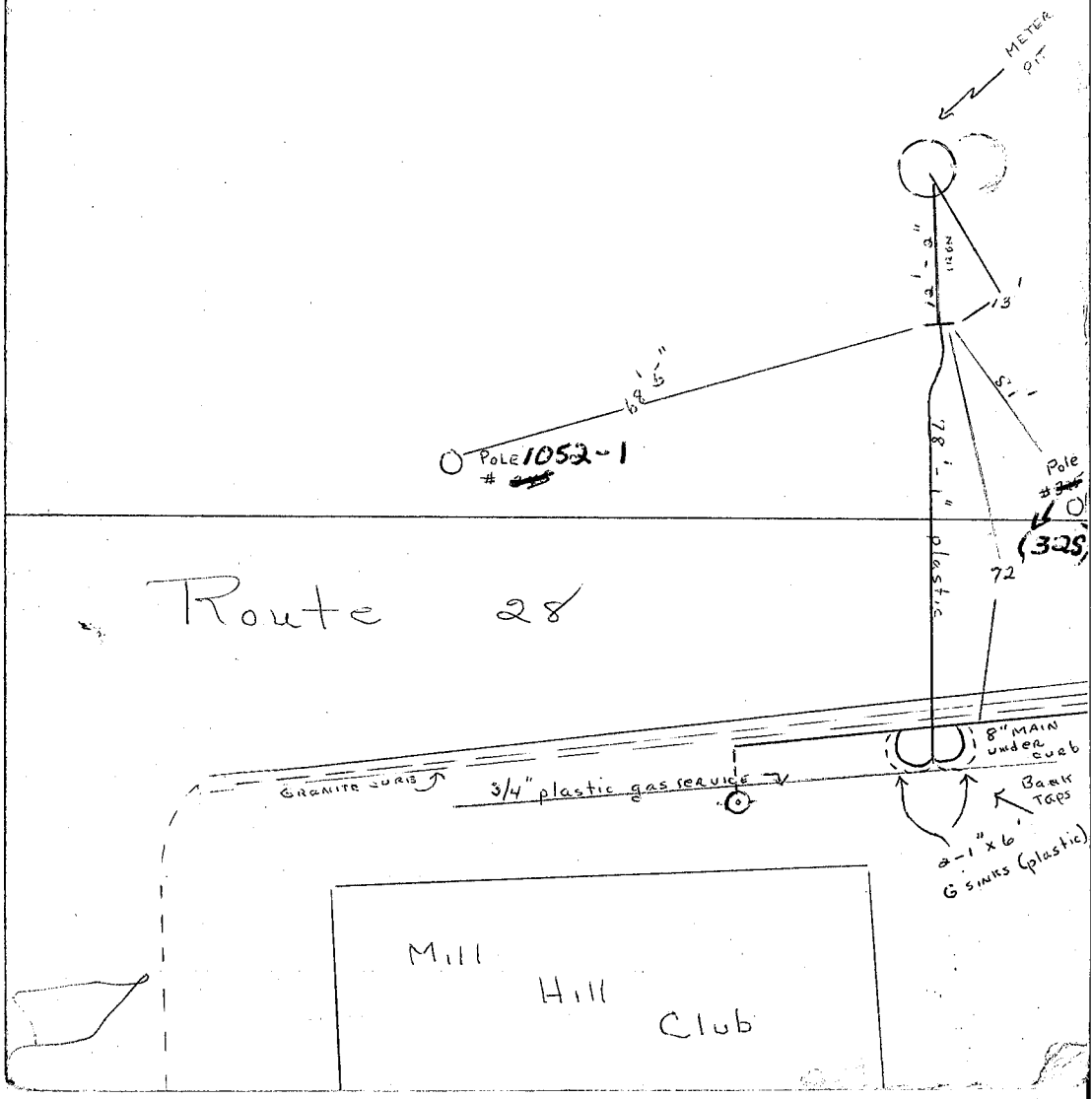
NAME ~~Lobster~~, ~~Hut~~ Clancys

STREET 175 Rte 28

VILLAGE

METER NO. 2833 5260 6-13-79 2"

ID # 00851891 Pad on elect meter Post
2-21-90



11,558-41 [redacted]

SERVICE NO.

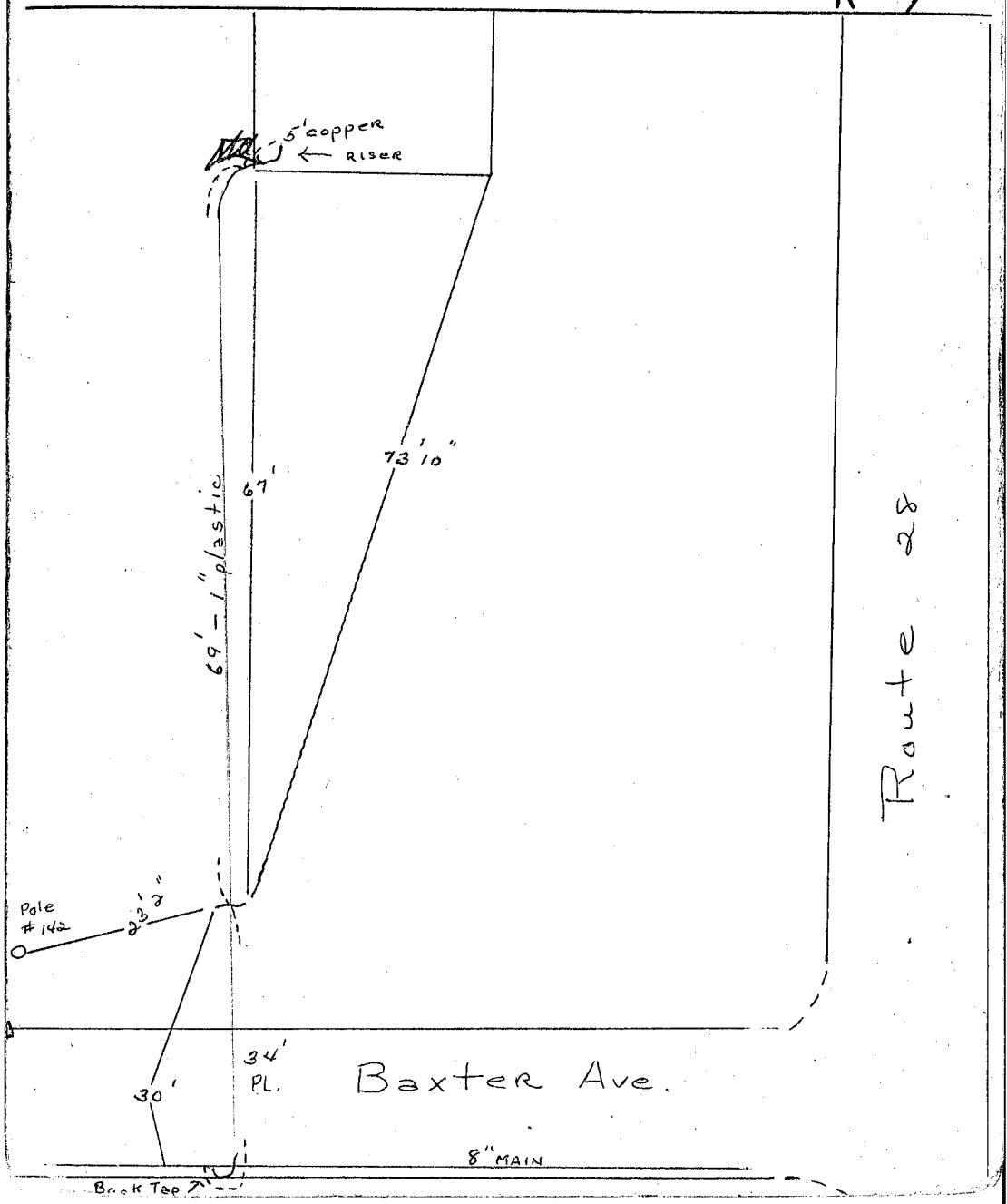
NAME James F. Hurley ~~Cape Holiday Motel~~ Putters Paradise

STREET 119 Svce Rte. 28 & Baxter Ave.

VILLAGE

METER NO. ~~2767-8660-1"~~ ~~2170-5835~~ 6/26/79 4701620

R-7



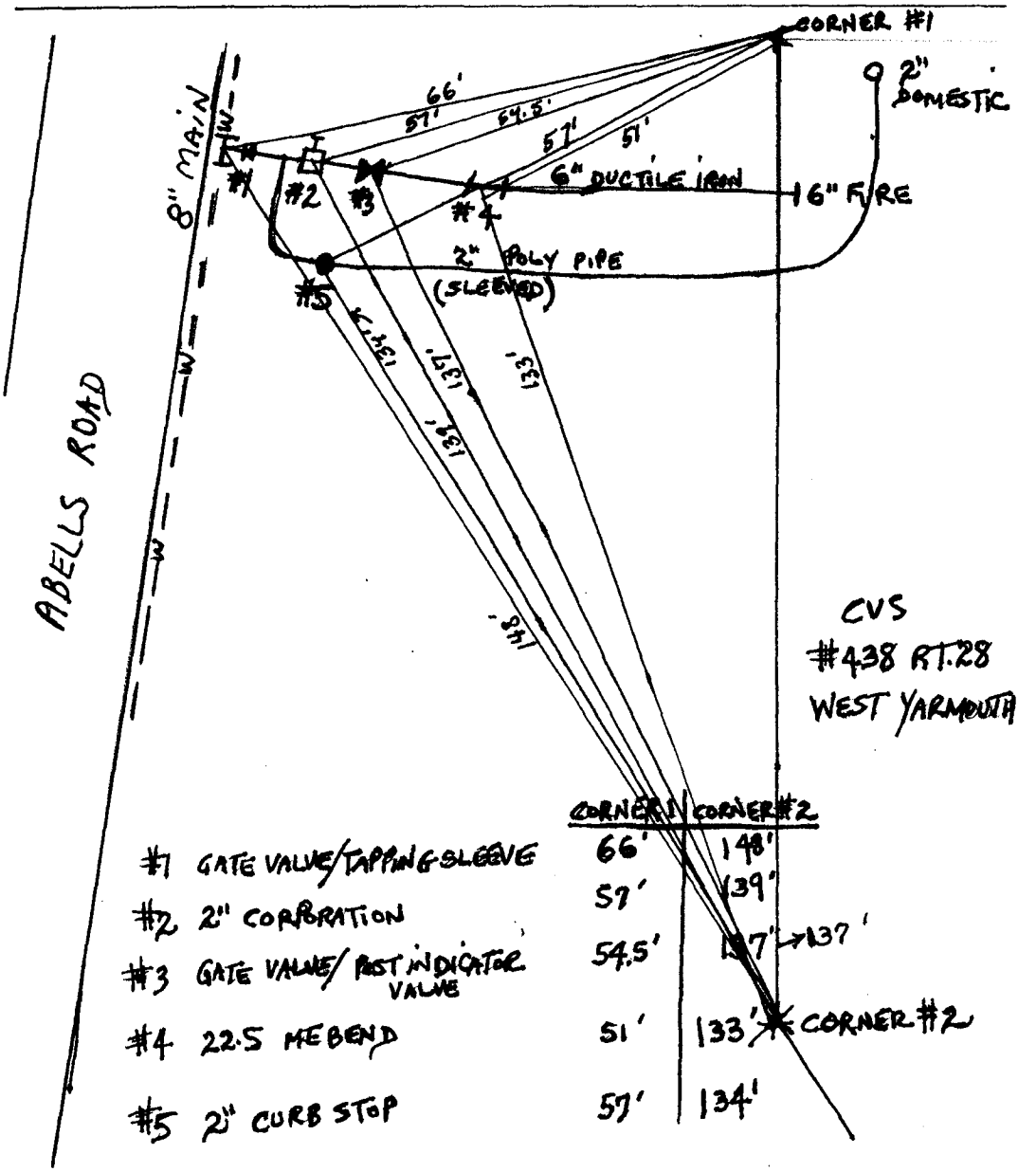
SERVICE NO. 11585

NAME C.V.S. PHARMACY

STREET 438 RT. 28 WEST YARMOUTH, MA

VILLAGE WY

METER NO.



11085 3C

CC

SERVICE NO.

NAME. ~~Aladdin Motor Inn Lot #24~~ INN AT MILL CREEK

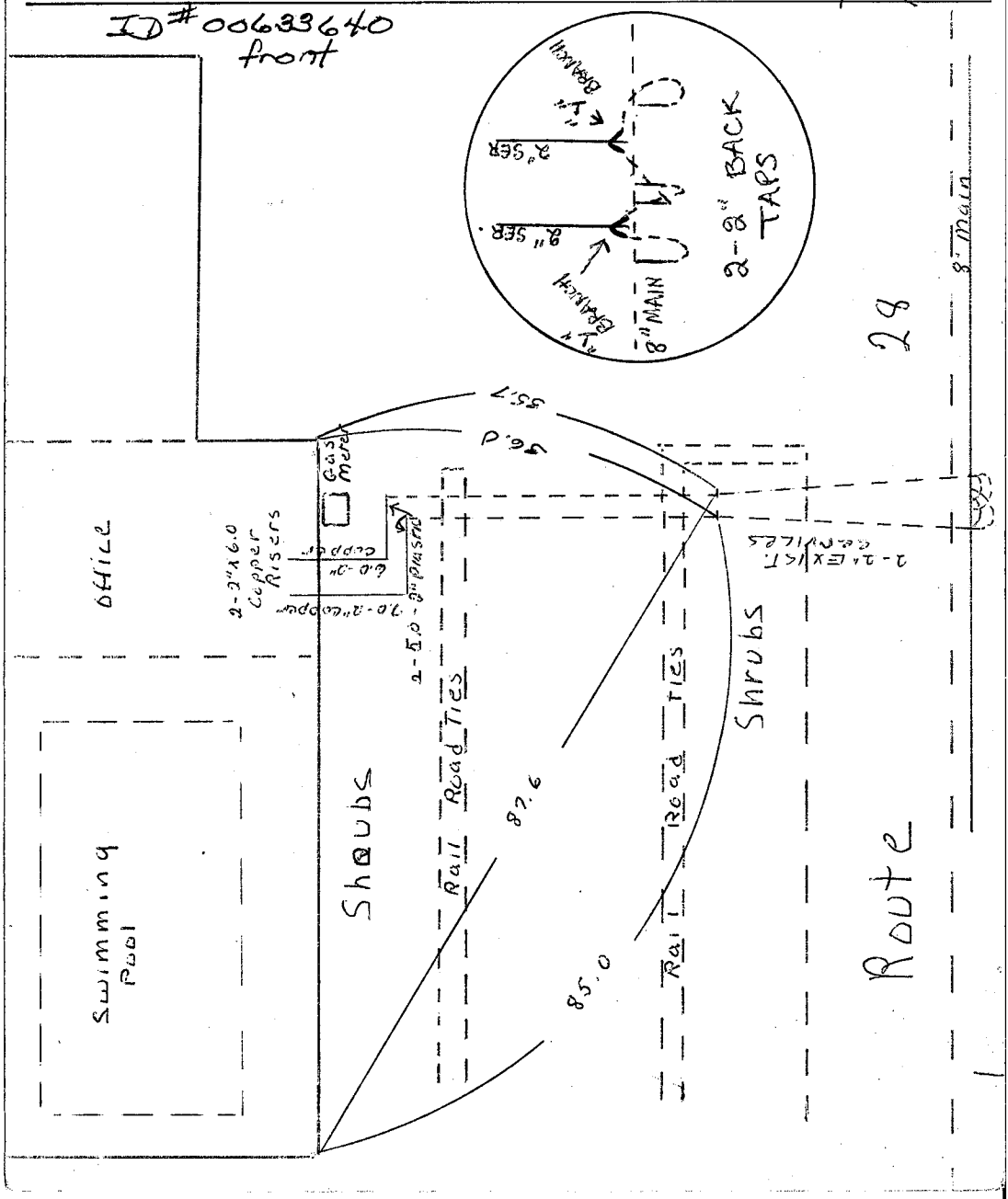
STREET # 225 Main St Rte 28

VILLAGE West Yarmouth

METER NO. ~~409~~ ~~412~~ 1275796 RC 3-14-89 ~~RA~~ 3" 5-11-81

2-2" Services 4/83

ID#00633640 front



11697-30 PRO

SERVICE NO.

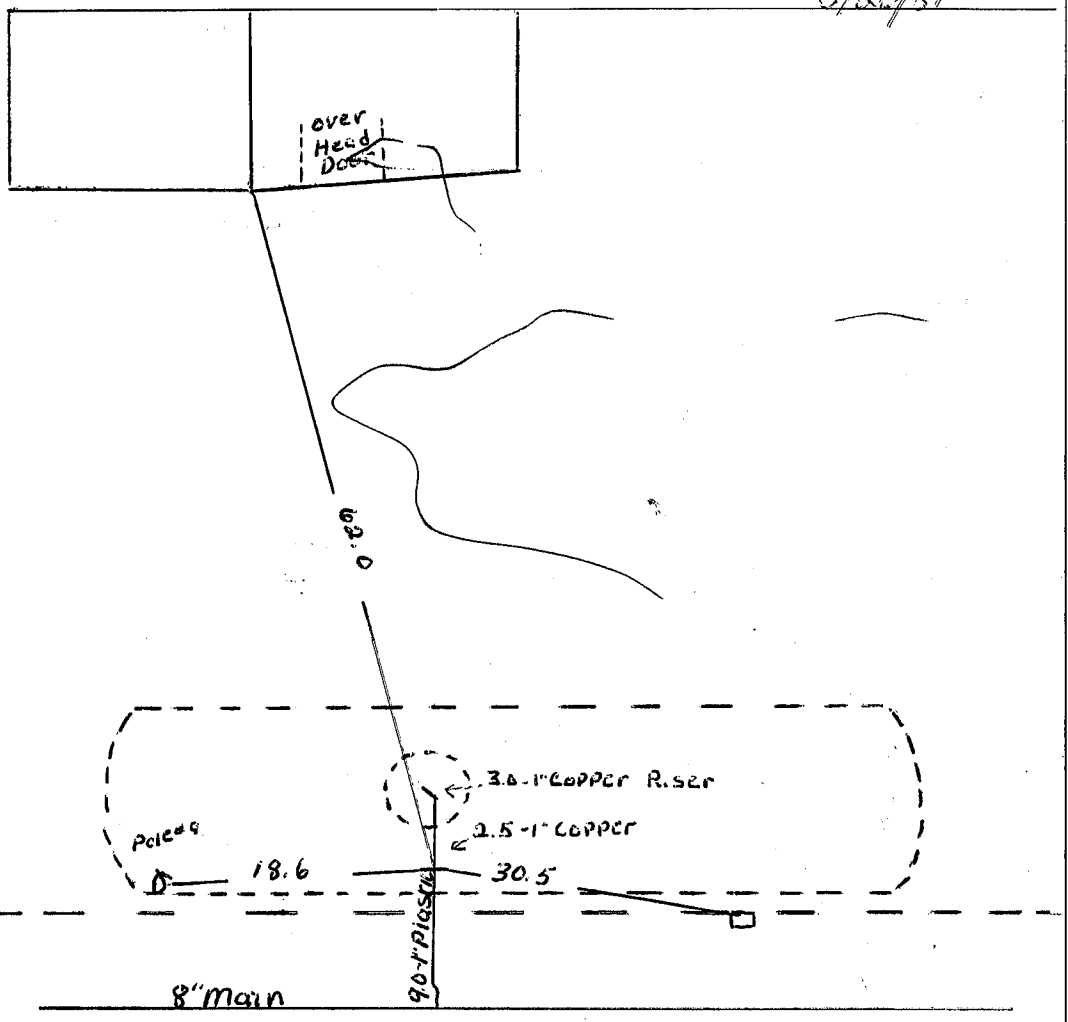
NAME Souza's B.P. Station

STREET ~~15 14 Route 28~~ 17 East Main Street ← AKA

VILLAGE

METER NO. 4211804 8-12-97 3004-1987 6-13-81

Pad next to pit 18' E of pole 37/gw in shrubs 5/30/91



13262 90

SERVICE NO.

PRD ~~ABS~~

NAME Joh | 13262 3/4/99 Flagship Hotel Inves LLC + Flagship Motel

STREET 343 Rte 28 Lot-P-3

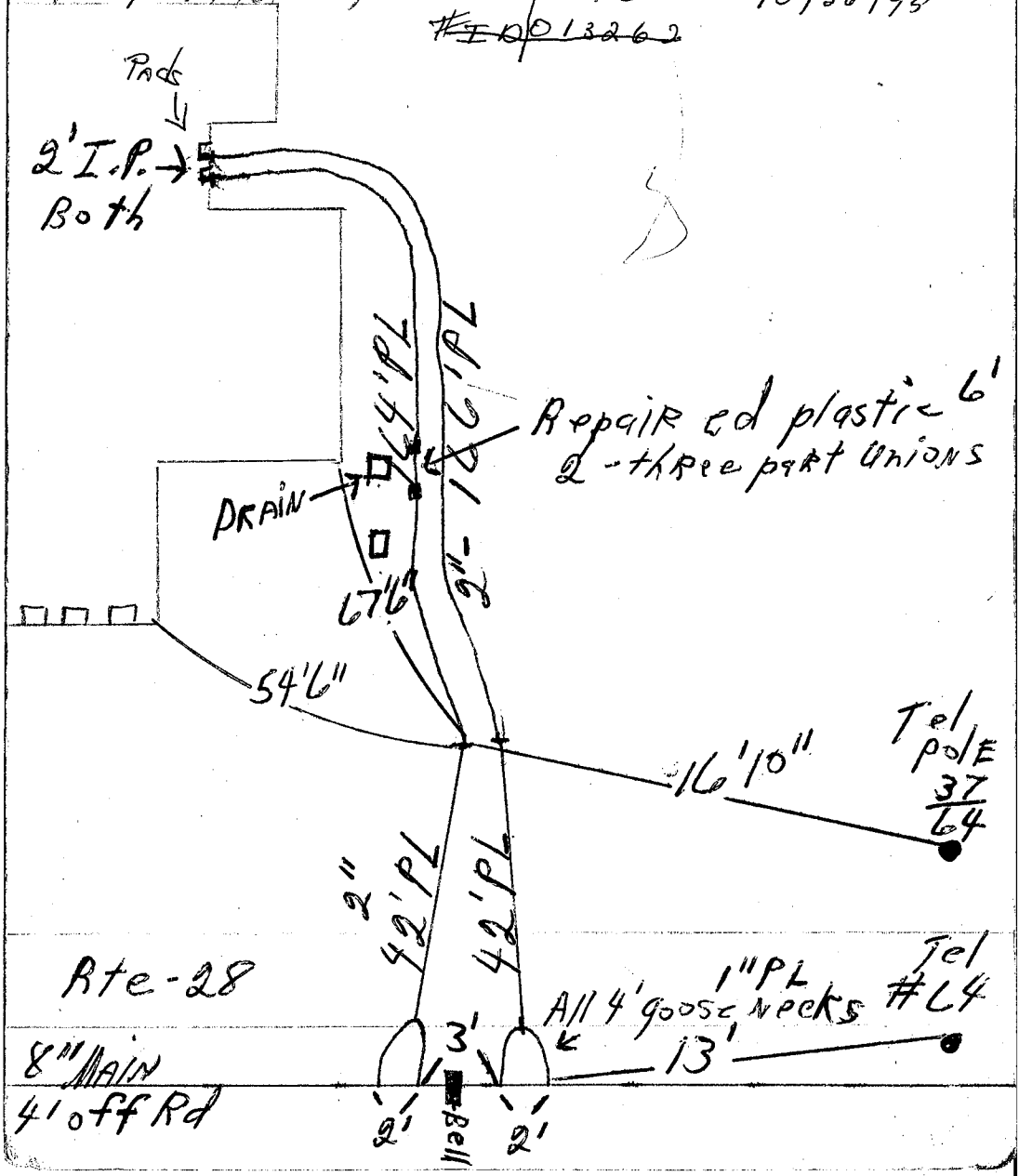
VILLAGE YARmouth

METER NO. 31988523 ~~01168891~~ 3" Turbo

2-2" n/plastic Services 418' 6/14+5/85

4-1" Plastic goose necks 16' 10/26/95

~~FED 13262~~



13369-33-157 PRO

SERVICE NO.

NAME Cape Cod Vacation Condo. Ass'n.

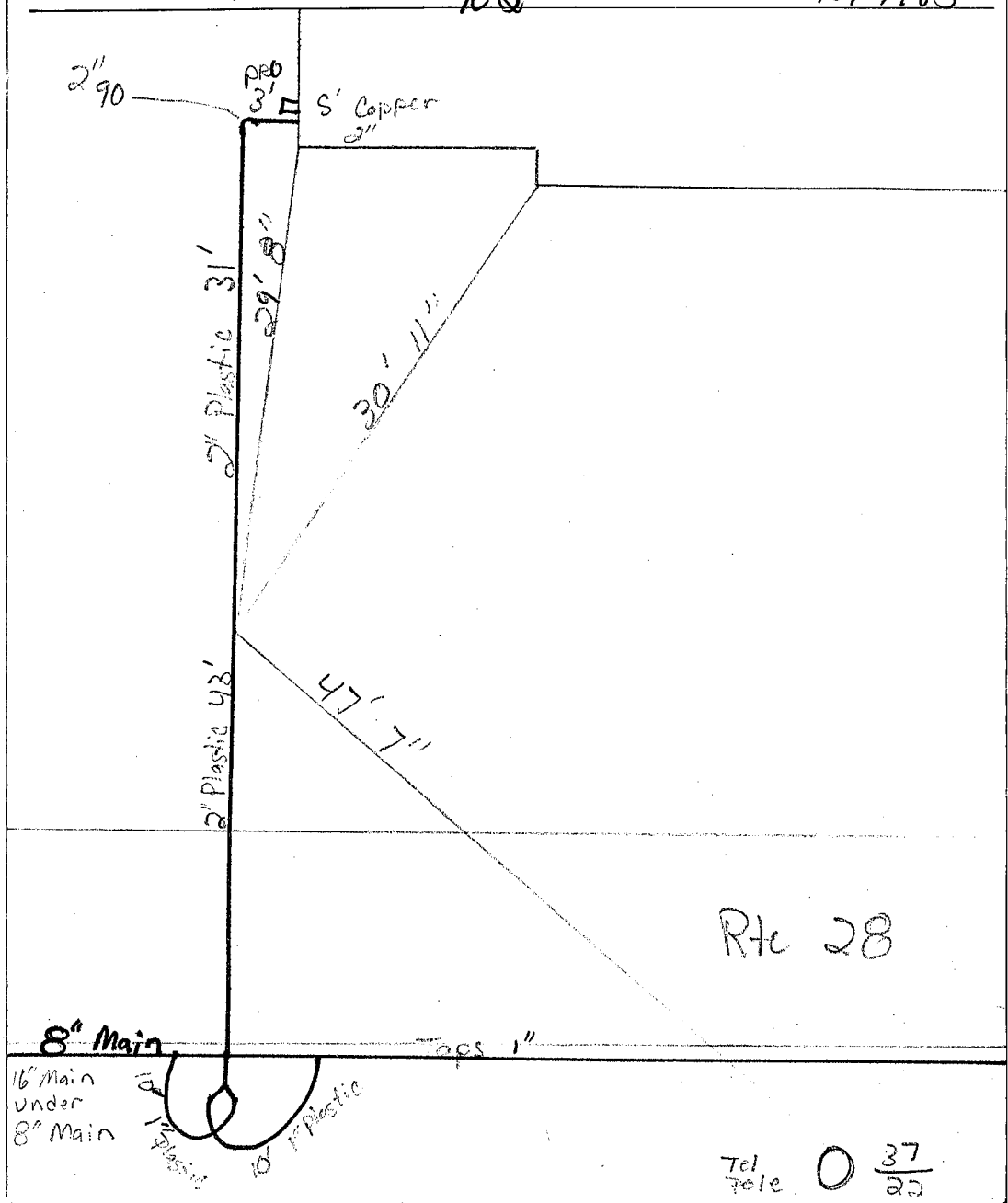
STREET 91 Rte 28 Bld. B Lot-1

VILLAGE

47916745 2089990946 5-14-99

METER NO. ~~2592 5002~~ ~~12-20-85~~

~~P# 30674~~ 102' 12/17/85



13422-30

SERVICE NO.

NAME Cove at Yarmouth

STREET 183 Route 28

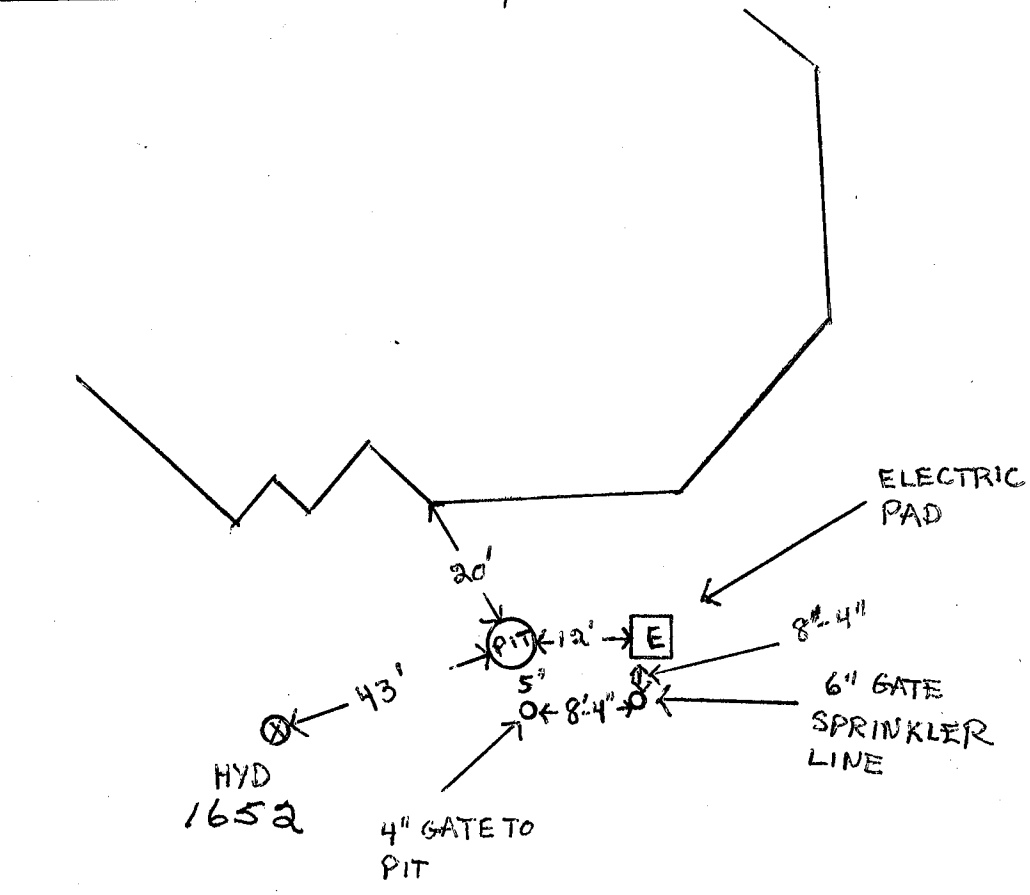
VILLAGE West Yarmouth 4-25-00

70000829 2" Compound

METER NO. ~~1197854~~ ~~3/2/06~~ R ~~4"~~ Turbo

Low pad # 2323930501 High # 5099960402

"A" Building Pads under pit cover Pit #1



← E

Route 28

PRO

13483-30
SERVICE NO.

NAME Cove At Yarmouth

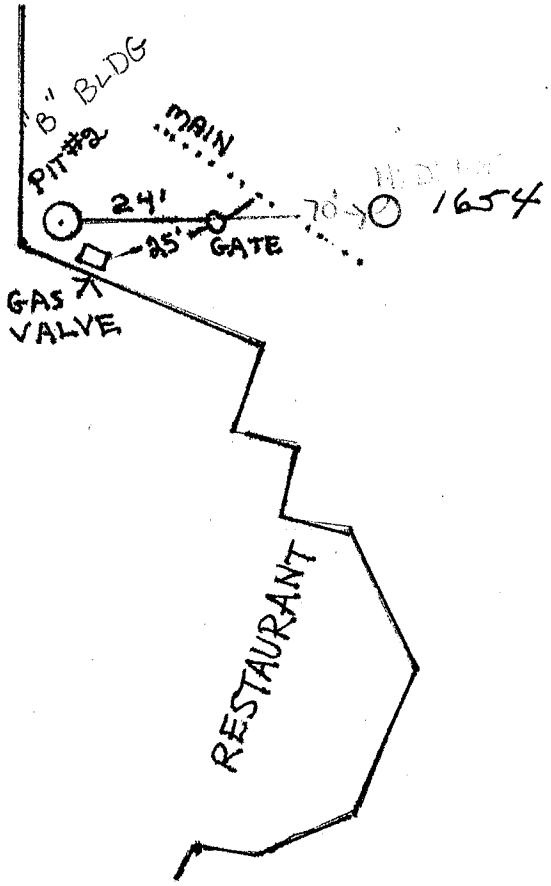
STREET 183 Route 28

VILLAGE West Yarmouth

70000836 low 2322930847 L/side
4" 2"
METER NO. ~~H99853~~
High 5098960417 R/side
PIT #2

B Building

2/3/86



ROUTE 28 W →

13429-30 Fire Line #60,070 PRO

SERVICE NO.

NAME HOLLY TREE MOTEL

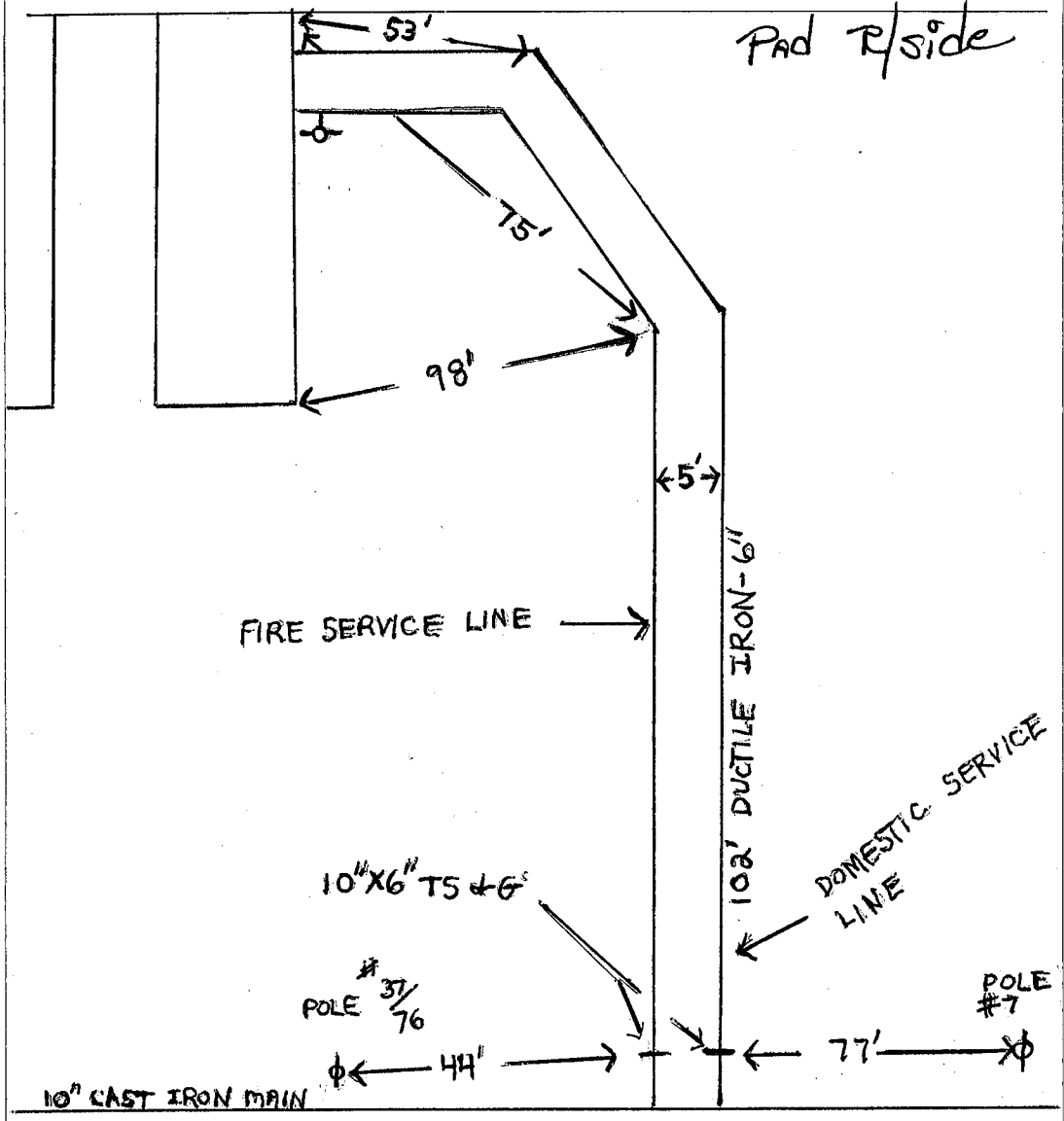
STREET 412 MAIN STREET

VILLAGE W. YARMOUTH

"NOTE: This Service ALSO Has Fire Sprinkler Line"

700615631194990524

METER NO. ~~1215090~~ RM 3" meter



ROUTE 28 E →

13490-30

SERVICE NO.

PRO

NAME: THE COVE AT YARMOUTH

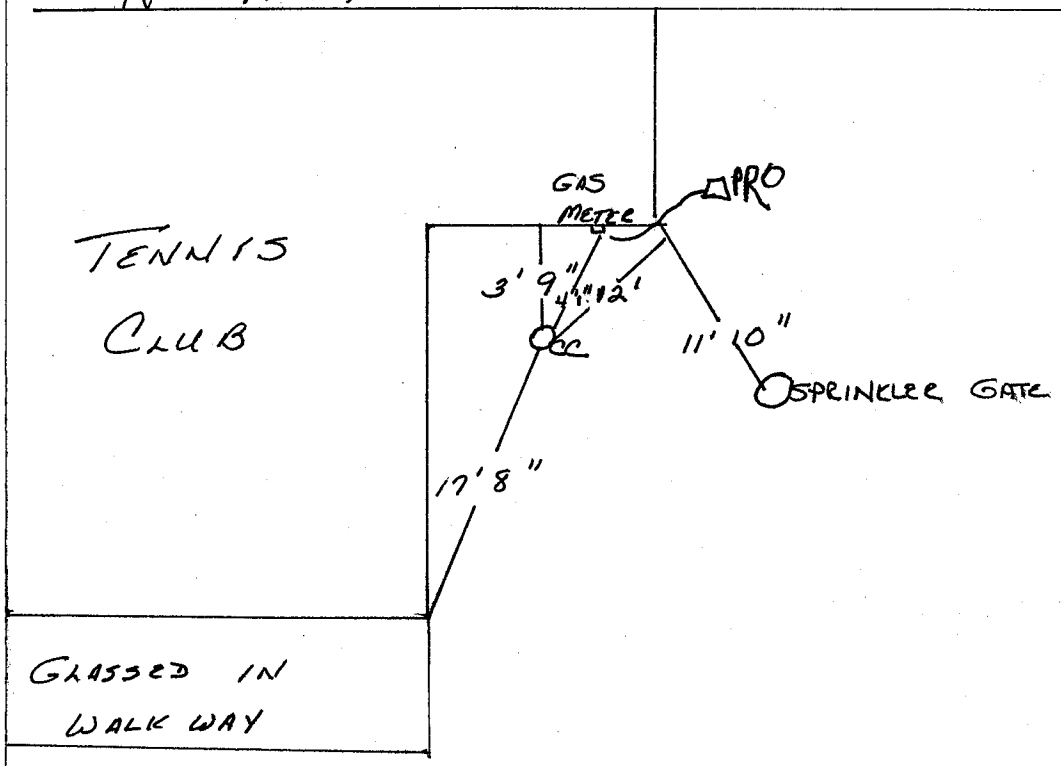
STREET 182 Rte 28 (TENNIS CLUB)

VILLAGE

60184669 Pad 119394327 3-16-00

METER NO. ~~3446-5880~~ 2" 7/23/86

~~R- 41647~~



PARKING LOT

4/2-hw 9/12/86 PRO

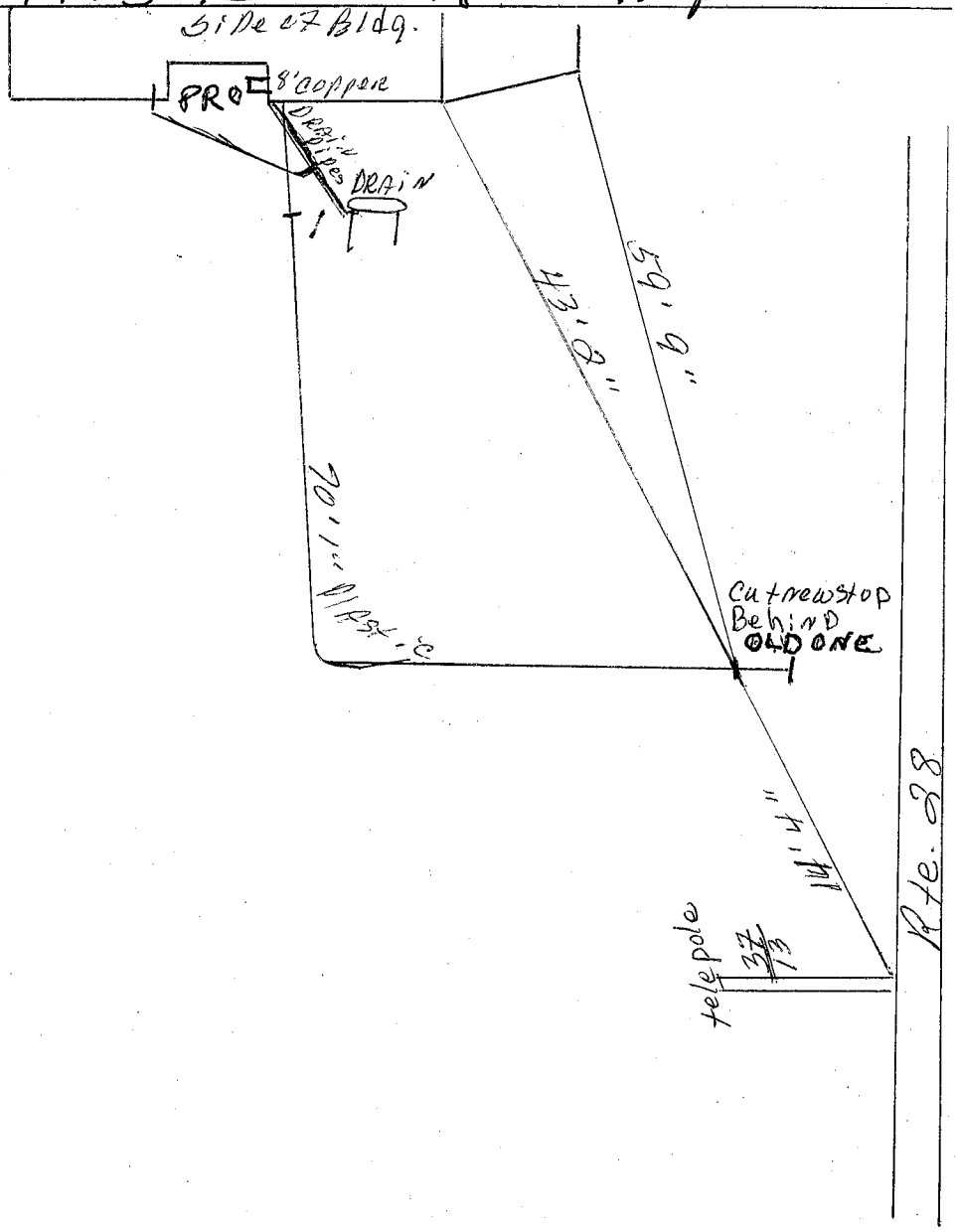
SERVICE NO. 13513 ~~-30~~ 33

NAME Ed 13513 1/22/98 Elias Kaldis Marie Kaldis il Bldg b left of Steve + Sues

STREET E-3, 38 Rt. 28 ICE CREAM

VILLAGE

METER NO. ~~3675 2489~~ 10/10/86 RX 5/8 ~~R# 51694~~ 12-15-96 4473-9355 5/8 78 plastic



PCO

SERVICE NO. 13546-30

NAME The Cove at Yarmouth

STREET #183 RTE 28

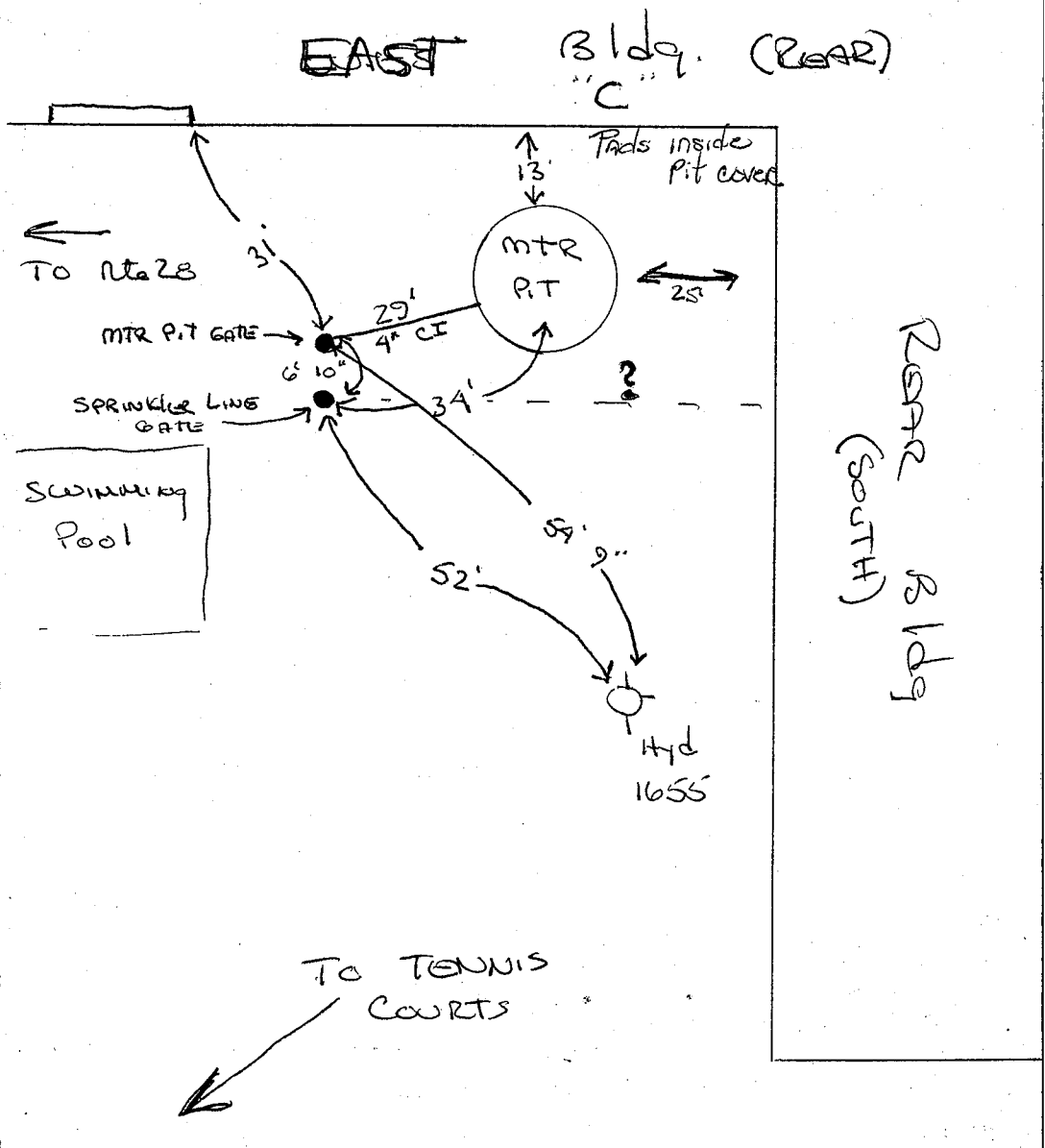
VILLAGE W. YARMOUTH Low Hside

700006128 2322930863 3-23-00 2" Compound

METER NO. ~~197852~~ 4" Tordo RA

1/9/87 20959600081 High R/side ~~EHF HAS~~ ~~126395~~

PIT #3



PRO

SERVICE NO. 13547-30

NAME Jill Cove

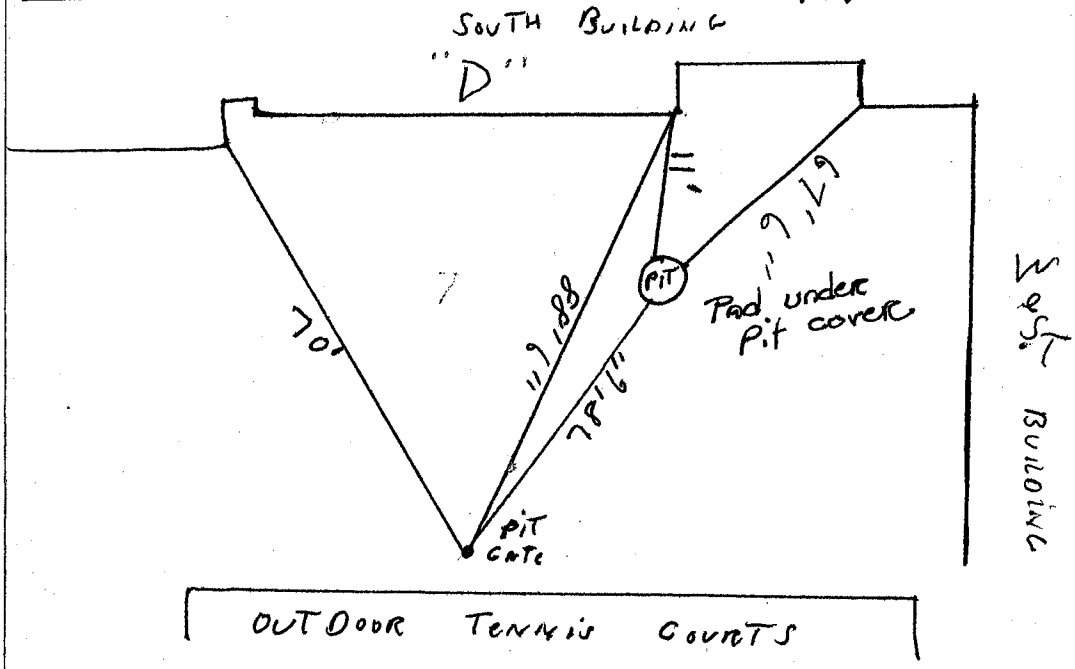
STREET 183 Rte 28 Pit # 4

VILLAGE Pit 4

7002082 2" Compound 4-25-00

METER NO. ~~1240608~~ ~~2/3/97~~

Low + High Pad #'s Are SAME ~~411 R-TURBO~~ ~~CAP HMS 1263277~~



PRO

SERVICE NO. 13548-30

NAME The Cove

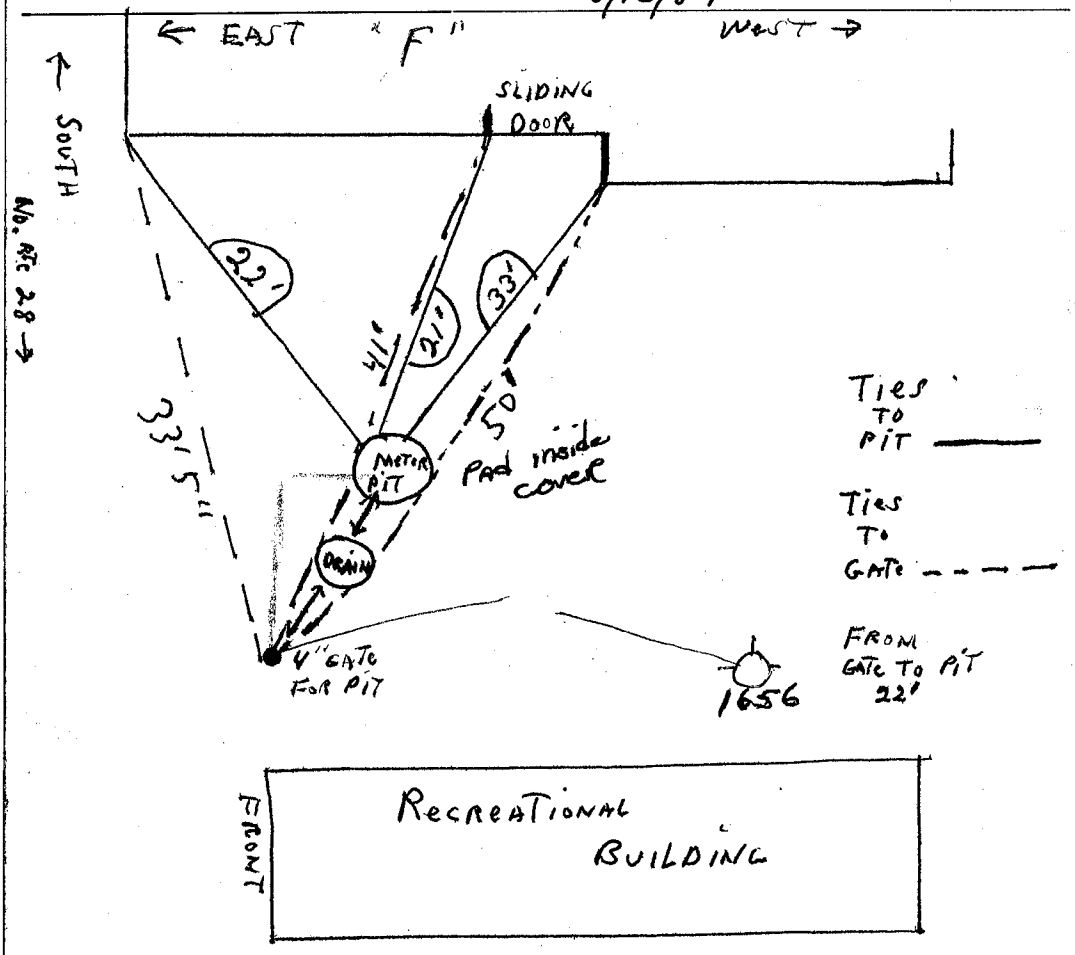
STREET 183 Rte 28 Pit #5 Bld. F

VILLAGE

METER NO. ~~240607~~ 70009989 Pad same 3-23-00 ~~4" R.T.~~ ~~RBO~~ 2" Compound

high pad # 35010136

3/12/87



ABB

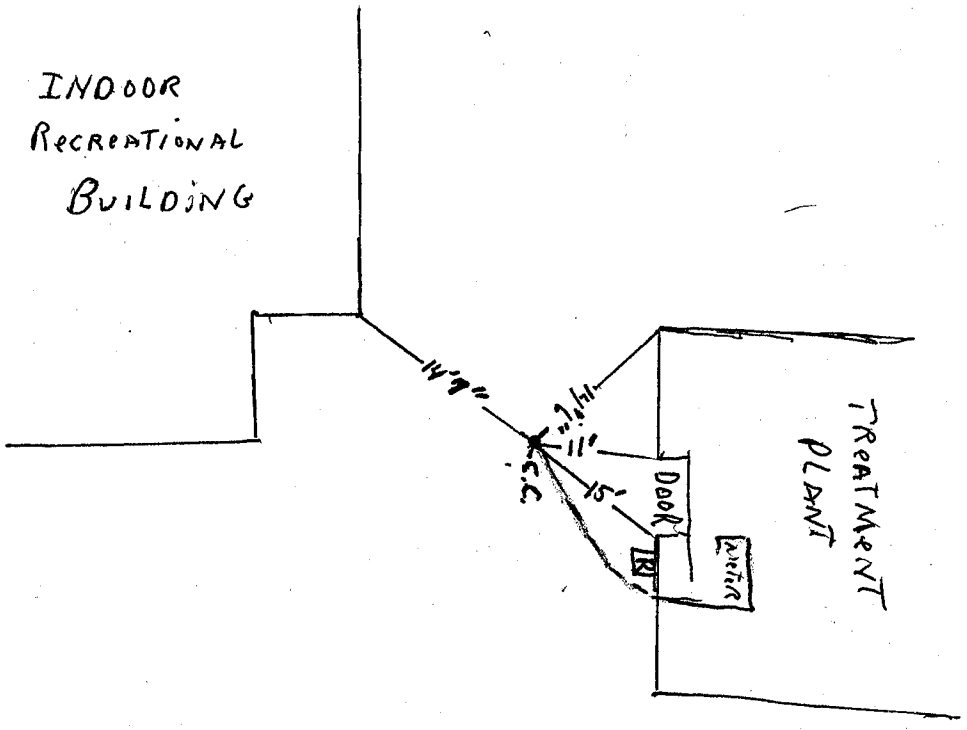
SERVICE NO. 13549-30

NAME The Cove TREATMENT PLANT

STREET 183 Rte 28, Treatment Plant

VILLAGE

METER NO. 11340475 12-13-01 5/8" 4421007862



This Service has Fire Sprinkler Line #60055

SERVICE NO. 13917-

PRO

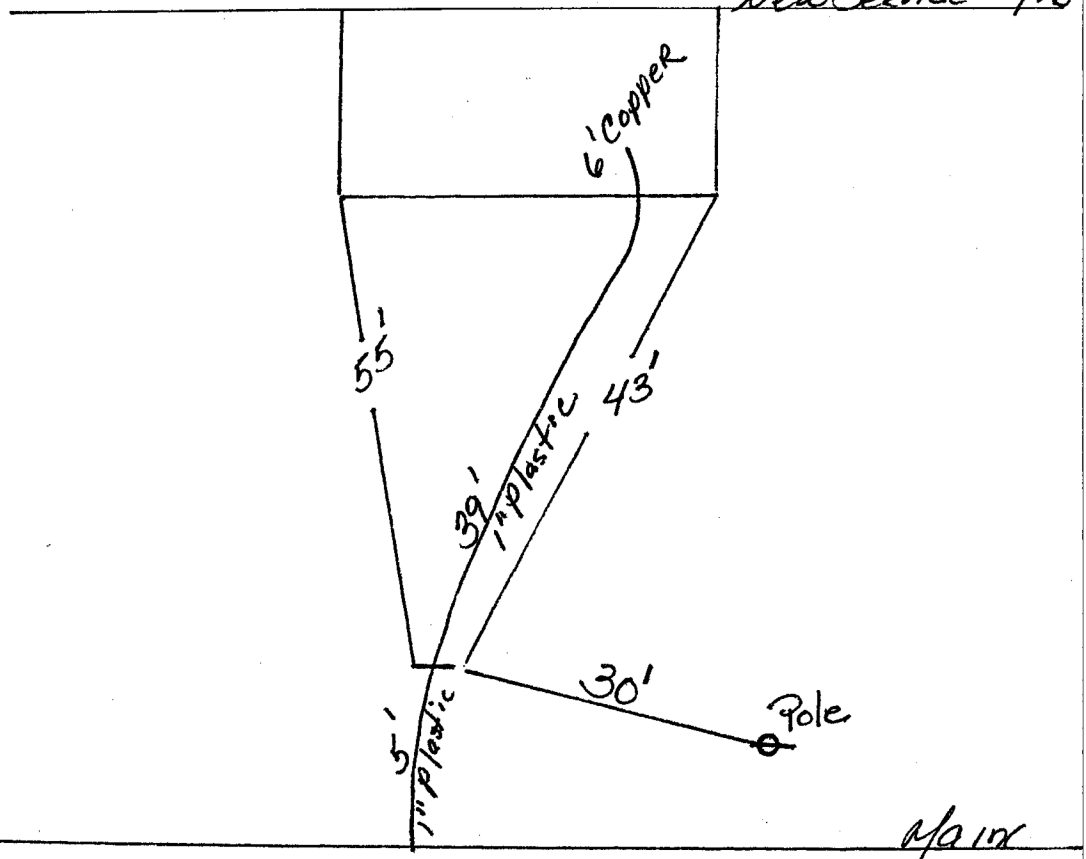
NAME Richard Shriner

STREET 174 Rte 28

VILLAGE West Yarmouth

METER NO. 4217456 1-6-97

New Service 12/96



Route 28

Fire line goes to Town Brook Road

ECR

SERVICE NO. 13922 -

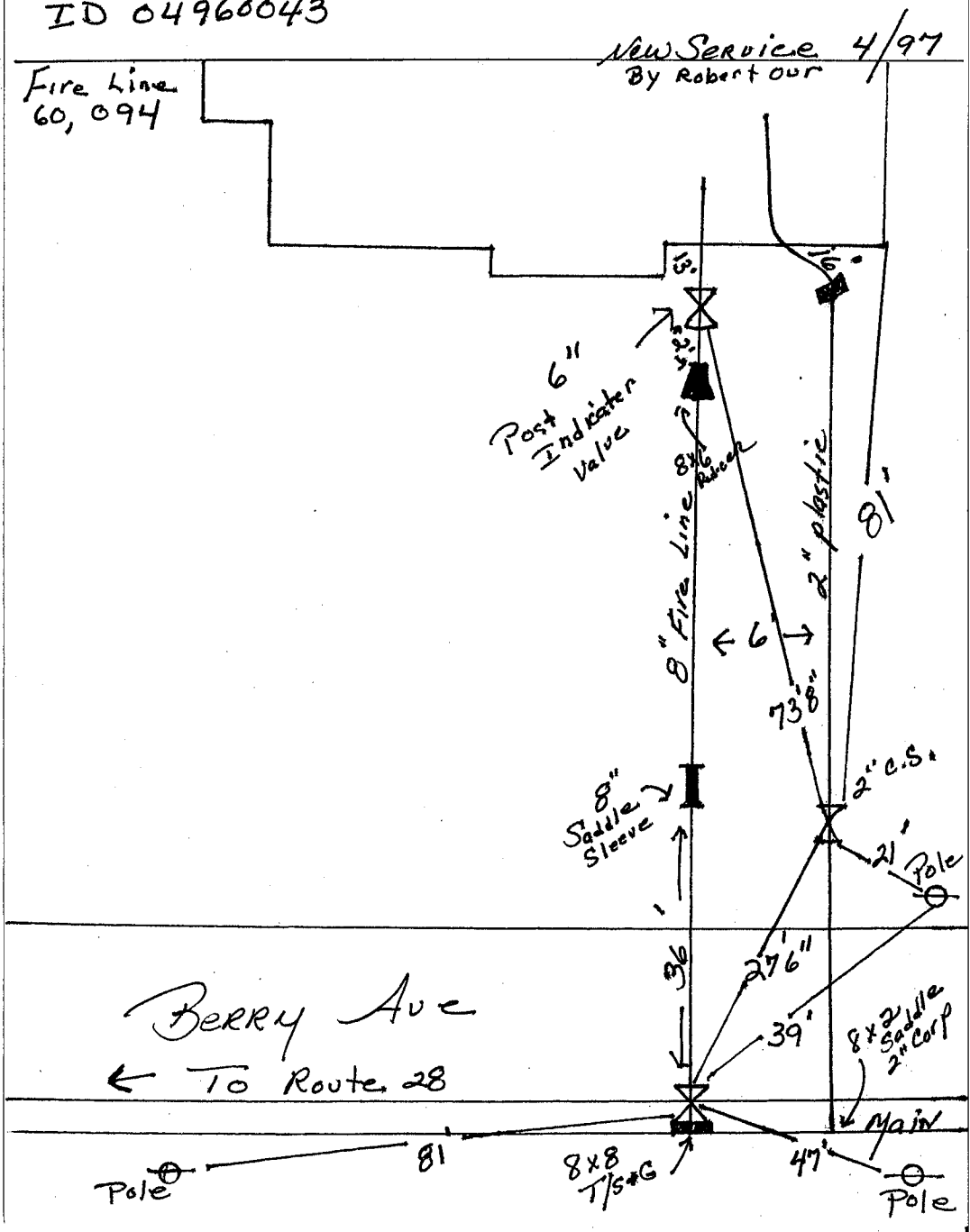
NAME 99 Restaurant

STREET 14 Berry Ave

VILLAGE West Yarmouth

METER NO. 60061768 - 5-7-97

ID 04960043



SERVICE NO. 15017-33

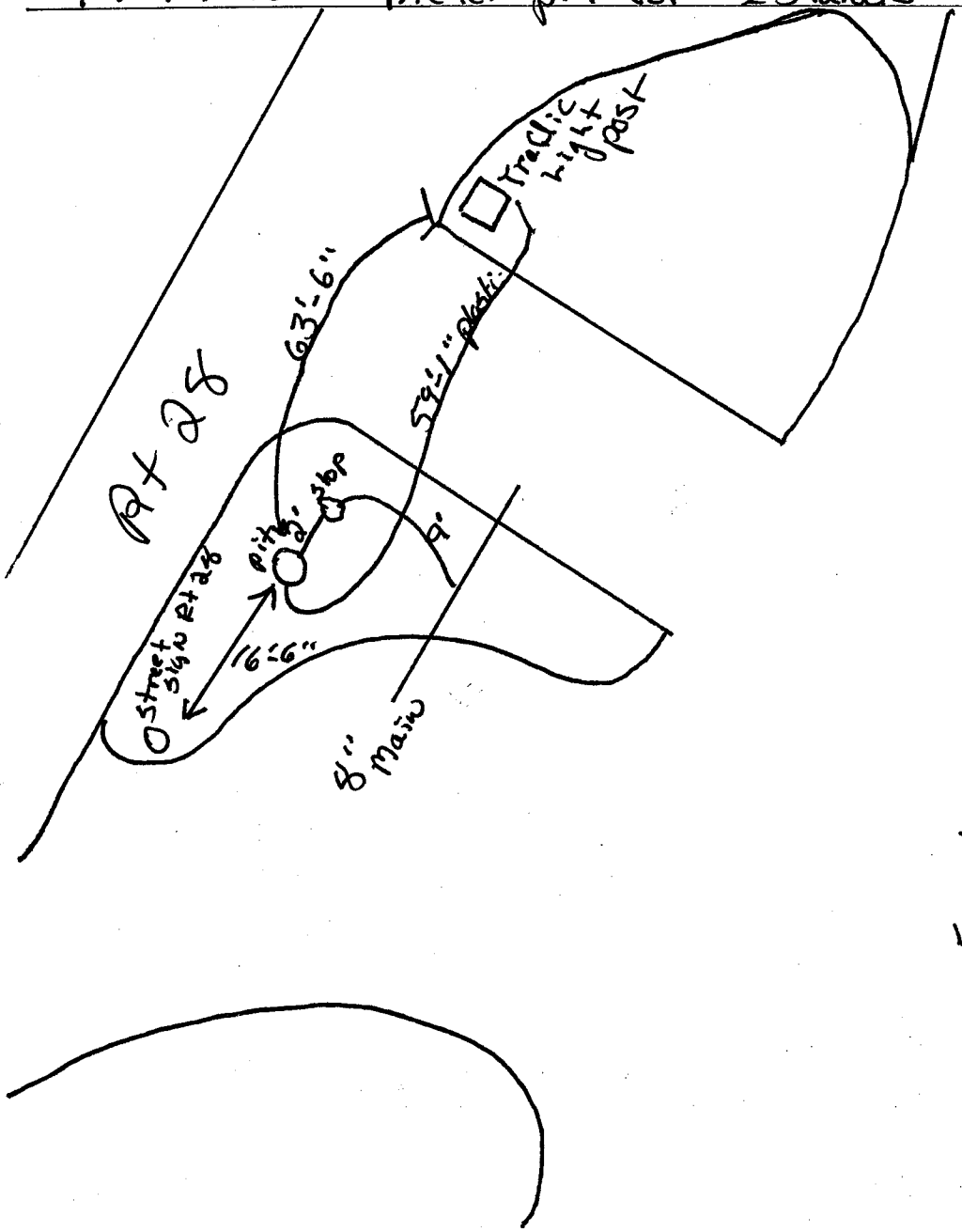
NAME Town of Yarmouth Park Dept.

STREET East Main and Rt 28 pit for Islands

VILLAGE W.Y.

METER NO.

12/6/01
74'-1" New meter pit for Islands



SERVICE NO. 15137

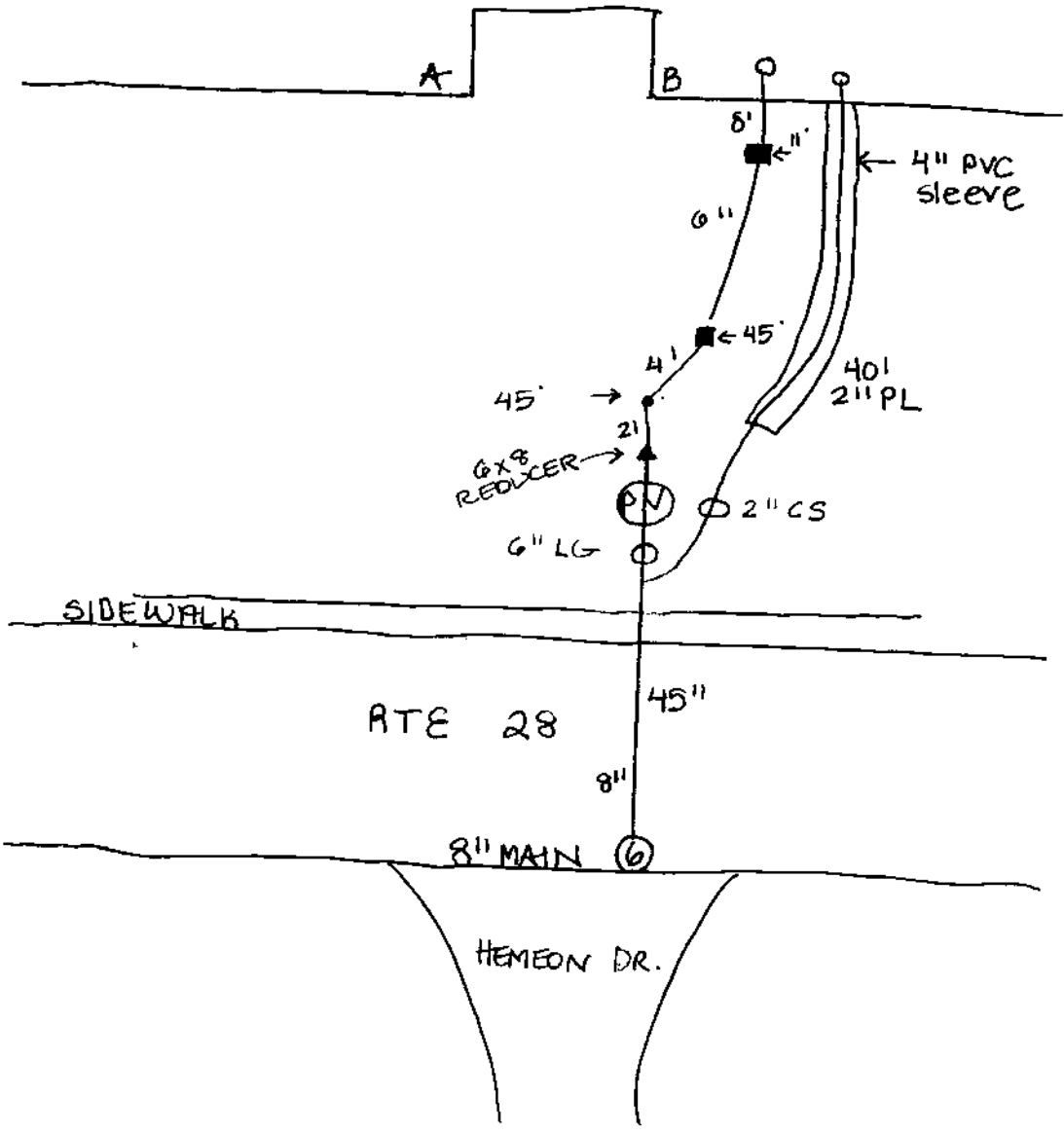
NAME

STREET 349 ROUTE 28

VILLAGE West Yarmouth

METER NO.

#349



SERVICE NO. 15243

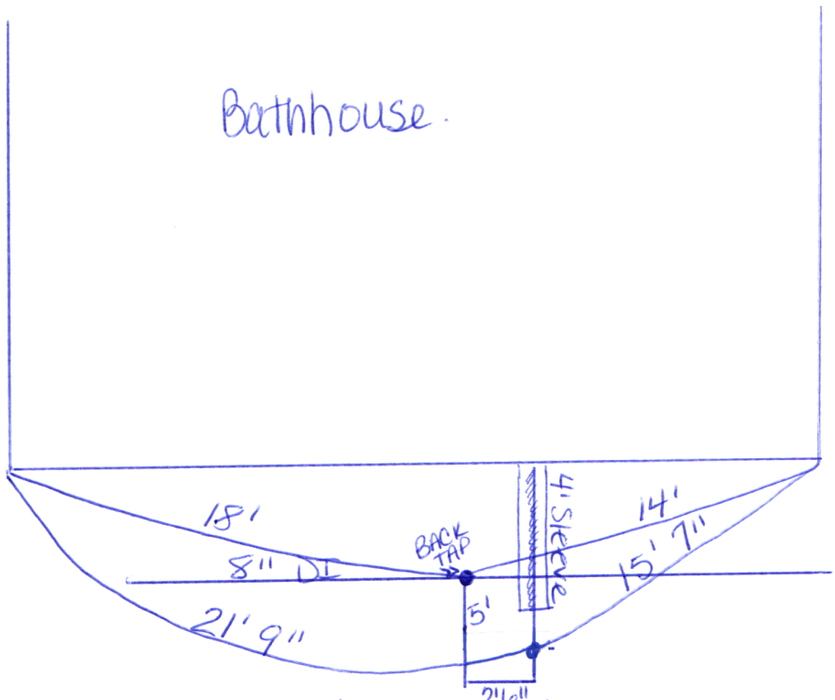
NAME Cove (Bathhouse)

STREET 183 Route 28

VILLAGE West Yarmouth

METER NO.

GFM
5/3/17



Corp to Curb 8' 6" / Curb to Build 12'
Total 2" Plastic 20' 6"

PARKING LOT

Appendix D

Yarmouth Conservation Commission Order of Conditions

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Bk 36632 Pg181 #42104
10-23-2024 @ 01:00p

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 5 - Order of Conditions
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
MassDEP File #:083-2442
eDEP Transaction #:1775924
City/Town:YARMOUTH

A. General Information

1. Conservation Commission: YARMOUTH
2. Issuance: a. ☑ OOC b. ☐ Amended OOC

3. Applicant Details

a. First Name	JEFFREY		b. Last Name	COLBY	
c. Organization	TOWN OF YARMOUTH				
d. Mailing Address	74 TOWN BROOK ROAD				
e. City/Town	YARMOUTH	f. State	MA	g. Zip Code	02673

4. Property Owner

a. First Name			b. Last Name		
c. Organization	TOWN OF YARMOUTH				
d. Mailing Address	1146 ROUTE 28				
e. City/Town	YARMOUTH	f. State	MA	g. Zip Code	02664

5. Project Location

a.Street Address	316, 669, 674, 700 AND 728 ROUTE 28 *		
b.City/Town	YARMOUTH	c. Zip Code	02673
d. Assessors Map/Plat#	30,32,32,32,32	e. Parcel/Lot#	153,122,92,93,94
f. Latitude	41.64930N	g. Longitude	70.22300W

6. Property recorded at the Registry of Deed for:

a. County	b. Certificate	c. Book	d. Page
BARNSTABLE		36065	19
BARNSTABLE		2839	0166

7.Dates

a. Date NOI Filed : 8/1/2024 b. Date Public Hearing Closed: 9/5/2024 c. Date Of Issuance: 9/24/2024

8.Final Approved Plans and Other Documents

a. Plan Title:	b. Plan Prepared by:	c. Plan Signed/Stamped by:	d. Revised Final Date:	e. Scale:
PHASE 1 - CONTRACT 5 EX-1, CD-1	JUSTIN R HEIL R.L.A.	CDM SMITH	July 2024	
PHASE 1 - CONTRACT 5 M1-4	WILLIAM J HOLTZ JR P.E.	CDM SMITH	July 2024	
PHASE 1 - CONTRACT 6 M1-6	WILLIAM J HOLTZ JR P.E.	CDM SMITH	July 2024	
PHASE 1 - CONTRACT 5 PS-A-1,2	BARRY L GIORGI R.A.	CDM SMITH	July 2024	

PHASE 1 - CONTRACT 6 EX-1,2 CD-1,2,4	JUSTIN R HEIL R.L.A.	CDM SMITH	July 2024	
PHASE 1 - CONTRACT 6 A-2,3	BARRY L GIORGI R.A.	CDM SMITH	July 2024	
PHASE 1 - CONTRACT 5 C-5	MICHAEL P GUIDICE JR P.E.	CDM SMITH	July 2024	1" = 40'
STORMWATER CHECKLIST AND REPORT	DIANNE E VELARDOCCHIA P.E.		7/31/2024	

B. Findings

1.Findings pursuant to the Massachusetts Wetlands Protection Act
Following the review of the the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act.

Check all that apply:

a. ☑ Public Water Supply	b. ☐ Land Containing Shellfish	c. ☑ Prevention of Pollution
d. ☑ Private Water Supply	e. ☐ Fisheries	f. ☑ Protection of Wildlife Habitat
g. ☑ Ground Water Supply	h. ☑ Storm Damage Prevention	i. ☑ Flood Control

2. Commission hereby finds the project, as proposed, is:

Approved subject to:

a. ☑ The following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

Denied because:

b. ☐ The proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect interests of the Act, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

c. ☐ The information submitted by the applicant is not sufficient to describe the site, the work or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the interests of the Act , and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c).**

3. ☐ Buffer Zone Impacts:Shortest distance between limit of project disturbance and the wetland resource area specified in 310CMR10.02(1)(a).

_____
a. linear feet

Inland Resource Area Impacts:(For Approvals Only):

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
4. ☐ Bank	a. linear feet	b. linear feet	c. linear feet	d. linear feet
5.☐ Bordering Vegetated Wetland	a. square feet	b. square feet	c. square feet	d. square feet
6. ☐ Land under Waterbodies and Waterways	a. square feet	b. square feet	c. square feet	d. square feet
	e. c/y dredged	f. c/y dredged		
7.☐ Bordering Land Subject to Flooding	a. square feet	b. square feet	c. square feet	d. square feet
Cubic Feet Flood Storage	e. cubic feet	f. cubic feet	g. cubic feet	h. cubic feet
8.☐ Isolated Land Subject to Flooding	a. square feet	b. square feet		
Cubic Feet Flood Storage	c. cubic feet	d. cubic feet	e. cubic feet	f. cubic feet
9.☑ Riverfront Area	23965 a. total sq. feet	23965 b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

Coastal Resource Area Impacts:

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
10.☐ Designated Port Areas	Indicate size under Land Under the Ocean, below			
11.☐ Land Under the Ocean	a. square feet	b. square feet		
	c. c/y dredged	d. c/y dredged		
12.☐ Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes below			
13.☐ Coastal Beaches	a. square feet	b. square feet	c. c/y nourishment	d. c/y nourishment
14.☐ Coastal Dunes	a. square feet	b. square feet	c. c/y nourishment	d. c/y nourishment

15.☐ Coastal Banks	a. linear feet	b. linear feet		
16.☐ Rocky Intertidal Shores	a. square feet	b. square feet		
17.☐ Salt Marshes	a. square feet	b. square feet	c. square feet	d. square feet
18.☐ Land Under Salt Ponds	a. square feet	b. square feet		
	c. c/y dredged	d. c/y dredged		
19.☐ Land Containing Shellfish	a. square feet	b. square feet	c. square feet	d. square feet
20.☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above			
	c. c/y dredged	d. c/y dredged		
21.☑ Land Subject to Coastal Storm Flowage	35430 a. square feet	35430 b. square feet		

22.

☐ Restoration/Enhancement (For Approvals Only)

If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c & d or B.17.c & d above, please entered the additional amount here.

a. square feet of BVW

b. square feet of Salt Marsh

23.

☐ Streams Crossing(s)

If the project involves Stream Crossings, please enter the number of new stream crossings/number of replacement stream crossings.

a. number of new stream crossings

b. number of replacement stream crossings

C. General Conditions Under Massachusetts Wetlands Protection Act

The following conditions are only applicable to Approved projects

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. the work is a maintenance dredging project as provided for in the Act; or

b. the time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.

5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order.
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not exceed the issuance date of the original Final Order of Conditions.
7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.
8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.
9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work..
10. A sign shall be displayed at the site not less then two square feet or more than three square feet in size bearing the words,

" Massachusetts Department of Environmental Protection"
[or 'MassDEP"]
File Number :"083-2442"

11. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before Mass DEP.
12. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.
13. The work shall conform to the plans and special conditions referenced in this order.
14. Any change to the plans identified in Condition #13 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.
15. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.
16. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.
17. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.
18. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall

remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

NOTICE OF STORMWATER CONTROL AND MAINTENANCE REQUIREMENTS

19. The work associated with this Order(the "Project") is (1) ☑ is not (2)☐ subject to the Massachusetts Stormwater Standards. If the work is subject to Stormwater Standards, then the project is subject to the following conditions;

a) All work, including site preparation, land disturbance, construction and redevelopment, shall be implemented in accordance with the construction period pollution prevention and erosion and sedimentation control plan and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollutant Discharge Elimination System Construction General Permit as required by Stormwater Standard 8. Construction period erosion, sedimentation and pollution control measures and best management practices (BMPs) shall remain in place until the site is fully stabilized.

b) No stormwater runoff may be discharged to the post-construction stormwater BMPs unless and until a Registered Professional Engineer provides a Certification that: *i.* all construction period BMPs have been removed or will be removed by a date certain specified in the Certification. For any construction period BMPs intended to be converted to post construction operation for stormwater attenuation, recharge, and/or treatment, the conversion is allowed by the MassDEP Stormwater Handbook BMP specifications and that the BMP has been properly cleaned or prepared for post construction operation, including removal of all construction period sediment trapped in inlet and outlet control structures; *ii.*. as-built final construction BMP plans are included, signed and stamped by a Registered Professional Engineer, certifying the site is fully stabilized; *iii.* any illicit discharges to the stormwater management system have been removed, as per the requirements of Stormwater Standard 10; *iv.* all post-construction stormwater BMPs are installed in accordance with the plans (including all planting plans) approved by the issuing authority, and have been inspected to ensure that they are not damaged and that they are in proper working condition; *v.* any vegetation associated with post-construction BMPs is suitably established to withstand erosion.

c) The landowner is responsible for BMP maintenance until the issuing authority is notified that another party has legally assumed responsibility for BMP maintenance. Prior to requesting a Certificate of Compliance, or Partial Certificate of Compliance, the responsible party (defined in General Condition 19(e)) shall execute and submit to the issuing authority an Operation and Maintenance Compliance Statement ("O&M Statement") for the Stormwater BMPs identifying the party responsible for implementing the stormwater BMP Operation and Maintenance Plan ("O&M Plan") and certifying the following: i.) the O&M Plan is complete and will be implemented upon receipt of the Certificate of Compliance, and ii.) the future responsible parties shall be notified in writing of their ongoing legal responsibility to operate and maintain the stormwater management BMPs and implement the Stormwater Pollution Prevention Plan.

d) Post-construction pollution prevention and source control shall be implemented in accordance with the long-term pollution prevention plan section of the approved Stormwater Report and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollutant Discharge Elimination System Multi-Sector General Permit.

e) Unless and until another party accepts responsibility, the landowner, or owner of any drainage easement, assumes responsibility for maintaining each BMP. To overcome this presumption, the landowner of the property must submit to the issuing authority a legally binding agreement of record, acceptable to the issuing authority, evidencing that another entity has accepted responsibility for maintaining the BMP, and that the proposed responsible party shall be treated as a permittee for purposes of implementing the requirements of Conditions 19(f) through 19(k) with respect to that BMP. Any failure of the proposed responsible party to

implement the requirements of Conditions 19(f) through 19(k) with respect to that BMP shall be a violation of the Order of Conditions or Certificate of Compliance. In the case of stormwater BMPs that are serving more than one lot, the legally binding agreement shall also identify the lots that will be serviced by the stormwater BMPs. A plan and easement deed that grants the responsible party access to perform the required operation and maintenance must be submitted along with the legally binding agreement.

f) The responsible party shall operate and maintain all stormwater BMPs in accordance with the design plans, the O&M Plan, and the requirements of the Massachusetts Stormwater Handbook.

g) The responsible party shall:
1. Maintain an operation and maintenance log for the last three (3) consecutive calendar years of inspections, repairs, maintenance and/or replacement of the stormwater management system or any part thereof, and disposal (for disposal the log shall indicate the type of material and the disposal location);
2. Make the maintenance log available to MassDEP and the Conservation Commission ("Commission") upon request; and
3. Allow members and agents of the MassDEP and the Commission to enter and inspect the site to evaluate and ensure that the responsible party is in compliance with the requirements for each BMP established in the O&M Plan approved by the issuing authority.

h) All sediment or other contaminants removed from stormwater BMPs shall be disposed of in accordance with all applicable federal, state, and local laws and regulations.

i) Illicit discharges to the stormwater management system as defined in 310 CMR 10.04 are prohibited.

j) The stormwater management system approved in the Order of Conditions shall not be changed without the prior written approval of the issuing authority.

k) Areas designated as qualifying pervious areas for the purpose of the Low Impact Site Design Credit (as defined in the MassDEP Stormwater Handbook, Volume 3, Chapter 1, Low Impact Development Site Design Credits) shall not be altered without the prior written approval of the issuing authority.

l) Access for maintenance, repair, and/or replacement of BMPs shall not be withheld. Any fencing constructed around stormwater BMPs shall include access gates and shall be at least six inches above grade to allow for wildlife passage.

Special Conditions:

D. Findings Under Municipal Wetlands Bylaw or Ordinance

1.Is a municipal wetlands bylaw or ordinance applicable? ☑ Yes ☐ No

2.The Conservation Commission hereby(check one that applies):

a. ☐ DENIES the proposed work which cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw specifically:

1. Municipal Ordinance or Bylaw _____ 2. Citation _____

Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order or Conditions is issued. Which are necessary to comply with a municipal ordinance or bylaw:

b. ☑ APPROVES the proposed work, subject to the following additional conditions.

1. Municipal Ordinance or Bylaw: YARMOUTH WETLAND BYLAW
2. Citation: CHAPTER 143

3. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

The special conditions relating to municipal ordinance or bylaw are as follows:
SEE SPECIAL CONDITIONS ATTACHED

WPA FORM 5-ORDER OF CONDITIONS
SPECIAL CONDITIONS-PAGE 8A OF 10
SE83-2442, Town of Yarmouth
316, 669, 674, 700 & 728 Route 28

1. This Order shall apply to any successors and assigns in interest or control and any other person engaging in activity on the property identified in the Notice of Intent.
2. The applicant/owner shall be responsible for always having a copy of the "Order of Conditions" on the job site and shall be responsible for insuring that all persons performing the permitted activity are fully aware of its terms and conditions. Failure to do so may result in the revocation of these "Orders", a fine or both.
3. The Conservation Commission, its agent(s) or assigned(s) shall have the express right of entry upon the job site at all reasonable times for the purposes of establishing compliance with the "Order of Conditions", "By -Laws" and "Regulations". Commission members and the Conservation Administrator may acquire any information, measurements, photographs, observations and/or materials or may require the submittal of any data/information deemed necessary by this Commission for that evaluation.
4. A preconstruction review shall be arranged by the contractor with the Conservation Administrator and shall occur prior to the commencement of any work.
5. Any change in the approved plan(s) shall require the Applicant to file, in writing, a notice of project change with this Commission. The Commission will determine the significance of the change and determine whether administrative approval or an "Amended Order of Conditions" is required. Should the project be changed without permission or found by the Yarmouth Conservation Commission to be altered in any way from the approved plan(s), all work will immediately cease until the project is reapproved by the Commission.
6. The "Order of Conditions" is valid for three years from the date of issuance unless otherwise specifically noted in the "Orders". Extension Permit requests must be applied for at least 30 calendar days prior to the expiration date of the original Orders". Failure to do so will result in a new "Notice of Intent" filing.
7. Noncompliance with these conditions shall constitute grounds for an Enforcement Order and possible fines. Fines shall not exceed $300.00 per day/per violation.
8. Gutters and downspouts directed into adequately sized drywells shall be provided for roof drainage. The Commission may also allow "drip trench es" instead of gutter systems. At no time shall roof run off be directed to a wetland resource area or abutting properties.
9. Grading shall be accomplished so that the project shall not cause flooding or storm damage to Wetland Resource Areas.
10. If fill is used to elevate a structure within the land subject to coastal storm flowage, the fill must be compacted and protected against scour and erosion.
11. A "work limit " line shall be established with Erosion Controls (i.e. straw bales, staked filter fabric, bark mulch, "silt sacks", products made with r ice straw, and other weed-free products or approved by the Commission). Hay bales are not allowed. It is the applicant's responsibility to implement and maintain appropriate and adequate erosion controls measures throughout the construction process.
12. No work of any kind shall occur on the Resource Area side of the work limit line. This line shall be established prior to any construction or work.
13. All imported fill shall be clean and not contain any foreign debris such as cement, bituminous concrete, rubber, metal, trash, boulders, etc. Boulders will be allowed in specific instances if part of the project design.
14. Debris, including litter, shall be picked up immediately. Any excess material that is excavated from the job site shall be disposed of at a location approved by the Conservation Administrator or in a covered dumpster. No debris shall be allowed in a Wetland or Waterway.
15. Washing of equipment/tools shall be done OFF -SITE or handled in a manner appropriate by the Conservation Administrator.
16. No equipment shall be refueled, nor shall fuel be stored within 100 feet of a resource area.
17. Any area that is disturbed during construction shall be revegetated immediately or as soon after the growing season commences, with appropriate native plantings. Permanent stabilization shall be carried out to minimize erosion.
18. The mitigation area of native vegetation shall be planted per the approved plan and shall be left UNDISTURBED. This is an on-going condition, in-perpetuity, that does not expire with the issuance of a Certificate of Compliance. The applicant must wait until the second growing season is complete before the Request for a Certificate of Compliance is submitted. During this time, the Commission/Conservation Administrator may require additional plantings if it is determined that any specimens are dead or dying and need replacement.
19. Landscape Debris, including leaves, grass clippings, brush, or other shall not be allowed within the wetland resource area. This is an on-going condition that does not expire with the issuance of a Certificate of Compliance.

20. The owner of the property covered by this Order of Conditions, or their successors in title, shall be responsible for the maintenance and operation of all components of the Stormwater Management System in accordance with the Operation and Maintenance sched ule provided on the approved plans. This condition is ongoing and does not expire with the issuance of a Certificate of Compliance.
21. A gravel apron shall be created and maintained at the edge of driveway/road entrance where vehicles will access the work site. The roadway shall be swept as necessary to keep sediment off the roadway.
22. Catch basins adjacent to wetland resource areas shall be protected with filter fabric to ensure sediments do not enter existing drainage system.
23. Upon completion of the project, a "Request for a "Certificate of Compliance" shall be submitted by the applicant to the Conservation Commission for review. The "Order of Conditions" shall be considered incomplete until the "Certificate of Compliance" is issued by the Conservation Commission and recorded at the Registry of Deeds.

DMF conditions

24. Appropriate containment measures shall be employed to prevent siltation in the marine environment during all activities.
25. An HDD Contingency Plan shall be submitted to Conservation and DMF at least 3 weeks prior to the start or work to minimize risk of a "frac out" event and develop response measures to minimize impacts if such an event occurs.
26. Dewatering plans for the entry/exit pits and sewer trench shall be submitted to Conservation and DMF at least 3 weeks prior to the start or work

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 5 - Order of Conditions
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
MassDEP File #: SE83-2442
eDEP Transaction #: 1775924
City/Town: YARMOUTH

E. Signatures

This Order is valid for three years from the date of issuance, unless otherwise specified pursuant to General Condition #4. If this is an Amended Order of Conditions, the Amended Order expires on the same date as the original Order of Conditions.

9/24/2024
1. Date of Original Order

Please indicate the number of members who will sign this form. This Order must be signed by a majority of the Conservation Commission.

4
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office, if not filing electronically, and the property owner, if different from applicant.

Signatures:

☐ by hand delivery on

Date

☑ by certified mail, return receipt requested, on

Date 9/24/2024

F. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate MassDEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order, or providing written information to the Department prior to issuance of a Superseding Order.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40), and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

G. Recording Information

This Order of Conditions must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land

subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

YARMOUTH
Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

YARMOUTH
Conservation Commission

Please be advised that the Order of Conditions for the Project at:

316, 669, 674, 700 AND 728 ROUTE 28 *
Project Location

083-2442
MassDEP File Number

Has been recorded at the Registry of Deeds of:

County | Book | Page

for:

Property Owner

and has been noted in the chain of title of the affected property in:

Book | Page

In accordance with the Order of Conditions issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant

Rev. 4/1/2010

BARNSTABLE REGISTRY OF DEEDS
John F. Meade, Register

Appendix E

B-PS2 Groundwater and Soil Summary Results

Table 1-1
Groundwater Sampling Results
Yarmouth Phase 1 - Contract 6

LOCATION				B-PS2		Trip Blank	
CLIENT SAMPLE ID							
SAMPLING DATE				14-Oct-25		14-Oct-25	
LAB SAMPLE ID				L2564953-01		L2564953-02	
	RCGW-1	DRGP	Units		Qual		Qual
Field Parameters							
Temperature	---	---	°C	**14.3**		NA	
Specific Conductivity	---	---	µs/cm	**177**		NA	
Conductivity	---	---	S/m	**141**		NA	
Salinity	---	---	ppt	**0.09**		NA	
Dissolved Oxygen	---	---	mg/L	**3.24**		NA	
pH	---	6.0-9.0	SU	**5.73**		NA	
Oxidative Reduction Potential	---	---	mV	**90.6**		NA	
Turbidity	---	50	NTU	**7.27**		NA	
General Chemistry							
Turbidity	---	50	NTU	**4.7**		NA	
Solids, Total Dissolved	---	500	mg/l	**110**		NA	
Solids, Total Suspended	---	30	mg/l	5	U	NA	
Nitrogen, Nitrate/Nitrite	---	---	mg/l	**0.83**		NA	
Total Nitrogen	---	10	mg/l	**1.3**		NA	
Nitrogen, Total Kjeldahl	---	---	mg/l	**0.478**		NA	
Phosphorus, Total	---	---	mg/l	**0.026**		NA	
Total Organic Carbon	---	---	mg/l	**0.59**		NA	
Oil & Grease, Hem-Grav	---	---	mg/l	4	U	NA	
TPH	0.2	5	mg/l	0.2	U	NA	
Microbiological Analysis							
Coliform, Total	---	---	MPN/100ml	**2**		NA	
E. Coli	---	---	MPN/100ml	2	U	NA	
Enterococcus	---	---	MPN/100ml	2	U	NA	
Dissolved Metals							
Arsenic, Dissolved	0.01	0.104	mg/l	0.005	U	NA	
Cadmium, Dissolved	0.005	---	mg/l	NA		NA	
Chromium, Dissolved	0.1	---	mg/l	NA		NA	
Copper, Dissolved	10	0.242	mg/l	0.01	U	NA	
Iron, Dissolved	---	5.0	mg/l	**2.17**		NA	
Lead, Dissolved	0.01	0.16	mg/l	0.01	U	NA	
Mercury, Dissolved	0.002	---	mg/l	0.0002	U	NA	
Molybdenum, Dissolved	---	---	mg/l	NA		NA	
Nickel, Dissolved	0.1	---	mg/l	NA		NA	
Selenium, Dissolved	0.05	---	mg/l	NA		NA	
Silver, Dissolved	0.007	---	mg/l	NA		NA	
Zinc, Dissolved	0.9	---	mg/l	0.05	U	NA	
Volatile Organics by GC/MS							
1,1,1,2-Tetrachloroethane	0.005	---	mg/l	0.001	U	0.001	U
1,1,1-Trichloroethane	0.2	---	mg/l	0.001	U	0.001	U
1,1,2,2-Tetrachloroethane	0.002	---	mg/l	0.001	U	0.001	U
1,1,2-Trichloroethane	0.005	---	mg/l	0.001	U	0.001	U
1,1-Dichloroethane	0.07	---	mg/l	0.001	U	0.001	U
1,1-Dichloroethene	0.007	---	mg/l	0.001	U	0.001	U
1,1-Dichloropropene	---	---	mg/l	0.002	U	0.002	U
1,2,3-Trichlorobenzene	---	---	mg/l	0.002	U	0.002	U
1,2,3-Trichloropropane	1	---	mg/l	0.002	U	0.002	U
1,2,4-Trichlorobenzene	0.07	---	mg/l	0.002	U	0.002	U
1,2,4-Trimethylbenzene	10	---	mg/l	0.002	U	0.002	U
1,2-Dibromo-3-chloropropane	0.1	---	mg/l	0.002	U	0.002	U
1,2-Dibromoethane	0.00002	---	mg/l	*0.002*	U	*0.002*	U
1,2-Dichlorobenzene	0.6	---	mg/l	0.001	U	0.001	U
1,2-Dichloroethane	0.005	---	mg/l	0.001	U	0.001	U
1,2-Dichloroethene, Total	---	---	mg/l	0.001	U	0.001	U
1,2-Dichloropropane	0.003	---	mg/l	0.001	U	0.001	U
1,3,5-Trimethylbenzene	0.1	---	mg/l	0.002	U	0.002	U
1,3-Dichlorobenzene	0.1	---	mg/l	0.001	U	0.001	U
1,3-Dichloropropane	5	---	mg/l	0.002	U	0.002	U
1,3-Dichloropropene, Total	0.0004	---	mg/l	0.0004	U	0.0004	U
1,4-Dichlorobenzene	0.005	---	mg/l	0.001	U	0.001	U
1,4-Dioxane	0.0003	---	mg/l	*0.25*	U	*0.25*	U
2,2-Dichloropropane	---	---	mg/l	0.002	U	0.002	U
2-Hexanone	1	---	mg/l	0.005	U	0.005	U

Table 1-1
Groundwater Sampling Results
Yarmouth Phase 1 - Contract 6

LOCATION				B-PS2		Trip Blank	
CLIENT SAMPLE ID							
SAMPLING DATE				14-Oct-25		14-Oct-25	
LAB SAMPLE ID				L2564953-01		L2564953-02	
	RCGW-1	DRGP	Units		Qual		Qual
Acetone	6.3	---	mg/l	0.005	U	0.005	U
Benzene	0.005	---	mg/l	0.0005	U	0.0005	U
Bromobenzene	1	---	mg/l	0.002	U	0.002	U
Bromochloromethane	---	---	mg/l	0.002	U	0.002	U
Bromodichloromethane	0.003	---	mg/l	0.001	U	0.001	U
Bromoform	0.004	---	mg/l	0.002	U	0.002	U
Bromomethane	0.007	---	mg/l	0.002	U	0.002	U
Carbon disulfide	1	---	mg/l	0.002	U	0.002	U
Carbon tetrachloride	0.002	---	mg/l	0.001	U	0.001	U
Chlorobenzene	0.1	---	mg/l	0.001	U	0.001	U
Chloroethane	1	---	mg/l	0.002	U	0.002	U
Chloroform	0.05	---	mg/l	0.001	U	0.001	U
Chloromethane	1	---	mg/l	0.002	U	0.002	U
cis-1,2-Dichloroethene	0.02	---	mg/l	0.001	U	0.001	U
cis-1,3-Dichloropropene	0.0004	---	mg/l	0.0004	U	0.0004	U
Dibromochloromethane	0.002	---	mg/l	0.001	U	0.001	U
Dibromomethane	5	---	mg/l	0.002	U	0.002	U
Dichlorodifluoromethane	10	---	mg/l	0.002	U	0.002	U
Diethyl ether	1	---	mg/l	0.002	U	0.002	U
Diisopropyl Ether	1	---	mg/l	0.002	U	0.002	U
Ethyl-Tert-Butyl-Ether	---	---	mg/l	0.002	U	0.002	U
Ethylbenzene	0.7	---	mg/l	0.001	U	0.001	U
Hexachlorobutadiene	0.0006	---	mg/l	0.0006	U	0.0006	U
Isopropylbenzene	10	---	mg/l	0.002	U	0.002	U
Methyl ethyl ketone	4	---	mg/l	0.005	U	0.005	U
Methyl isobutyl ketone	0.35	---	mg/l	0.005	U	0.005	U
Methyl tert butyl ether	0.07	---	mg/l	0.002	U	0.002	U
Methylene chloride	0.005	---	mg/l	0.002	U	0.002	U
n-Butylbenzene	---	---	mg/l	0.002	U	0.002	U
n-Propylbenzene	1	---	mg/l	0.002	U	0.002	U
Naphthalene	0.14	---	mg/l	0.002	U	0.002	U
o-Chlorotoluene	1	---	mg/l	0.002	U	0.002	U
o-Xylene	3	---	mg/l	0.001	U	0.001	U
p-Chlorotoluene	---	---	mg/l	0.002	U	0.002	U
p-Isopropyltoluene	1	---	mg/l	0.002	U	0.002	U
p/m-Xylene	3	---	mg/l	0.002	U	0.002	U
sec-Butylbenzene	---	---	mg/l	0.002	U	0.002	U
Styrene	0.1	---	mg/l	0.001	U	0.001	U
tert-Butylbenzene	1	---	mg/l	0.002	U	0.002	U
Tertiary-Amyl Methyl Ether	---	---	mg/l	0.002	U	0.002	U
Tetrachloroethene	0.005	---	mg/l	0.001	U	0.001	U
Tetrahydrofuran	5	---	mg/l	0.002	U	0.002	U
Toluene	1	---	mg/l	0.001	U	0.001	U
trans-1,2-Dichloroethene	0.09	---	mg/l	0.001	U	0.001	U
trans-1,3-Dichloropropene	0.0004	---	mg/l	0.0004	U	0.0004	U
Trichloroethene	0.005	---	mg/l	0.001	U	0.001	U
Trichlorofluoromethane	10	---	mg/l	0.002	U	0.002	U
Vinyl chloride	0.002	---	mg/l	0.001	U	0.001	U
Xylenes, Total	3	---	mg/l	0.001	U	0.001	U
Semivolatile Organics by GC/MS							
1,2,4-Trichlorobenzene	0.07	---	mg/l	0.005	U	NA	
1,2-Dichlorobenzene	0.6	---	mg/l	0.002	U	NA	
1,3-Dichlorobenzene	0.1	---	mg/l	0.002	U	NA	
1,4-Dichlorobenzene	0.005	---	mg/l	0.002	U	NA	
2,4,5-Trichlorophenol	0.2	---	mg/l	0.005	U	NA	
2,4,6-Trichlorophenol	0.01	---	mg/l	0.005	U	NA	
2,4-Dichlorophenol	0.01	---	mg/l	0.005	U	NA	
2,4-Dimethylphenol	0.06	---	mg/l	0.005	U	NA	
2,4-Dinitrophenol	0.2	---	mg/l	0.02	U	NA	
2,4-Dinitrotoluene	0.03	---	mg/l	0.005	U	NA	
2,6-Dinitrotoluene	1	---	mg/l	0.005	U	NA	
2-Chloronaphthalene	10	---	mg/l	0.002	U	NA	
2-Chlorophenol	0.01	---	mg/l	0.002	U	NA	

Table 1-1
Groundwater Sampling Results
Yarmouth Phase 1 - Contract 6

LOCATION				B-PS2		Trip Blank
CLIENT SAMPLE ID						
SAMPLING DATE				14-Oct-25		14-Oct-25
LAB SAMPLE ID				L2564953-01		L2564953-02
	RCGW-1	DRGP	Units		Qual	Qual
2-Methylnaphthalene	0.01	---	mg/l	0.002	U	NA
2-Methylphenol	5	---	mg/l	0.005	U	NA
2-Nitrophenol	1	---	mg/l	0.01	U	NA
3,3'-Dichlorobenzidine	0.08	---	mg/l	0.005	U	NA
3-Methylphenol/4-Methylphenol	5	---	mg/l	0.005	U	NA
4-Bromophenyl phenyl ether	1	---	mg/l	0.002	U	NA
4-Chloroaniline	0.02	---	mg/l	0.005	U	NA
4-Nitrophenol	1	---	mg/l	0.01	U	NA
Acenaphthene	0.02	---	mg/l	0.002	U	NA
Acenaphthylene	0.04	---	mg/l	0.002	U	NA
Acetophenone	10	---	mg/l	0.005	U	NA
Aniline	10	---	mg/l	0.002	U	NA
Anthracene	0.03	---	mg/l	0.002	U	NA
Azobenzene	0.5	---	mg/l	0.002	U	NA
Benzo(a)anthracene	0.001	---	mg/l	*0.002*	U	NA
Benzo(a)pyrene	0.0002	---	mg/l	*0.002*	U	NA
Benzo(b)fluoranthene	0.001	---	mg/l	*0.002*	U	NA
Benzo(ghi)perylene	0.02	---	mg/l	0.002	U	NA
Benzo(k)fluoranthene	0.001	---	mg/l	*0.002*	U	NA
Biphenyl	---	---	mg/l	0.0007	U	NA
Bis(2-chloroethoxy)methane	5	---	mg/l	0.005	U	NA
Bis(2-chloroethyl)ether	0.03	---	mg/l	0.002	U	NA
Bis(2-chloroisopropyl)ether	0.03	---	mg/l	0.002	U	NA
Bis(2-ethylhexyl)phthalate	0.006	---	mg/l	0.003	U	NA
Butyl benzyl phthalate	1	---	mg/l	0.005	U	NA
Chrysene	0.002	---	mg/l	0.002	U	NA
Di-n-butylphthalate	0.5	---	mg/l	0.005	U	NA
Di-n-octylphthalate	10	---	mg/l	0.005	U	NA
Dibenzo(a,h)anthracene	0.0005	---	mg/l	*0.002*	U	NA
Dibenzofuran	1	---	mg/l	0.002	U	NA
Diethyl phthalate	2	---	mg/l	0.005	U	NA
Dimethyl phthalate	0.3	---	mg/l	0.005	U	NA
Fluoranthene	0.09	---	mg/l	0.002	U	NA
Fluorene	0.04	---	mg/l	0.002	U	NA
Hexachlorobenzene	0.001	---	mg/l	*0.002*	U	NA
Hexachlorobutadiene	0.0006	---	mg/l	*0.002*	U	NA
Hexachloroethane	0.008	---	mg/l	0.002	U	NA
Indeno(1,2,3-cd)pyrene	0.0005	---	mg/l	*0.002*	U	NA
Isophorone	1	---	mg/l	0.005	U	NA
Naphthalene	0.14	---	mg/l	0.002	U	NA
Nitrobenzene	5	---	mg/l	0.002	U	NA
Pentachlorophenol	0.001	---	mg/l	*0.01*	U	NA
Phenanthrene	0.05	---	mg/l	0.002	U	NA
Phenol	0.9	---	mg/l	0.005	U	NA
Pyrene	0.02	---	mg/l	0.002	U	NA
Pyridine	5	---	mg/l	0.0035	U	NA

Key:
NA = Not Analyzed
# U= U, laboratory qualifier. Result was not detected above the reporting limit for the sample.
Italicized values are non-detects exceeding any of the criteria.
--- = Criteria Not Established
Bolded values are above the laboratory reporting limit.
Dewatering and Remediation General Permit (DRGP) is a federal law that sets forth criteria for dewatering and remediation-related activities.
RCGW-1 MCP 2024 RCGW-1 Reportable Concentrations Criteria effective March 1, 2024.
Yellow highlighted values exceed NPDES DRGP effluent criteria
Red Highlighted values exceed MCP RCGW-1 Criteria.

Table 1-2
Soil Sampling Results
Yarmouth Phase 1 - Contract 6

LOCATION					B-PS2 (2-8)		B-PS2 (12-18)		B-PS2 (24-30)		TRIP BLANK	
CLIENT SAMPLE ID												
SAMPLING DATE					09-SEP-25		09-SEP-25		09-SEP-25		09-SEP-25	
LAB SAMPLE ID					L2556680-01		L2556680-02		L2556680-03		L2556680-04	
	Similar Soils (<RCS-1 Facility)	RCS-1-24	COMM-97 Unlined LF	Units		Qual		Qual		Qual		Qual
General Chemistry												
Specific Conductance @ 25 C	---	---	4000	umhos/cm	**17**		**16**		NA		NA	
Solids, Total	---	---	---	%	**97.4**		**80.7**		**79.9**		NA	
pH (H)	---	---	---	SU	**7.3**		**7.39**		NA		NA	
Cyanide, Reactive	---	---	---	mg/kg	10	U	10	U	NA		NA	
Sulfide, Reactive	---	---	---	mg/kg	10	U	10	U	NA		NA	
Ignitability of Solids												
Ignitability	---	---	---	-	NI		NI		NA		NA	
MCP Total Metals												
Arsenic, Total	20	20	40	mg/kg	0.804	U	0.949	U	NA		NA	
Cadmium, Total	20	80	30	mg/kg	0.804	U	0.949	U	NA		NA	
Chromium, Total	100	100	1000	mg/kg	**1.15**		**1.34**		NA		NA	
Lead, Total	200	200	1000	mg/kg	4.02	U	4.74	U	NA		NA	
Mercury, Total	3	20	10	mg/kg	0.075	U	0.095	U	NA		NA	
MCP Volatile Organics by EPA 5035												
1,1,1,2-Tetrachloroethane	---	0.1	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
1,1,1-Trichloroethane	---	30	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
1,1,2,2-Tetrachloroethane	---	0.005	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
1,1,2-Trichloroethane	---	0.1	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,1-Dichloroethane	---	0.4	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,1-Dichloroethene	---	3	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,1-Dichloropropene	---	---	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
1,2,3-Trichlorobenzene	---	---	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,2,3-Trichloropropane	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,2,4-Trichlorobenzene	---	2	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,2,4-Trimethylbenzene	---	1000	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,2-Dibromo-3-chloropropane	---	10	---	mg/kg	0.0032	U	0.0021	U	0.0027	U	0.003	U
1,2-Dibromoethane	---	0.1	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,2-Dichlorobenzene	---	9	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,2-Dichloroethane	---	0.1	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,2-Dichloroethene, Total	---	---	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,2-Dichloropropane	---	0.1	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
1,3,5-Trimethylbenzene	---	10	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,3-Dichlorobenzene	---	3	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,3-Dichloropropane	---	500	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,3-Dichloropropene, Total	---	0.01	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
1,4-Dichlorobenzene	---	0.7	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
1,4-Dioxane	---	0.2	---	mg/kg	0.085	U	0.056	U	0.072	U	0.08	U
2,2-Dichloropropane	---	---	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
2-Hexanone	---	100	---	mg/kg	0.01	U	0.007	U	0.009	U	0.01	U
Acetone	---	6	---	mg/kg	0.026	U	0.017	U	0.022	U	0.025	U
Benzene	---	2	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
Bromobenzene	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Bromochloromethane	---	---	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Bromodichloromethane	---	0.1	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
Bromoform	---	0.1	---	mg/kg	0.0042	U	0.0028	U	0.0036	U	0.004	U
Bromomethane	---	0.5	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Carbon disulfide	---	100	---	mg/kg	0.01	U	0.007	U	0.009	U	0.01	U
Carbon tetrachloride	---	5	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Chlorobenzene	---	1	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
Chloroethane	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Chloroform	---	0.2	---	mg/kg	0.0016	U	0.001	U	0.0014	U	0.0015	U
Chloromethane	---	100	---	mg/kg	0.0042	U	0.0028	U	0.0036	U	0.004	U
cis-1,2-Dichloroethene	---	0.1	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
cis-1,3-Dichloropropene	---	0.01	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
Dibromochloromethane	---	0.005	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Dibromomethane	---	500	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Dichlorodifluoromethane	---	1000	---	mg/kg	0.01	U	0.007	U	0.009	U	0.01	U
Diethyl ether	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Diisopropyl Ether	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Ethyl-Tert-Butyl-Ether	---	---	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Ethylbenzene	---	40	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Hexachlorobutadiene	---	30	---	mg/kg	0.0042	U	0.0028	U	0.0036	U	0.004	U
Isopropylbenzene	---	1000	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Methyl ethyl ketone	---	4	---	mg/kg	0.01	U	0.007	U	0.009	U	0.01	U
Methyl isobutyl ketone	---	0.4	---	mg/kg	0.01	U	0.007	U	0.009	U	0.01	U
Methyl tert butyl ether	---	0.1	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Methylene chloride	---	0.1	---	mg/kg	0.0053	U	0.0035	U	0.0045	U	0.005	U
n-Butylbenzene	---	---	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
n-Propylbenzene	---	100	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Naphthalene	---	4	---	mg/kg	0.0042	U	0.0028	U	0.0036	U	0.004	U
o-Chlorotoluene	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
o-Xylene	---	100	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
p-Chlorotoluene	---	---	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
p-Isopropyltoluene	---	100	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
p/m-Xylene	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
sec-Butylbenzene	---	---	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U

Table 1-2
Soil Sampling Results
Yarmouth Phase 1 - Contract 6

LOCATION					B-PS2 (2-8)		B-PS2 (12-18)		B-PS2 (24-30)		TRIP BLANK	
CLIENT SAMPLE ID												
SAMPLING DATE					09-SEP-25		09-SEP-25		09-SEP-25		09-SEP-25	
LAB SAMPLE ID					L2556680-01		L2556680-02		L2556680-03		L2556680-04	
	Similar Soils (<RCS-1 Facility)	RCS-1-24	COMM-97 Unlined LF	Units		Qual		Qual		Qual		Qual
Styrene	---	3	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
tert-Butylbenzene	---	100	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Tertiary-Amyl Methyl Ether	---	---	---	mg/kg	0.0021	U	0.0014	U	0.0018	U	0.002	U
Tetrachloroethene	---	1	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
Tetrahydrofuran	---	500	---	mg/kg	0.0042	U	0.0028	U	0.0036	U	0.004	U
Toluene	---	30	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
trans-1,2-Dichloroethene	---	1	---	mg/kg	0.0016	U	0.001	U	0.0014	U	0.0015	U
trans-1,3-Dichloropropene	---	0.01	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Trichloroethene	---	0.3	---	mg/kg	0.00053	U	0.00035	U	0.00045	U	0.0005	U
Trichlorofluoromethane	---	1000	---	mg/kg	0.0042	U	0.0028	U	0.0036	U	0.004	U
Vinyl chloride	---	0.3	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
Xylenes, Total	---	100	---	mg/kg	0.001	U	0.0007	U	0.0009	U	0.001	U
MCP Semivolatile Organics												
1,2,4-Trichlorobenzene	---	2	---	mg/kg	0.17	U	0.2	U	NA		NA	
1,2-Dichlorobenzene	---	9	---	mg/kg	0.17	U	0.2	U	NA		NA	
1,3-Dichlorobenzene	---	3	---	mg/kg	0.17	U	0.2	U	NA		NA	
1,4-Dichlorobenzene	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2,4,5-Trichlorophenol	---	4	---	mg/kg	0.17	U	0.2	U	NA		NA	
2,4,6-Trichlorophenol	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2,4-Dichlorophenol	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2,4-Dimethylphenol	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2,4-Dinitrophenol	---	3	---	mg/kg	0.81	U	0.96	U	NA		NA	
2,4-Dinitrotoluene	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2,6-Dinitrotoluene	---	100	---	mg/kg	0.17	U	0.2	U	NA		NA	
2-Chloronaphthalene	---	1000	---	mg/kg	0.17	U	0.2	U	NA		NA	
2-Chlorophenol	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2-Methylnaphthalene	0.7	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
2-Methylphenol	---	500	---	mg/kg	0.17	U	0.2	U	NA		NA	
2-Nitrophenol	---	100	---	mg/kg	0.37	U	0.43	U	NA		NA	
3,3'-Dichlorobenzidine	---	3	---	mg/kg	0.17	U	0.2	U	NA		NA	
3-Methylphenol/4-Methylphenol	---	500	---	mg/kg	0.24	U	0.29	U	NA		NA	
4-Bromophenyl phenyl ether	---	100	---	mg/kg	0.17	U	0.2	U	NA		NA	
4-Chloroaniline	---	1	---	mg/kg	0.17	U	0.2	U	NA		NA	
4-Nitrophenol	---	100	---	mg/kg	0.24	U	0.28	U	NA		NA	
Acenaphthene	4	4	---	mg/kg	0.14	U	0.16	U	NA		NA	
Acenaphthylene	1	2	---	mg/kg	0.14	U	0.16	U	NA		NA	
Acetophenone	---	1000	---	mg/kg	0.17	U	0.2	U	NA		NA	
Aniline	---	1000	---	mg/kg	0.2	U	0.24	U	NA		NA	
Anthracene	10	1000	---	mg/kg	0.1	U	0.12	U	NA		NA	
Azobenzene	---	50	---	mg/kg	0.17	U	0.2	U	NA		NA	
Benzo(a)anthracene	7	20	---	mg/kg	0.1	U	0.12	U	NA		NA	
Benzo(a)pyrene	2	2	---	mg/kg	0.14	U	0.16	U	NA		NA	
Benzo(b)fluoranthene	7	20	---	mg/kg	0.1	U	0.12	U	NA		NA	
Benzo(ghi)perylene	10	1000	---	mg/kg	0.14	U	0.16	U	NA		NA	
Benzo(k)fluoranthene	10	200	---	mg/kg	0.1	U	0.12	U	NA		NA	
Biphenyl	---	0.05	---	mg/kg	0.034	U	0.04	U	NA		NA	
Bis(2-chloroethoxy)methane	---	500	---	mg/kg	0.18	U	0.22	U	NA		NA	
Bis(2-chloroethyl)ether	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
Bis(2-chloroisopropyl)ether	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
Bis(2-ethylhexyl)phthalate	---	100	---	mg/kg	0.17	U	0.2	U	NA		NA	
Butyl benzyl phthalate	---	100	---	mg/kg	0.17	U	0.2	U	NA		NA	
Chrysene	20	200	---	mg/kg	0.1	U	0.12	U	NA		NA	
Di-n-butylphthalate	---	50	---	mg/kg	0.17	U	0.2	U	NA		NA	
Di-n-octylphthalate	---	1000	---	mg/kg	0.17	U	0.2	U	NA		NA	
Dibenzo(a,h)anthracene	0.7	2	---	mg/kg	0.071	U	0.084	U	NA		NA	
Dibenzofuran	---	100	---	mg/kg	0.17	U	0.2	U	NA		NA	
Diethyl phthalate	---	10	---	mg/kg	0.17	U	0.2	U	NA		NA	
Dimethyl phthalate	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
Fluoranthene	40	1000	---	mg/kg	0.1	U	0.12	U	NA		NA	
Fluorene	10	1000	---	mg/kg	0.17	U	0.2	U	NA		NA	
Hexachlorobenzene	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
Hexachlorobutadiene	---	30	---	mg/kg	0.17	U	0.2	U	NA		NA	
Hexachloroethane	---	0.7	---	mg/kg	0.071	U	0.084	U	NA		NA	
Indeno(1,2,3-cd)pyrene	7	20	---	mg/kg	0.14	U	0.16	U	NA		NA	
Isophorone	---	100	---	mg/kg	0.15	U	0.18	U	NA		NA	
Naphthalene	4	4	---	mg/kg	0.17	U	0.2	U	NA		NA	
Nitrobenzene	---	500	---	mg/kg	0.15	U	0.18	U	NA		NA	
Pentachlorophenol	---	3	---	mg/kg	0.34	U	0.4	U	NA		NA	
Phenanthrene	10	10	---	mg/kg	0.1	U	0.12	U	NA		NA	
Phenol	---	0.9	---	mg/kg	0.17	U	0.2	U	NA		NA	
Pyrene	40	1000	---	mg/kg	0.1	U	0.12	U	NA		NA	
Pyridine	---	500	---	mg/kg	0.18	U	0.22	U	NA		NA	
MCP Polychlorinated Biphenyls												
Aroclor 1016	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1221	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1232	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1242	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	

Table 1-2
Soil Sampling Results
Yarmouth Phase 1 - Contract 6

LOCATION					B-PS2 (2-8)		B-PS2 (12-18)		B-PS2 (24-30)		TRIP BLANK	
CLIENT SAMPLE ID												
SAMPLING DATE					09-SEP-25		09-SEP-25		09-SEP-25		09-SEP-25	
LAB SAMPLE ID					L2556680-01		L2556680-02		L2556680-03		L2556680-04	
	Similar Soils (<RCS-1 Facility)	RCS-1-24	COMM-97 Unlined LF	Units		Qual		Qual		Qual		Qual
Aroclor 1248	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1254	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1260	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1262	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
Aroclor 1268	---	1	---	mg/kg	0.051	U	0.0567	U	NA		NA	
PCBs, Total	---	1	<2	mg/kg	0.051	U	0.0567	U	NA		NA	
Petroleum Hydrocarbon Quantitation												
TPH (C10-C36)	500**	1000	2500	mg/kg	33.9	U	39.6	U	NA		NA	

Key:
NA = Not Analyzed
# U= U, laboratory qualifier. Result was not detected above the reporting limit for the sample.
Italicized values are non-detects exceeding any of the criteria.
--- = Criteria Not Established
Bolded values are above the laboratory reporting limit.
Similar Soils RCS-1 Facility Limiting Soils: MA Similar Soils Provision - RCS-1 Limiting Soil Concentrations Criteria (Table 2) per Similar Soils Guidance Provision, September 4, 2014.
** There is no MassDEP Similar Soils criteria for TPH, however, 500 mg/kg was used as a screening value based on experience with many "<RCS-1" / Similar Soils disposal facilities utilizing a site-specific limit of 500 mg/kg for TPH.
RCS-1 MCP 2024 RCS-1 Reportable Concentrations Criteria effective March 1, 2024.
COMM97 Unlined Landfill: Unlined Landfill Limits current as of August, 1997

Green highlighted values are above Similar Soils criteria. Disposal at a < RCS-1 Facility may not be an option. Concentrations are not an exceedance of the RCS-1, but assume disposal at Unlined Landfill facility will be required.
Yellow highlighted values are above RCS-1 and/or Similar Soils criteria. Requires disposal at Unlined Landfill Facility.
Orange highlighted values are above RCS-1, Similar Soils, and Unlined Landfill Criteria. Requires disposal at Lined Landfill facility.

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