SECTION 16 SUPPLEMENTING GENERAL CONDITIONS

FY 2026 DOWNTOWN HYANNIS GREAT STREETS IMPLEMENTATION PROJECT

IMPROVEMENTS TO THE ROADWAYS ANDS INTERSECTIONS OF THE HISTORIC DOWNTOWN HYANNIS VILLAGE IN THE TOWN ON BARNSTABLE, MASSACHUSETTS

SECTION TITLE Page

SCOPE OF WORK (SUPPLEMENTING SECTION 4.00, ETC.)

This Project involves intersection alignment modifications at the intersections of Main Street and South Street, South Street and Ocean Street/Old Colony Road (Six-Points), and South Street and Lewis Bay Road; intersection control modifications at the intersections of Main street and Sea Street, Main Street and High School Road, and Main Street and Ocean Street/Barnstable Road; signalization and timing changes at the intersection of Main Street and Old Colony Road/Center Street; directional traffic conversions of Main Street and South Street into two-way travel; improvements to multimodal traffic including bicycle lanes and shared use paths; and accessibility improvements along Main Street; all within in the Historic Downtown Hyannis village in the Town of Barnstable, MA.

Work to be performed under this contract shall include, but is not limited to furnishing all labor, materials, and equipment necessary to perform the scope of work outlined below:

- Furnishing and installing new light poles and pedestrian signals;
- Constructing cement concrete pedestrian curb ramps, bump-outs, median islands and installation of detectable warning panels;
- Installing and connecting new drainage structures to existing drainage system;
- Mill and overlay, and full depth pavement reconstruction;
- Installing signs and pavement markings; and
- All other associated and incidental work stipulated in the construction plans and specifications.

Plans and Specifications for the work on this Project refer to those drawings and documents prepared by the design engineer.

The Department (or Owner) in these Special Provisions refers to the Barnstable Public Works Department, the public body or authority, corporation, association, firm or person with whom the Contractor has entered into an agreement and for whom the work is to be provided.

PROJECT OWNER – TOWN OF BARNSTABLE
Department of Public Works
382 Falmouth Road
Hyannis, MA 02601
Attn: Paul Graves, P.E., Senior Project Manager
(774) 487-0641

The Design Engineer referred to in these Special Provisions shall mean the engineer employed at the site by the Owner, or other duly authorized engineer representing the Owner.

DESIGN ENGINEER – STANTEC CONSULTING SERVICES, INC.
40 Water Street, 3rd Floor
Boston MA, 02109
Attn: Anna Jahn, P.E., Associate
(617) 654-6067

All work under this Contract shall be done in conformance with the contract documents and the following: Massachusetts Department of Transportation's (MassDOT's) Standard Specifications for Highways and Bridges dated 2024 and September 30, 2024 Supplement to the 2024 Standard Specifications for Highways and Bridges; Federal Highway Administration's Manual on Uniform Traffic Control Devices for Streets & Highways, 11th Edition, dated December 2023; MassDOT's The Massachusetts Amendments to the 2009 Manual on Uniform Traffic Control Devices for Streets and Highways dated November 2022; MassDOT's Construction Standard Details dated October 2017;

MassDOT's Overhead Signal Structure & Foundation Standard Drawings dated December 2015; MassDOT's Traffic Management Plans and Detail Drawings, current edition; American Association of Nurserymen's American Standard for Nursery Stock (ANSI Z60.1) dated 2014; U.S. Department of Justice's 2010 ADA Standards for Accessible Design; Massachusetts Architectural Access Board's Rules and Regulations (521 CMR) dated 2006; Massachusetts Highway Department's (MassHighway's – now MassDOT's) Project Development & Design Guide dated 2006; Commonwealth of Massachusetts Department of Public Works' [now MassDOT] Standard Drawings for Signs and Supports dated 1990; Commonwealth of Massachusetts Department of Public Works' (now MassDOT) Standard Drawings for Traffic Signals and Highway Lighting dated 1968; the Plans, Technical Specifications, and these Supplemental General Conditions (a.k.a. Special Provisions).

The General Conditions, Supplementary Conditions and Special Provisions shall take precedence over the General Requirements of Division I of the Standard Specifications.

All references in the Standard Specifications to the "Department" or "Engineer" shall be replaced with "Town of Barnstable or their designated representative".

CONTRACTOR'S REPRESENTATIVE

The Contractor shall designate one person to be the Contractor's Representative, or point-of-contact, for this project. The Contractor's Representative shall coordinate with the Engineer, or the Engineer's designee, regarding all planning, scheduling, sequencing of activities and day-to-day operations. The Contractor's Representative shall be on-site when work is being performed, whether by the Contractor's internal personnel or any and all subcontractors.

FIELD CONDITIONS, MEASUREMENTS, AND QUANTITIES

The Contractor shall review the existing and proposed conditions with the Engineer prior to the beginning of work. The Contractor is responsible for taking accurate measurements of actual field conditions prior to ordering proposed materials or beginning construction. The Contractor shall notify the Engineer of quantities that differ from the bid form prior to placing any material orders or performing work.

STAGING AREAS

The Contractor is responsible for securing offsite staging areas for storing construction equipment and materials for construction as incidental to this project. No separate payment shall be made.

WORK BY OTHERS

Relocation and/or resetting to new grades of all private utilities, including utility poles, made necessary by the construction of this project, shall be accomplished by the respective utility companies unless otherwise specified.

DRAINAGE

The Contractor shall maintain properly functioning drainage in the project areas to provide continual drainage of the roadway and construction area prior to the time when final acceptance is made.

The Contractor shall be responsible for actively monitoring and maintaining drainage within the construction limits during precipitation and runoff.

All pipes and structures (existing and proposed) within the limits of this Contract shall be left in clean and operable condition at the completion of the work. The Contractor is required to clean existing structures and pipes if clogged during execution of the work.

Maintaining, monitoring, and cleaning drainage systems as necessary shall be incidental to the

contract pay items, with no additional compensation made.

SAW CUTS

Saw cuts shall be made in existing pavement at the limits of work, in areas of new or reset curb, driveways and sidewalks, and at limits of full depth pavement construction as shown on the plans or as directed by the Town. Saw cuts shall be incidental to the work performed, with no additional compensation made.

EXCAVATION AND PATCHING OF TRENCHES ON PAVED SURFACES

Whenever the existing pavement or sidewalk is to be disturbed, the existing surface shall be cut in neat true lines by mechanical means along the length of the trench, equally spaced from the center line of the trench and not more than one and one-half feet (1.50 ft) apart. The trench shall then be excavated, conduit placed and backfilled in accordance with MassDOT Specifications and Standard Drawings, to a compacted depth of one and one-half (1.5 in) inches below the existing surface. The trench will then be patched temporarily with one and one-half (1.5 in) inches of Bituminous Concrete Pavement Type I-1 placed in one course, unless otherwise approved by the Engineer.

Permanent patching will not begin until, in the Engineer's judgment, final compaction and settlement of the trench area has taken place. All abutting edges of existing pavement shall be painted with Bitumen (RS-1), immediately prior to placement of permanent patch. All trenches shall be maintained at all times from inception until final acceptance of the project.

BACKFILL AND FILL

All backfill and fill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on the Drawings. The fill and backfill materials shall be in layers not exceeding 6 inches in thickness.

Suitable excavated material shall be free from large clods, silt clumps, balls of clay, stones and rock fragments with larger than 12-inch maximum dimension, organics, peat and frozen materials.

Do not mechanically or hand compact material that is, in the opinion of the Owner, too wet.

Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.

Place material in a manner that will prevent stones and lumps from becoming nested.

Completely fill all voids between stones with fine material.

COMPACTION

Control soil compaction during construction to provide not less than the minimum percentage of the density specified for each area of classification.

Percentage of Maximum Density Requirements: Compact soil not less than the following

percentages of maximum dry density determined in accordance with ASTM D1557 as indicated.

Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).

Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D1557).

Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density

(ASTM D1557).

Roadways, Drives, and Paved Areas: Compact each layer of backfill or fill material to at least 95% of maximum dry density (ASTM D1557).

Pipes: Compact bedding material and each layer of backfill to at least 90% of maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.

Embankments: Compact each layer of backfill or fill material to at least 95% of maximum dry density (ASTM D1557).

MATERIALS REMOVED AND DISPOSED, REMOVED AND STACKED, OR REMOVED AND RESET

Unless otherwise stipulated by the Owner, all materials removed within the Town Layout shall become the property of the Contractor. The Contractor shall properly dispose of this material outside and away from the limits of the project, without additional compensation.

All materials designated to be removed and reset, such as fences, signage, etc., shall be stacked neatly, safely, and not blocking driveways or sidewalks on the properties to which they belong. Town-owned signage and other items shall be removed and stacked neatly, safely, and not blocking driveways or sidewalks in the Contractor's staging area or another location acceptable to the Town.

DISPOSAL OF EXCAVATED MATERIALS

Surplus materials obtained from any type of excavation, and not needed for further use as determined by the Engineer, shall become the property of the Contractor and shall be disposed of by the Contractor outside the location subject to the regulations and requirements of local authorities governing the disposal of such materials, at no additional compensation.

DISPOSAL OF SURPLUS MATERIALS

All existing and other materials not required or needed for use on the project, and not required to be removed and stacked, shall become the property of the Contractor and shall be removed from the site during the construction period and legally disposed of. No separate payment shall be made for this work. All costs in connection with these materials shall be included in the prices bid for their associated contract items.

CEMENT CONCRETE SIDEWALKS

All proposed cement concrete sidewalks and curb ramps shall include wire mesh and fiber mesh reinforcing, plus sealant to protect the concrete from deicing compounds. Wire mesh shall be 6" x 6", #10 mesh, installed in the middle of the concrete slab. Support blocks shall be placed under the mesh to control the location, followed by the placement of the concrete with the mesh fixed in position.

Fiber mesh shall be SIKA® FIBERMESH® 650-e3 or Specter Monofilament Fiber or approved equivalent.

Concrete sealant shall be Prosoco Saltguard WB or approved equivalent.

PAVEMENT MARKINGS

All permanent pavement markings on public ways shall be thermoplastic and meet existing pavement markings at the limit of work.

BOUNDS

Bounds or property line markers that are disturbed by the Contractor shall be replaced and/or realigned by the Contractor. No payment shall be made for replacement or resetting required due to

the actions of the Contractor.

The Contractor shall submit sketches of the location of each reset bound to the Engineer and the Town of Barnstable, showing at least three tie points. The sketch shall be stamped by a Professional Land Surveyor registered in Massachusetts.

WORK ON PRIVATE PROPERTY

If necessary, performance of designated re-grading and related construction work outside the limits of the roadway layout is dependent upon the obtainment of rights of entry or construction easements from private owners by the Town. No work shall be done in these areas until clearance is given by the Town.

Any disturbance to property outside of the roadway limits shall be repaired to pre-construction conditions, and no additional payment shall be made for such work.

WARRANTY

The Contractor shall, at their own expense, replace any work performed under this Contract found to be defective in workmanship, material, or manner of functioning within twelve (12) months from date of final acceptance of all the installations under this Contract.

EXAMINATION OF SITE AND CONTRACT DOCUMENTS (SUPPLEMENTING SUBSECTION 2.03)

Each bidder is responsible for inspecting the site and for being thoroughly familiar with the contract documents. The failure or omission of any bidder to do any of the foregoing shall in no way relieve any bidder from any obligation in respect to their bid.

Bidders must satisfy themselves with the accuracy of the estimated quantities in the bid schedule by examination of the sites and a review of the drawings and specifications including addenda. After bids have been submitted, the Bidder shall not assert that there was a misunderstanding concerning the quantities of work or of the nature of the work to be done.

Plans, surveys, measurements, and dimensions under which the work is to be performed are believed to be correct to the best of the Engineer's knowledge. The Contractor shall have examined these bid documents for themselves during the bidding period. No allowance shall be made for errors or inaccuracies that may be found therein.

CONTRACTOR QUESTIONS

Contractors are required to submit all questions to the Barnstable Department of Public Works by the date and time noted on the cover of the Invitation for Bids. Questions received after this date will not be considered for review by the Owner.

MINIMUM BID PRICES

All contracts, bid in accordance with Massachusetts General Law (MGL) Chapter 30, § 39M or MGL Chapter 149, §44A through 44H, which include bid items for hourly wage rates for, but not limited to; mechanics, electricians, plumbers, masons, laborers, etc. must include a bid price equal to or greater than the prevailing wage rate shown in the proposal booklet. The rate as set by the Commonwealth of Massachusetts Department of Labor and Workforce Development, in accordance with MGL chapter 149, § 26 through 27H, shall be the minimum hourly rate allowed. If a bid is received containing a rate lower than that specified for that class of work, the Owner may declare the bid non-responsive.

BUY AMERICA PROVISIONS (23 CFR 635.410) (SUPPLEMENTING SUBSECTION 6.01 SOURCE OF SUPPLY AND QUALITY)

Federal law 23 CFR 635.410 requires that all manufacturing processes, including application of the coating, for steel and iron materials to be permanently incorporated in Federal-aid highway construction projects must occur in the United States. Coating includes all processes which protect or enhance the value of a material to which the coating is applied.

Foreign steel and iron may be used if the cost of the materials, as they are delivered to the jobsite, does not exceed 0.1% of the total contract cost or $2,500 whichever is greater.

PROMPT PAYMENT AND RELEASE OF RETAINAGE TO SUBCONTRACTORS

The Contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of subcontract work not later than 10 business days from the receipt of each payment the prime Contractor receives from the Owner. Failure to comply with this requirement may result in the withholding of payment to the prime Contractor until such time as all payment due under this provision has been received by the subcontractor(s) and/or referral to the Prequalification Committee for action which may affect the Contractor's prequalification status. The Contractor agrees to make payment in full, including retainage, to each subcontractor not later than 10 business days after the subcontractor has completed all of the work required under its subcontract.

QUALIFIED ELECTRICIANS

Within 10 days after opening of bids, the low bidder shall submit a list of the Journeyman Electricians (Massachusetts License) who will perform the electrical work in this contract. The low bidder shall submit copies of each Journeyman Electrician's current Massachusetts License. The Town shall determine whether the low bidder has an adequate qualified work force to perform the work.

ORDERING OF MATERIALS AND DRAWINGS

The Contractor shall provide the Town, within fifteen (15) days of receipt of the Contract, written evidence that:

1. The Contractor has ordered the shop drawings for the materials for which shop drawings are required on the subject contract; and
2. The Contractor has ordered from a supplier or manufacturer items not requiring shop drawings. Upon receipt of a notice of proposed delivery from the supplier or manufacturer, the Contractor shall forward a copy of same to the Engineer.

The Contractor shall further provide the Town written evidence within thirty (30) days of receipt of the Contract that these orders have been confirmed in writing by the manufacturer with delivery dates appropriate for timely completion of the project.

Failure to comply with the above will nullify a request for an extension of the project completion date because of a late delivery.

INCREASE OR DECREASE IN CONTRACT QUANTITIES

The Town reserves the right to increase or decrease the quantity of any particular item of work. When the accepted quantities of work vary from the quantities in the bid schedule, the Contractor shall accept as payment in full, payment at the original contract prices for the accepted quantities of work done. No allowance will be made for any increased expenses, loss of expected reimbursement, loss of anticipated profits suffered or claimed by the Contractor resulting either directly or indirectly from such increased or decreased quantities or from unbalanced allocation among the contract items, loss of overhead expense on the part of the bidder and subsequent loss of expected reimbursement

therefore or from any other cause.

PLANS

The Contractor shall furnish all changes made during the construction period to the Design Engineer prior to the date of final acceptance for incorporation into "AS BUILT" plans and signal permits.

APPROVAL OF EQUIPMENT AND MATERIALS

All equipment and materials to be furnished under this Section shall conform to the requirements and standards of the Commonwealth of Massachusetts Highway Department (MassDOT) and be included on the latest edition of the State's Approved Equipment List, unless otherwise approved by the Engineer. The Contractor shall furnish written information to the Engineer stating the original sources of supply and dates of manufacture of all signal-related materials manufactured away from the actual site of the work.

Cut sheets showing details and manufacturers of all signal items in this Contract shall be given to the Engineer prior to any delivery of said materials to the site unless arranged otherwise between the Contractor and the Town. The Contractor shall allow the Engineer sufficient time to approve or disapprove any of the materials in question before delivery is made to the site.

Only new and first quality materials, conforming to the requirements of these specifications or otherwise approved by the Engineer shall be used in the work, unless otherwise noted in the construction plans.

In the case of all option items, as listed in the proposal, the Contractor shall inform the Engineer of their option prior to the installation of the material. Once the option is designated, all material for a particular item shall remain the same throughout the job.

SHOP DRAWING SUBMITTALS (SUPPLEMENTING SUBSECTION 5.02)

The following procedure shall be followed when submitting shop drawings for this project:

1. The Contractor shall email shop drawings in PDF format to the Engineer for review, and shall copy the Owner. Separate shop drawing files shall be provided for unrelated items.
2. The Engineer will send a written reply to the Contractor, including markups as appropriate within twenty-one (21) working days of the receipt of the drawings. The Engineer will consult with the Owner as appropriate during shop drawing reviews and will copy the Owner on the responses.
3. If the Engineer's reply indicates rejections or advises corrections or additions to the drawings, steps 1 and 2 are repeated until the Engineer indicates acceptance will be given.
4. The Contractor shall take care that every separate document in each set of every submittal shall carry the following identifying information:

Information Required:	Example:
a. Community name	Barnstable, MA
b. Project location	Main Street
c. Item number(s), if applicable	504, 504.1
d. Item(s) description	Granite Curb Type VA4
e. Name of submitting prime contractor	J. Doe Construction
f. Signature, name, and title of authorized contractor rep.	Joe Doe, Project Manager
g. Date of submittal	September 12, 2026

The Contractor shall not receive payment for, nor be allowed to install any item or materials, which require shop drawings approval unless and until he has received shop drawing approval for that item from the Engineer with an approval stamp placed thereon. Submittals are required for the following items of work of this contract:

- Contractor Baseline Construction Schedule
- Contractor Quality Control Plan
- Construction equipment
- Traffic management plans
- Traffic signal equipment
- Asphalt mix designs and pavement sections
- Asphalt emulsion
- Joint sealant
- Sediment and erosion control materials/products
- Borrow material
- Curbs
- Curb ramp detectable warning panels
- Drainage materials
- Landscaping materials
- Traffic signs
- Pavement markings
- Cement concrete mix designs, additives, reinforcing, and sealants
- All other applicable items normally required by MassDOT

CONSTRUCTION STAKING AND LAYOUT (SUPPLEMENTING SUBSECTION 5.07)

The Contractor shall employ a Massachusetts Professional Land Surveyor to establish the baselines or centerlines of construction for the project. The Engineer shall supply the electronic files for the surveyor's use. Surveyor shall also ensure that the project is constructed as shown on the Contract Drawings.

The Contractor shall furnish and set, at their own expense, all stakes (such as batter boards, slope stakes, pins, offset stakes, etc.) required for the construction operations and the Contractor shall be solely responsible for the accuracy of the line and grade of all features of the work.

The Contractor shall be responsible for maintaining all benchmarks, control stations, and other survey control points. The Contractor shall be held responsible for the preservation of all stakes and marks. If any such stakes or marks are disturbed or destroyed by the Contractor, The Contractor shall replace said stakes or marks at their own expense.

The cost of survey work shall be deemed to be included in the cost of various items of work under this contract.

SAMPLES AND TESTS (SUPPLEMENTING SUBSECTION 6.02)

SOIL TEST METHODS

1. Gradation Analysis: where a gradation is specified the testing shall be in accordance with ASTM C-117-90 and ASTM C-136-93

2. Compaction Control:

    a. Unless otherwise indicated, wherever a percentage of compaction for backfill is indicated, it shall be the in-place density divided by the maximum density and multiplied by 100. The maximum density shall be the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using 10-lb Hammer and 18-in. Drop, Designation D-1557-91 (Modified Proctor).

    b. The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in place by the Nuclear method Designation D2922.

    c. Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D-698-91 (Standard Proctor).

REQUIRED TESTS

1. The Contractor shall retain an independent testing company acceptable to the Owner and Engineer to conduct all soil sampling and field and laboratory testing, and to observe earthwork activities. Laboratory testing will consist of sieve analyses, natural water content determinations, and compaction tests. Field testing will consist of in-place field density tests and determination of water contents. All sampling and testing and related observation shall be performed at the Contractor's expense.

2. Paved Areas: Make at least one field density test of subgrade for every 2000 sq. ft. of paved area, but in no case less than 3 tests. In each compacted fill layer, make at least one field density test of subgrade for every 2000 sq. ft. of paved area, but in no case less than 3 tests.

3. Trenches: Field density test in trenches shall be taken at the beginning of trenching and at 75 linear foot intervals thereafter, on the initial lift and every third lift thereafter.

4. In addition to the above tests the independent testing company will perform additional density tests at locations and times requested by the Engineer.

    a. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary, at no additional cost to the Owner, to obtain the required compaction. The cost of retesting will be paid by the Owner. The cost of retesting will be determined by the Owner and the Owner will invoice the Contractor for this cost. If unpaid after 60 days, the invoice amount of retesting will be deducted from the Contract Price. No allowance will be considered for the delays in the performance of the work.

    b. If the test results pass and meet the requirements of these specifications, the cost of the testing service will be borne by the Owner, but no allowance will be considered for delays in the performance of work.

PERMITS AND LICENSES (SUPPLEMENTING SUBSECTION 7.03)

ROAD OPENING/TRENCH PERMITS

The Contractor is required to apply for this Town of Barnstable permit. Costs to apply for the permit and any work required to comply with these conditions of the permit shall be considered incidental to the pay items of this contract and no separate payment will be made.

OVERLOADED TRUCKS

The Town will not allow any materials delivered to any project in motor vehicles or semitrailer units that exceed the legal maximum gross weight allowed for the particular class as specified in Section 19A of Chapter 90 of the General Laws of Massachusetts. The provisions of Subsection 7.03 of the Standard Specifications shall still apply.

PUBLIC SAFETY AND CONVENIENCE (SUPPLEMENTING SUBSECTION 7.09)

PROJECT CONTACT:

Paul Graves, P.E., Senior Project Manager – Capital Projects
Town of Barnstable, Department of Public Works
382 Falmouth Road, Hyannis, MA 02601
Main Office: (508) 790-6400
Direct/Mobile: (774) 487-0641
Email: paul.graves@town.barnstable.ma.us

EMERGENCY VEHICLES

The Contractor shall provide necessary access for fire apparatus and other emergency vehicles through the work zones and to abutting properties at all times.

CONDITIONS AT THE END OF WORKDAYS

By the end of each work day, the Contractor shall backfill and patch with asphalt any areas in the roads, sidewalks, driveways, and parking where the contractor has disturbed or removed pavement unless the Engineer allows steel plating or other temporary measures, in which case the Contractor shall backfill and patch those areas with asphalt when the underground work in each such location is suspended or completed, or as directed by the Engineer.

STEEL PLATES IN CONSTRUCTION ZONES

At the end of each working day where trenches in areas of public travel are covered with steel plates, each edge of such plates shall either be beveled or protected by a sloped pavement patch of 2-feet horizontally to 1-inch vertically. Any temporary patching materials and their maintenance and removal will be considered incidental to the item involved with no separate payment.

CONDITIONS PRIOR TO SUSPENDING WORK

At the suspension of work prior to the summer construction break, and at other times when there will be a period of inactivity, the Contractor shall leave all areas in a safe and acceptable condition. This shall include but shall not necessarily be limited to completing the initial paving course on all roads, sidewalks, driveways, and parking within the scope of work; providing required traffic signs and temporary pavement markings; adjusting catch basin grates, manhole covers, valve covers, junction boxes, and other castings or fixtures within paved areas to be flush with the current pavement surface; providing fully functional drainage systems; backfilling and grading all other disturbed areas to drain and to avoid trip/fall hazards; providing unobstructed pedestrian, bicycle, and vehicular travel ways; providing ADA/AAB compliant pedestrian paths of travel; maintaining erosion and sediment controls to prevent stormwater pollution and to prevent hazards or public nuisances; providing covers or other protection at any light pole bases with protruding bolts or other potential safety hazards; providing a clean and presentable roadway; removing or covering construction signs as appropriate; and other actions as stipulated in the contract documents or as directed by the Engineer.

SNOW AND ICE OPERATIONS

The Contractor shall be responsible for snow and ice removal or treatment on roads and sidewalks in the active work zones within the project limits unless the Town agrees to perform snow and ice removal or treatment.

If the roads and sidewalks in the active work zones within the project limits are in a condition suitable for the Town to perform snow and ice clearing – for example, if the pavement is not open or plated or fenced or barricaded, and if structures in the pavement are not raised, and if there are not other types of construction-related impediments to snow and ice clearing – then the Town may opt to perform normal snow and ice clearing; otherwise the Contractor shall be responsible for providing snow and ice removal from the roads and sidewalks within the active work zones of the project limits to the Owner's satisfaction.

If the Contractor needs snow and ice clearing that exceeds the Town's normal snow and ice removal procedures – for example, if the Contractor needs more frequent snow and ice clearing than the Town's normal snow and ice removal procedures provide, or if the Contractor needs snow windrows removed or some other types of enhanced snow and ice removal – then that will be the Contractor's responsibility.

The contract conditions stipulate that the Contractor shall provide necessary access for fire apparatus and other emergency vehicles through the work zones to abutting properties at all times; the Contractor shall continuously maintain traffic on the various streets during construction; and the Contractor shall provide and maintain access at all times to all properties abutting the work. If these Contractor responsibilities require snow and ice clearing beyond that being provided by the Town, if any, then the Contractor shall be responsible for timely performing any regular or additional snow and ice clearing in a manner acceptable to the Owner.

TRAFFIC OFFICERS AND ROADWAY FLAGGERS (SUPPLEMENTING SUBSECTION 7.11)

Uniformed Traffic Police Officers shall be required for traffic control during work necessitating lane closures. The Contractor shall be responsible for providing the following information to the Town's project manager and the Town's construction inspector by 12:00 PM of each Tuesday prior to the following week of construction to facilitate the Town's filling of police detail requests:

- A weekly schedule of specific days and hours when the Contractor plans to perform work necessitating police details.
- The number of police officers needed each day, and whether cruisers are requested.
- Location/meeting point for the start of work.
- Traffic management plans corresponding to the scheduled work (e.g., lane closure with lane shift, lane closure with alternating traffic, etc.).

The Contractor shall bear the costs of any details canceled without sufficient (24 hours) notice where fees are charged to the Town. Prior to submitting the police detail schedule to the Town, the Contractor shall meet with the Town's construction inspector with enough time in advance to determine and come to an agreement on how many police officers the detail(s) will require for the upcoming working week. On days where the Contractor and the Town's construction inspector have agreed that one or more police details are needed, the Contractor will not be allowed to start working until the police details are in place on site. Cancellation of any scheduled police detail due to inclement weather or any other reason shall be the responsibility of the Town, subject to timely notification from the Contractor. The intent is to ensure public safety by police direction of traffic. Police are not to serve as watchmen over the Contractor's equipment and materials, or to be responsible for warning pedestrians of such hazards as open trenches. Nothing contained herein shall

be construed as relieving the Contractor of any of their responsibilities for protection of persons and property under the terms of the Contract.

If police details are not available, the Town may utilize qualified civilian roadway flaggers. The scheduling and coordination of police details and civilian roadway flaggers shall be considered incidental to the pay items of this contract and no separate payment will be made to the Contractor.

PROTECTION OF UTILITIES AND PROPERTY (SUPPLEMENTING SUBSECTION 7.13)

The Contractor shall notify "Mass. DIG SAFE" and procure a DIG SAFE number of each location prior to disturbing ground in any way.

"DIG-SAFE" Call Center: +1 (888) 344-7233

The Contractor shall make their own investigation to assure that no damage occurs to existing structures, drainage lines, and other utilities as a result of their operations.

Given the presence of underground utilities within the project area, the Contractor shall anticipate the need to conduct additional exploratory investigations at the request of the Engineer to avoid breakage and interruption of existing utilities. The Contractor shall perform test pits at the start of construction when the weather allows, to determine any potential utility conflict in advance so they can be resolved in a timely manner.

Full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all the work involved in protecting or repairing property as specified in this section shall be included in the Contract prices bid, and no additional compensation will be allowed therefore.

The Contractor, in constructing or installing facilities alongside or near sanitary sewers, storm drains, water or gas pipes, electric or telephone conduits, poles, sidewalks, walls, vaults or other structures shall, at their expense, sustain them securely in place, cooperating with the officers and agents of the various utility companies and municipal departments which control them, so that the services of these structures shall be maintained. The Contractor shall also be responsible for the repair or replacement, at their own expense, of any damage to such structures caused by their acts or neglect, and shall leave them in the same condition as they existed prior to commencement of the work. In case of damage to utilities, the Contractor shall promptly notify the utility owner and shall, if requested by the Engineer, furnish labor and equipment to work temporarily under the utility owner's direction in providing access to the utility. Pipes or other structures damaged by the operation of the Contractor may be repaired by the Department or by the utility owner that suffers the loss. The cost of such repairs shall be borne by the Contractor, without compensation therefore. The Contractor shall be borne the responsibility and cost to coordinate if a pole needs to be secure in place while construction is in progress.

If, as the work progresses, it is found that any of the utility structures are so placed as to render it impracticable, in the judgment of the Engineer, to do the work called for under this Contract, the Contractor shall protect and maintain the services in such utilities and structures and the Owner will, as soon thereafter as reasonable, cause the position of the utilities to be changed or take such other actions deemed suitable and proper.

If live service connections are to be interrupted by excavations of any kind, the Contractor shall not break the service until new services are provided. Abandoned services shall be plugged off or otherwise made secure.

Full compensation for furnishing all labor, materials, tools, equipment and incidentals for doing all the work involved in protecting or repairing property as specified in this section, shall be considered included in the prices paid for the various Contract items of work and no additional compensation will

be allowed therefore.

The Contractor shall be required to accommodate utility pole and overhead utility relocations that may occur during this project. The Contractor will have input on the sequence of utility pole relocations as it is the Owner's intent for the two efforts to be performed in a coordinated manner.

Spills of materials shall be removed immediately, whether within or outside the project limits. Sweeping and cleaning of surfaces to remove material caused by spillage or vehicular tracking during the various phases of the work shall be considered as incidental to the work being performed under the Contract and there will be no additional compensation.

The Contractor shall not utilize private roads or private property for parking, hauling, staging, detours (except as required by police, fire, or emergency medical), or any other purpose except by written permission of the owners thereon.

The Contractor will cooperate fully with all utility companies private or public, and will notify all such companies at least seventy-two (72) hours prior to excavating in the vicinity of any utility. It is understood that the Contractor has considered in their bid the existence of the various utilities and that no additional compensation will be allowed for any delays, inconvenience, or damage sustained by him due to any interference by said utilities.

At locations where the proposed drainage crosses the existing gas mains care should be taken during excavation to avoid undermining or damaging the existing gas mains. If the existing gas main is required to be undermined, the Contractor shall keep the trench width to a minimum and provide in-place support to gas mains as approved by the representative of the utility or as directed by the Engineer.

WORK IN THE IMMEDIATE VICINITY OF CERTAIN UNDERGROUND STRUCTURES AND UTILITY POLES (SUPPLEMENTING SUBSECTION 7.13)

For overhead connections, the local power company will make the connection from the top of the riser on the utility pole to the power source. The Contractor shall supply all labor, materials and equipment to install the service connection, complete in place and in accordance with the power company procedures, from the meter to and including the riser with enough wire coiled above the riser to permit the power company to make the final connection.

For underground connections, the power company will perform the actual wiring of the service connections from its power source to the meter, but all steel sweeps, ducts, entrance holes into manholes, patching and all other necessary labor, materials and equipment required to install the electric service, complete in place, shall be furnished by the Contractor.

The Contractor shall pay the power company for their services rendered for the connection of overhead and underground service connections.

No work is to be performed in the immediate vicinity of the power company manholes or utility poles, or other utilities without prior notice (at least 48 hours) to the affected company. Before starting work at existing manholes, the Contractor shall test for gas and blow out the manholes.

NOTICE TO OWNERS OF UTILITIES (SUPPLEMENTING SUBSECTION 7.13)

Written notice shall be given by the Contractor to all public service corporations or municipal and State officials owning or having charge of publicly or privately owned utilities of their intention to commence operations affecting such utilities at least one week in advance of the commencement of such operations. The Contractor shall, at the same time, file a copy of such notice with the Engineer. Contact information for the principal utilities potentially affected is listed in Article 23 in the General

Conditions in the Project Manual, but completeness or accuracy of the list is not guaranteed by the Town.

WORK SCHEDULE (SUPPLEMENTING SUBSECTION 8.02)

Work on this project is restricted to a normal eight-hour day, five-day week, with the Contractor and all Subcontractors working on the same shift. Work hours shall be 7:00 am to 3:30 pm.

No work shall be performed on this Contract from the Thursday before Memorial Day weekend to the Tuesday after Labor Day, inclusive, without prior approval by the Owner.

No work shall be performed on this Contract on Saturdays, Sundays, or holidays listed below, or on the day before or the day after a long weekend that involves a holiday listed below, without prior approval by the Owner. Consult Owner regarding dates of holiday observances.

The following holidays are observed by the Town of Barnstable DPW - New Year's Day, Martin Luther King Jr. Day, Presidents Day, Patriots Day, Memorial Day, Juneteenth, Independence Day, Labor Day, Columbus Day, Veterans Day, Thanksgiving Day, the day following Thanksgiving, the afternoon before Christmas, and Christmas Day.

The Contractor shall submit a comprehensive construction schedule to the Owner for review due upon issuance of the Notice to Proceed at least ten (10) days prior to the start of work. The construction schedule shall demonstrate in detail the means by which the Contractor will perform the work specified herein in the time allotment stated in the Contract Agreement. The Contractor shall not begin any work until the Engineer has reviewed and approved the submitted schedule. The Contractor shall submit an updated project schedule to the Town weekly or as requested by the Town during construction period for review and approval.

The construction schedule shall contain all significant tasks with an anticipated start date and end date. The schedule shall identify landmark tasks, critical tasks, dependent tasks and duration for each task in days.

The Contractor may be required to submit an updated schedule each week. The updated schedule shall include all information described above. If the updated schedule indicates that a delay is anticipated in the final end date, the Contractor shall submit to the Engineer and Owner a written reason for the delay, possible remedy, and justification for the new end date. The Engineer and Owner shall review the statement to determine if the Contractor is responsible for the delay. If found responsible, the Contractor shall pay liquidated damages in accordance with the contract documents. If the Contractor is deemed not responsible, the contract duration will be extended in accordance with the General Conditions.

The Contractor shall attend weekly progress meetings with the Owner and Engineer at a mutually agreeable day, time, and location to be determined during construction.

PROVISIONS FOR TRAVEL AND PROSECUTION OF THE WORK (SUPPLEMENTING SUBSECTION 8.03)

Before starting any work under this Contract, the Contractor shall prepare, and submit to the Engineer for approval, a plan (based on the Contract traffic management plans) that indicates the traffic routing proposed by the Contractor during the various stages and time periods of the work and the temporary barricades, signs, drums and other traffic control devices to be employed during each stage and time period of the work to maintain traffic and access to abutting properties.

Particular care shall be taken to establish and maintain methods and procedures that will not create unnecessary or unusual hazards to public safety. Traffic control devices required only during working

hour operations shall be removed at the end of each working day.

NECESSARY ACCESS FOR FIRE APPARATUS AND OTHER EMERGENCY VEHICLES SHALL BE MAINTAINED AT ALL TIMES. THE CONTRACTOR SHALL COORDINATE WITH THE POLICE AND FIRE DEPARTMENTS ON A DAILY BASIS REGARDING ACCESS.

When vehicular passage through the work area is limited due to lane or shoulder closures or other work in progress, the Contractor's flaggers or police details shall give top priority to emergency vehicles passage. School buses shall be given the next highest priority passage.

Traffic Management during construction operations shall be in accordance with these Special Provisions, the Manual on Uniform Traffic Control Devices, Latest Edition and Supplements, and the Town of Barnstable.

Temporary signs shall be covered or removed when not in use. No signs shall be visible to traffic that may conflict with actual conditions.

It shall be the responsibility of the Contractor to maintain a safe uninterrupted traffic flow within the project roadways throughout the duration of the project. Detours onto surrounding streets will not be allowed unless approved by the Town of Barnstable. Detours shall have appropriate signs directing traffic along the entire detour route.

Signs having messages that are irrelevant to normal traffic conditions shall be removed or properly covered at the end of each work period. Signs shall be kept clean at all times and legends shall be distinctive and unmarred.

The Contractor shall submit a Traffic Management Plan to the Town and Engineer for approval. Construction shall not begin until the Plan has been approved. The Plan shall detail construction time frames and phasing, address pedestrian and vehicular flow to and through the construction operations, parking, approved detour routes, access by emergency vehicles, and bus and delivery truck traffic. The Contractor shall update this plan as construction progresses, subject to the approval of the Town of Barnstable and the Engineer. Payment for development of the Traffic Management Plan shall be considered incidental to the Contract prices bid.

MAINTENANCE OF TRAFFIC

Traffic shall be continuously maintained on the various streets during construction. Work on this contract may require work to be scheduled to one side of streets and intersections at a time, allowing for one lane of continuous traffic movement in each direction and one sidewalk shall remain open at all times. The Contractor shall provide temporary pavement for disturbed travel lanes, sidewalks, and driveways overnight, prior to weekends and holidays, and prior to other periods when work is not occurring.

PROPERTY ACCESS

The Contractor shall provide and maintain access at all times to all properties abutting the work. The Contractor shall provide safe and ready means of ingress and egress to all businesses and residences in the project area, both day and night, for the duration of the project.

The Contractor shall maintain access for trash removal services, mail and other deliveries, and the like, and shall provide alternative methods when the abutter's mailbox has been temporarily removed or a driveway is temporarily blocked or unusable. The contractor shall make provisions to provide access and provide for services at no additional cost to the Contract.

The Contractor shall notify an abutter a minimum of 24 hours in advance of any work to be performed adjacent to property of said abutter. The Contractor shall notify an abutter a minimum of 48 hours in advance of any work to be performed adjacent to property of said abutter that will disrupt or prevent access to the property or the ability to park their vehicle in front of or within an established driveway for said property.

PAVING OPERATIONS (SUPPLEMENTING SUBSECTION 450)

The Town requires that all hot mix asphalt installed under this project be batched and delivered from a batching plant within a 20-mile radius of the street being paved.

The Contractor shall provide continuous radio communications between the asphalt plant and the project to assure immediate response due to breakdowns, emergencies such as accidents, and to assure the best quality results possible. Communication shall be provided by the Contractor at no additional compensation.

No less than a week in advance before the scheduled start of paving operations, a meeting will be held in which representatives from the Contractor and the Town will come to an agreement on the details for the paving operation including but not limited to Hot Mix Asphalt delivery, amount of days that pavement operations are expected to last, traffic management plan, amount of trucks that will be needed, paver speed, etc. Paving equipment shall be capable of using automatic screed control (Automatic Grade Control). A tack coat shall be spread per MassDOT specifications. Surface shall be dry and cleaned of all foreign and loose material by means of a machine sweeper before applying tack coat. The tack distributor shall be working properly and be set up correctly. Tack distributor shall be capable of maintaining proper temperature and pressure and also capable of adjusting the spray bar height throughout the day to ensure proper coverage and even application of the tack coat.

Final paving on the public way shall be performed after all other work is finished.

TRAFFIC CONTROL FOR CONSTRUCTION AND MAINTENANCE OPERATIONS (SUPPLEMENTING SUBSECTION 850)

All signs, barricades, and drums shall have Reflective Sheeting in accordance with Material Specification M9.30.0 of the Department's "Standard Specifications for Highways and Bridges - 1995 Edition".

Drums shall meet the requirements of Section M9.30.9. Plastic drums with mounted lighting devices must pass the criteria set forth in NCHRP 350 “Recommended Procedures for the Safety Performance Evaluation of Highway Features”. Plastic drums with mounted lighting devices that do not meet the criteria shall be removed from the Project.

The contractor shall deploy drums, cones, barricades, safety signage and other traffic control devices that are in new or like new condition, clean, and unmarred. The contractor shall promptly remove and replace any damaged, defective, or worn traffic control devices, as determined by the Engineer or Owner.

The speed of traffic through work limits shall be determined by the Town of Barnstable.

Channelization, if required, shall consist of the use of proper temporary pavement markings, reflectorized plastic drums, signing, barricades and other traffic control devices in order to facilitate traffic flow.

Positioning, adjusting and re-positioning of all devices shall be considered incidental to this contract.

All traffic control devices shall be removed immediately when no longer needed.

The Contractor shall remove and dispose of all detour and safety signing erected for this Contract at the completion of work.

The Contractor shall be responsible for furnishing, installing, relocating and maintaining all traffic control devices as shown on the plans or required by the Town of Barnstable, including but not limited to, safety signing, drums, cones, Type III barricades, flashing arrow boards and temporary pavement marking.

PERSONAL PROTECTIVE SAFETY EQUIPMENT FOR CONTRACTOR PERSONEL

The Contractor is responsible to ensure that all personnel, including all Subcontractors, working on the project are issued and are wearing all necessary personal protective safety equipment while working within the project limits. This equipment shall include, as a minimum, a hardhat and a safety vest, regardless of the type of work being performed. Other safety equipment shall be added as required to perform the work in which they are engaged and in accordance with all local, state and federal requirements in effect.

PREVENTION OF WATER POLLUTION – SANITARY PROVISIONS

During the performance of all Work done under this contract, the Contractor shall adopt such precautions in the conduct of their operations as may be necessary to avoid contaminating water in adjacent streams, pond or channel areas. All moving of equipment and other operations likely to create silting, shall be so planned and conducted as to minimize pollution in adjacent streams, pond or channel areas. Water used for any purpose by the Contractor, which has been contaminated with soil, bitumen, salt or other pollutants shall be so discharged as to avoid affecting nearby waters. Under no circumstances shall the Contractor discharge pollutants directly into any stream or pond area.

When the Contractor uses water from natural sources for any operations, intake methods shall be such as to avoid contaminating the source of supply and maintain adequate downstream flow when the source is a stream.

The Contractor shall apply water quality control measures to all drainage structures in the project area prior to commencing work.

MAINTENANCE AND CLEANING OF ROADS

Existing roadways intended to be used for hauling earth and rock excavated materials shall be cleaned and maintained by the Contractor throughout the duration of the Project. If necessary, the Contractor shall be responsible for providing street sweepers and operators for sweeping of haul road paved surfaces. Sweeping services shall be provided on an hourly basis at the discretion of Engineer. Street sweepers shall be self-propelled, diesel-powered units with brushes and a water spray, less than three years old. The Contractor shall remove debris from the work area and deposit sweepings at locations as directed by the Engineer. The Contractor shall also be responsible for repairing roadways and bridges damaged by construction vehicles. Payment for maintenance and cleaning of roads will not be paid for separately but shall be considered incidental to the contract.

OIL AND HAZARDOUS MATERIAL SPILL PREVENTION

Measures must be taken by the Contractor to prevent spills and leaks of oils and other hazardous materials to the environment. Such measures include but are not limited to properly maintaining construction equipment, establishing fuel and hazardous material handling areas that are designed to prevent releases to the environment (include containment structures if needed), instructing personnel in proper waste handling procedures and strictly prohibiting disposal into drains, water ways or receptacles, such as dumpsters, designed for non-hazardous waste. Spills or leaks of oil or hazardous materials must be reported to the DEP in accordance with the reportable quantities and criteria for

"spills" as designed by the DEP in 310 CMR 40.370. Notification to the Engineer and to DEP must be made as soon as possible, but not more than two (2) hours after a spill or leak occurs.

ENVIRONMENTAL COMPLIANCE

The Contractor is advised that if field conditions and/or Contractor-suggested methodologies warrant either amending or obtaining environmental permits, the Contractor must notify the Engineer prior to commencement of the proposed activity. The Engineer will coordinate all contact between local, State, or Federal environmental agencies and the MassDOT Environmental Section. The Contractor is further advised that any and all time delays as a result of filing for and obtaining or modifying permits are not subject to a claim. The Contractor may also be required to submit additional information with respect to proposed work subject to environmental regulations.

PUBLIC RIGHTS-OF-WAY ACCESS GUIDELINES TOLERANCES

The Contractor is hereby notified that they are ultimately responsible for constructing all project elements in strict compliance with the current Public Rights-of-Way Access Guidelines (PROWAG), regulations and standards.

All construction elements in this project associated with sidewalks, walkways, wheelchair ramps and curb cuts are controlled by PROWAG. These construction elements shall also be in conformance with ADA requirements of detectability. Detectable warning surfaces shall be 2 feet wide square-pattern truncated dome surfaces setback 6 inches from the gutter line.

PROWAG specifies maximum slopes and minimum dimensions required for construction acceptance. There is no tolerance allowed for slopes greater than the maximum slope nor for dimensions less than the minimum dimensions.

Contractors shall establish grade elevations at all accessible ramp locations and shall set transition lengths according to the appropriate table in the Construction Standards (or to the details shown on the plans).

All accessible ramp joints and transition sections which define grade changes shall be formed, staked and checked prior to placing cement concrete. All grade changes are to be made at joints.

INSPECTION OF WORK

The Engineer may appoint such assistants and representatives as they desire and they shall be authorized to inspect work and materials, to give directions pertaining to the work or to the safety and convenience of the public, to approve or reject materials, to make measurements of quantities, and to perform such other duties as may be designated by the Engineer.

Failure to reject any defective work or materials shall not in any way prevent later rejection when such defect is discovered or obligate The Town to make final payment.

COOPERATION OF THE CONTRACTOR

Agents of various public service agencies, municipal and State departments may be entering on the work site to remove existing facilities, to construct or place new facilities or to make alterations to existing facilities.

The Contractor shall perform the work in cooperation with the various agencies in a manner which causes the least interference with the operations of the aforementioned agencies and shall have no claim for delay which may be due, or result, from said work of these agents.

FINE TUNING, ADJUSTMENT, AND TESTING PERIOD

After the Contractor has finished installing the traffic signal equipment as specified in the contract documents, the fine tuning, adjusting and testing period shall begin. The Contractor shall advise the Engineer, and Town in writing of the date of the beginning of the fine-tuning and testing period.

During this period, the Contractor, under the direction of the Engineer will make necessary adjustments and tests to ensure safe and efficient operation of the equipment. This period shall not last for more than 30 days. The contract completion date shall take this testing period into consideration. No request for final acceptance will be considered until successful completion of the testing period.

FINAL INSPECTION AND ACCEPTANCE

Upon successful completion of the 30-day testing period wherein the Traffic Signal installation has operated for 30 days without failure, the Contractor shall notify the Engineer. The Engineer will make a final inspection of the installation in the presence of the Town, and the Contractor. An inspection check will be made to ensure that all equipment, materials, installation and operations are in accordance with the construction contract, plans and specifications. Items to be checked will include, but not be limited to, documents (wiring diagrams, as-built plans, instruction manuals, parts lists, warranties, grounding resistivity test report, loop detector test report, etc.), signs, and pavement markings, and street hardware (posts, bases, housings, mast arms, brackets, pull boxes, etc.).

The Engineer will notify the Contractor in writing of any items in which the inspection reveals that the work is incomplete, defective, or does not otherwise meet the project specifications. The Contractor shall perform the corrective actions necessary to achieve final acceptance by the Town. These corrective actions shall be done by and at the expense of the Contractor, and within 15 days of the date of the inspection report, unless otherwise approved in writing by the Town.

SOIL DISPOSAL

Soil to be removed from the project area shall not be assumed to be uncontaminated and must be evaluated prior to off-site management for potential contamination with hazardous materials. Quantities for soil disposal are based on the project design, existing knowledge of soil contamination in the project area, the presence of known risk factors for soil contamination in the project area, and the designer's best professional judgment.

Any stockpiling of soil must be performed in compliance with Policy Directive P-22-001, Off- Site Stockpiling of Soil from MassDOT Construction Projects. This directive limits the allowable locations for off-site stockpiling of soil generated during MassDOT projects and includes various requirements that must be satisfied by the contractor prior to off-site stockpiling.

SECTION 17 TECHNICAL SPECIFICATIONS

ITEM 102.511 TREE PROTECTION – ARMORING & PRUNING EACH

DESCRIPTION

The work under this item shall conform to the relevant provisions of Sections 771 and shall be for furnishing and installing temporary tree trunk protection and for limb pruning to prevent injury to the tree from construction equipment and activities.

Trunk armoring is for instances where construction activity (the use of heavy equipment) comes close enough to potentially damage the tree trunk or limbs. It is to be used where shown on the plans and as directed by the Engineer.

REFERENCES

If requested, the Contractor shall provide to the Engineer one copy of the latest edition of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance: Part 1-Pruning and Part 5-Construction Management Standard. Provision of reference shall be incidental to this item.

MATERIALS

Trunk armoring shall be such that it prevents damage to the trunk from construction equipment. Selected material shall be such that installation and removal will not damage the trunk.

Acceptable materials include 2x4 wood cladding with wire or metal strapping, or, for instances when duration of construction activities is less than three months, corrugated plastic pipe mounted with duct tape. Height of cladding shall be from base of tree (including root flare) to the bottom of the first branch or as recommended by the Arborist. Material and methods shall be approved by the Engineer.

Other materials or methods may be acceptable if approved by Landscape Architect or an Arborist.

METHODS OF WORK

Prior to construction activities, the Engineer, the Contractor, the Town Tree Warden, and the Arborist, if specified, shall review trees noted on the plans to be protected. Final decision as to trees armored and/or pruned shall be per the Engineer.

Care shall be taken to avoid damage to the bark during installation and removal of armoring. Trunk armoring shall be replaced and maintained such that it is effective for as long as required and shall be removed immediately upon completion of work activities adjacent to trees.

Pruning of limbs shall conform to the techniques and standards of the most recent ANSI A300 standards.

The Contractor shall assume that the majority of tree roots extend to the tree dripline or edge of canopy. Any disturbance within this zone shall result in root reduction. In certain instances, demolition may need to occur within this zone. Tree protection fencing shall be located at the tree's dripline, or as indicated on the drawings.

Removal of pavements and granular base materials under pavement and within the dripline of trees shall be excavated without heavy equipment to preserve as many roots as possible.

Removal of soil within the dripline of trees shall be performed with an air spade by a Certified Arborist wherever possible.

DAMAGES & PENALTIES

In the event that trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall, at his own expense obtain an Arborist. The Arborist shall be approved by the town.

If, based on the recommendations of the Arborist, the Landscape Architect determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage will be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Landscape Architect determines that damages are irreparable, the Contractor shall pay for the damages in the amount of $500.00 per diameter inch at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal will include clean up of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 102.511 will be measured and paid at the contract unit price per each. This will include full compensation for all labor, equipment, materials, and incidentals for the satisfactory completion of the work and the subsequent removal and satisfactory disposal of the protective materials upon completion of the contract.

In the event of tree damage, cost of Arborist services, of remediation measures, and/or tree removal will be borne by the Contractor.

Payment under this item will be scheduled throughout the length of contract:

- 40% of value shall be paid upon installation of trunk armoring and completion of pruning work, if required.
- 60% shall be paid at the end of construction operations that would damage the tree and after protection materials have been removed and properly disposed of by the Contractor. In the event of repairable damages, payment shall be made after the completion of remediation measures.

In the event of irreparable damage due to lack of proper protective measures being take there will be no compensation in addition to the $1000.00 per diameter inch penalty.

ITEM 102.522 TREE AND PLANT PROTECTION FENCE - CHAIN LINK FOOT

The work under this Item shall conform to the relevant provisions of Sections 644 and 771 of the Standard Specifications and the following:

Work under this item consists of furnishing, installing, removing and resetting, maintaining fence in a vertical and effective position at all times, and final removal of temporary fence.

The purpose of the fence is to prevent damage to tree roots, tree trunks, soil, and all other vegetation within a delineated Tree and Plant Protection Zone (TPPZ) as shown on the plans, as directed by the Engineer, and as described herein.

Protection shall be for the duration of the construction activities unless otherwise directed.

MATERIALS

Chain Link Fence shall be 6 foot tall metal chain link set in metal frame panels on movable core drilled concrete blocks of sufficient size to hold the fence erect in areas of existing paving to remain.

Panels shall be such that they create a barrier to encompass the entire root zone area to the extent possible.

Unless otherwise indicated, the following types of chain link fence are acceptable:

- New materials or previously used salvaged chain link fencing in good condition, subject to inspection and approval by the Engineer.
- Posts: Galvanized steel pipe of diameter to provide rigidity.
- Fabric: Woven galvanized steel wire mesh. Provide in continuous lengths to be wire tied to fence posts or prefabricated into modular pipe-framed fence panels.

REFERENCES

If requested, the Contractor shall provide to the Engineer one copy of the American National Standards Institute (ANSI) A300 Standard Practices for Tree, Shrub, and Other Woody Plant Maintenance Part 1, Pruning and Part 5, Construction Management Standard. Provision of reference shall be incidental to this item.

ESTABLISHMENT OF TPPZ

Fencing shall be used for construction areas, staging areas, and stockpile areas as shown on the plans and as directed by the Engineer to establish the Tree and Plant Protection Zone (TPPZ).

Fence shall be located as close to the work zone limit and as far from the trunk as possible to maximize the area to be protected. Fence shall run parallel and adjacent to construction activity to create a barrier between the work zone and the root zone or designated limit of plants and soils to be protected.

When construction activities surround (or have the potential to surround) trees or plants to be protected, a circular enclosure shall be used. In these instances, the TPPZ limit shall be the Drip Line of each tree or as close as possible to the Drip Line, and as shown on the plans and details. The Drip Line is defined as the limit of tree canopy.

The Contractor shall not engage in any construction activity within the TPPZ without the approval of the Engineer, including: operating, moving or storing equipment; storing supplies or materials; locating temporary facilities including trailers or portable toilets; and shall not permit employees to traverse the area to access adjacent areas of the project or use the area for lunch or any other work breaks.

METHOD OF WORK

Fence shall be installed prior to any construction work or staging activities and shall be installed and maintained in a vertical and effective position at all times.

Fence shall be repositioned where and as necessary for optimum effectiveness. Repositioning shall be incidental to this item. Fence shall not be moved without prior approval by the Engineer.

The TPPZ shall be protected at all times from compaction of the soil; damage of any kind to trunks, bark, branches, leaves, and roots of all plants; and contamination of the soil with construction materials, debris, silt, fuels, oils, and any chemicals substance. In the event of spills, compaction or damage, the Contractor shall take corrective action immediately using methods approved by the Engineer in coordination with an Arborist.

After construction activities are completed, or when directed by the Engineer, fence, stakes, and other materials shall be removed and disposed off-site by the Contractor.

REQUIRED WORK WITHIN THE TPPZ

In the event that grading, trenching, utility work, or storage is unavoidable within the TPPZ, the Engineer shall be notified. Measures may be required for tree protection and preservations, including air spading, the use of six inch depth of wood chips or approved matting for root protection, pruning of branches, and/or trunk protection. These protection measures will be paid under applicable items.

Landscaping work specified within the TPPZ shall be accomplished by hand tools. Where hand work is not feasible, with permission of the Engineer, work shall be conducted with the smallest mechanized equipment necessary.

TREE AND PLANT DAMAGES OR LOSS

If the TPPZ is intruded upon, at the discretion of the Engineer, the Contractor will be required to provide a more durable barrier (e.g., Jersey Barriers) to secure the area. Cost of furnishing and installing additional or more durable barrier shall be borne by the Contractor.

If the Contractor intrudes into a TPPZ without approval, soil will be considered compacted and tree root damage will be assumed. Action will be taken as specified below.

In the event that trees designated for protection under this item are damaged, including root damage from unapproved trespassing onto the root zone, the Contractor shall, at his own expense obtain an Arborist. The Arborist shall be approved by MassDOT.

If, based on the recommendations of the Arborist, the Engineer determines that damages can be remedied by corrective measures, such as repairing trunk or limb injury, soil compaction remediation, pruning, and/or watering, the damage will be repaired as soon as possible within the appropriate season for such work and according to industry standards.

If the Engineer determines that damages are irreparable, the Contractor shall pay for the damages in the amount of $1000.00 per diameter inch at breast height (DBH) per tree.

Additionally, if the Engineer determines that the damages are such that the tree is sufficiently compromised as to pose a future safety hazard, the tree shall be removed. Tree removal will include clean up of all wood parts, grinding of the stump to a depth sufficient to plant a replacement tree or plant, removal of all chips from the stump site, and filling the resulting hole with topsoil.

Shrubs will be replaced with a plant of similar species and equal size or the largest size plants reasonably available. The Engineer will approve the size and quality of the replacement plant. Replacement will include a minimum of one year of watering and care.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 102.522 will be measured and paid for payment by the foot of Tree and Plant Protection Fence–Chain Link, complete in place. This includes all labor, materials, equipment, maintenance, final removal and disposal of the protective materials, damages repair, and all incidental cost required to complete the work.

Payment of 40 percent of value will be made upon installation of Fence. The remaining 60 percent will be made when protection materials have been removed and disposed off-site.

No separate payment will be made for costs of remedial actions, including addition of more durable barriers, or arborist services, but all costs in connection therewith shall be included in the Contract unit price bid.

In the event of irreparable damage due to lack of proper protective measures being take there will be no compensation in addition to the $1000.00 per diameter inch penalty.

ITEM 120.1 **UNCLASSIFIED EXCAVATION** **CUBIC YARD**

The work to be done hereunder consists of removing and disposing in accordance with the relevant provisions of Section 120, all materials required for execution of the required work as shown on the Plans and as directed, except materials for which payment is made under other items of this contract.

The work shall also include the removal and disposal of substandard or damaged berm or curb, signs and sign posts to be removed and discarded, and all other materials not designated to be reused on the project. The Engineer shall determine the disposition of all materials with respect to removal and disposal.

Edges of excavations made in existing pavements shall be squared by saw-cutting with power-driven tools to provide a neat, clean edge for joining new pavement as shown on the Plans. Ragged, uneven edges shall not be accepted. Pavement areas which have been broken or undermined shall be edged neatly with a minimum disturbance to the remaining pavement.

The contractor shall perform all excavation in such a manner as to maintain slopes, longitudinally and laterally and to insure proper and continuous drainage at all times.

BASIS OF PAYMENT

Payment for work under this item will be made at the contract unit price per cubic yard for Item 120.1 Unclassified Excavation.

ITEM 127. CONCRETE EXCAVATION CUBIC YARD

DESCRIPTION

Work under this Item shall include the removal and disposal of any concrete walkways and driveway aprons specifically shown on the Plans, or where and as required by the Engineer.

CONSTRUCTION METHODS

Concrete at the edges of all areas to be removed shall be saw cut to a minimum depth of 1 inch.

Materials shall be removed carefully so as to avoid injury to persons and damage to the remaining portions of the structure. All materials removed shall become the property of the Contractor and shall be removed from the site and properly disposed of. The Contractor shall obtain approval from the Engineer for his methods of accomplishing the work under this Item before commencing work.

METHOD OF MEASUREMENT

Item 127, Concrete Excavation, shall be measured per cubic yard.

BASIS OF PAYMENT

Item 127, Concrete Excavation, shall be paid at the contract unit price bid per cubic yard, which payment shall be considered as full compensation for all labor, tools, equipment, materials, and incidental work required to complete the work as required.

Saw cutting, as shown on the Plans, shall be considered incidental to the work under Item 127, and no further compensation will be allowed.

ITEM 153. CONTROL DENSITY FILL – EXCAVATABLE CUBIC YARD

DESCRIPTION

The work to be performed under these Items, without limiting the generality thereof, shall consist of providing flowable fill (also known as controlled density fill) at locations and to the lines and grades as indicated on the Contract Documents and/or as required by the Engineer.

SUBMITTALS

The Contractor shall submit the following items:

1. Cement: A Certificate by the manufacturer of cement certifying its conformity to the type and quality specified herein.

2. Fly Ash: A certificate prepared by the flowable fill supplier attesting that fly ash is in compliance with the specified properties.

MATERIALS

FLOWABLE FILL

Flowable fill shall conform to the Massachusetts Highway Department's Standard Specifications for Highways and Bridges Subsection M4.08.0. Flowable Fill shall be either Type 1E or 2E depending on the application and as required by the Engineer. Type 1E and 2E shall have a compressive strength 80 pounds per square inch (psi) required at 28 days.

Water: Water used in mixing flowable fill shall be clean and free from deleterious materials.

QUALITY CONTROL OF FLOWABLE FILL

Flowable fill shall be supplied by an approved concrete producer from the QCML who has an approved CDF mix design.

CONSTRUCTION METHODS

FLOWABLE FILL CONVEYANCE BY CHUTES

When flowable fill is conveyed by chutes, the equipment shall be of such size and U-shaped design as to insure a continuous flow in the chute. Flat chutes shall not be employed. The chutes shall be of metal, metal lined, or other smooth material and the different portions shall have approximately the same slope.

FLOWABLE FILL CONVEYANCE BY PUMPING

Equipment and procedures for pumped flowable fill shall be suitable and adequate to maintain a steady flow at the discharge end of the pipe, and to maintain the specified properties of compressive strength, unit weight, slump and air content.

CURING

Newly placed flowable fill shall be protected against any damage due to low and extremely high temperatures, rapid loss of moisture and against any foot and vehicular traffic. No bituminous concrete or cement concrete pavements shall be laid on flowable fill until such flowable fill has been cured as determined by the Engineer.

INSPECTION AND TESTING

The Engineer will make on-site inspections of the placing of the flowable fill. Contractor shall pay for tests at his/her own expense. Inspection and testing does not relieve the Contractor of his/her responsibility to provide his/her own inspection, testing, and quality control as necessary to complete the work in accordance with the requirements of the Contract Documents.

Notify the Engineer prior to the placement of flowable fill. Such notification shall be made at least 24 hours in advance.

Slump test shall consist of a 6-inch long with a 3-inch diameter hollow metal cylinder rested on its base on a flat clean surface. The cylinder shall be filled to the top with flowable fill and then slowly raised. As it is being raised a flowable fill "pancake" is formed. The diameter of the resulting "pancake" shall be measured. The diameter shall be compared to the specified diameter of "pancake". The slump testing shall be performed as frequently as required and determined by the Engineer to ensure that furnished flowable fill is acceptable.

METHOD OF MEASUREMENT

Flowable fill shall be measured by the cubic yard complete-in- place.

BASIS OF PAYMENT

The unit price bid shall be full compensation for all labor, tools, equipment, materials, pumping, testing, and all incidentals required to do the work of this section as indicated on the Contract Documents, as specified herein and as required by the Engineer.

ITEM 590. **CURB REMOVED AND STACKED** **FOOT**

Work under this Item shall conform to the requirements of Section 580 of the Standard Specifications and the following:

All curb or edging, removed and stacked shall be delivered and carefully stacked at the Department of Public Works Equipment Yard, and placed per the direction of the Town or Engineer.

The Contractor is responsible for notifying the Town representative when the curbing will be available.

CONSTRUCTION METHODS

The existing curb or edging shall be removed without damage.

BASIS OF PAYMENT

The quantity of curb or edging removed and stacked to be paid for will be the length actually removed and stacked as measured along the face of the curb in place prior to removal.

Any curb determined to be unsuitable for re-use, stacking, or not desired by the Town shall be discarded by the Contractor without additional compensation.

The quantity of curb inlets removed and stacked to be paid for will be each section

Curb removed and stacked (Item 590.) will be paid for at the Contract unit price bid per foot which payment will be full compensation for all materials, tools, equipment and labor incidental to and necessary for the completion of the work, including the temporary storage, protection, loading, transporting, unloading and stacking of curb as required.

ITEM 599. MOUNTABLE GRANITE CURB FOOT

Work to be done under this item shall be done in accordance with Subsection 501 of the Standard Specifications and the following:

The Mountable Granite Curb shall be T100-type curb and used at the truck aprons as shown on the Plans. The T100 curb shall be cut to the dimensions shown on the Plans and shall have a minimum length of 4' – 6" except for the closure piece. The curb shall be finished as required for VA curb in section M9.04.1. Where the radius of the curb is 100 feet or less, the curb shall be cut to the required curvature. If curb is placed after the placement of the adjacent HMA pavement, then concrete as shown on the plans shall be used to bed the curb. The same concrete used under Item 431 shall be used.

METHOD OF MEASUREMENT

Item 599. will be measured for payment by the Foot, complete in place along the front arris line of the curb.

BASIS OF PAYMENT

Item 599. will be paid for at the Contract unit price per Foot, which price shall include all labor, materials, including concrete, if needed, equipment, and incidental costs required to complete the work.

ITEM 697.1 **SILT SACK** **EACH**

Work under this item shall conform to the relevant provisions of Sections 227 and 670 of the Standard Specifications and the following:

The work under this item includes the furnishing, installation, maintenance and removal of a reusable fabric sack to be installed in drainage structures for the protection of wetlands and other resource areas and the prevention of silt and sediment from the construction site from entering the storm water collection system. Devices shall be ACF Environmental (800)-448-3636; Reed & Graham, Inc. Geosynthetics (888)-381-0800; The BMP Store (800)-644-9223; or approved equal.

CONSTRUCTION

Silt sacks shall be installed in retained existing catch basins and drop inlets within the project limits and as required by the Resident Engineer.

The silt sack shall be as manufactured to fit the opening of the drainage structure under regular flow conditions and shall be mounted under the grate. The insert shall be secured from the surface such that the grate can be removed without the insert discharging into the structure. The filter material shall be installed and maintained in accordance with the manufacturer's written literature and as directed by the Engineer.

Silt sacks shall remain in place until the placement of the pavement overlay, or top course and the graded areas have become permanently stabilized by vegetative growth. All materials used for the filter fabric will become the property of the Contractor and shall be removed from the site.

The Contractor shall inspect the condition of silt sacks after each rainstorm and during major rain events. Silt sacks shall be cleaned periodically to remove and dispose of accumulated debris as required. Silt sacks, which become damaged during construction operations, shall be repaired or replaced immediately at no additional cost to the Department.

When emptying the silt sack, the contractor shall take all due care to prevent sediment from entering the structure. Any silt or other debris found in the drainage system at the end of construction shall be removed at the Contractors expense. The silt and sediment from the silt sack shall be legally disposed of offsite. Under no condition shall silt and sediment from the insert be deposited on site and used in construction.

All curb openings shall be blocked to prevent stormwater from bypassing the device.

All debris accumulated in silt sacks shall be handled and disposed of as specified in Section 227 of the Standard Specifications

COMPENSATION

Silt sacks will be measured and paid at the Contract unit price per Each, complete in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work. No separate payment will be made for removal and disposal of the sediment from the insert, but all costs in connection therewith shall be included in the Contract unit price bid.

ITEM 701.	**CEMENT CONCRETE SIDEWALK**	**SQUARE YARD**
ITEM 701.2	**CEMENT CONCRETE PEDESTRIAN CURB RAMP**	**SQUARE YARD**
ITEM 701.3	**DETECTABLE WARNING PANEL**	**EACH**

The work under these items shall conform to the relevant provisions of Section 701 and the following:

In addition to the requirements of Section 701 the work shall include the application of a liquid penetrant/sealer to protect concrete surfaces from chloride intrusion. The material shall meet the requirements of section M 9.15.0 and appear on the most current version of the Qualified Construction Materials List (QCML) for penetrating sealer found at:

https://www.mass.gov/qualified-construction-materials-list-qcml

CONSTRUCTION METHODS

Application of the penetrant/sealer shall be done in accordance with the manufacturer's instructions which shall be submitted to the Engineer 30 days in advance of any work done under these items. Unless otherwise allowed by the manufacturer's instructions all concrete shall be fully cured, clean, dry, and have no chemical films or coatings applied before application of the penetrant/sealer.

Concrete sealant shall be Prosoco Saltguard WB or approved equivalent.

Concrete placed under these items shall be cured using a 3 day moist cure. Curing compounds will not be allowed. Following the moist cure the concrete shall be cured for an additional length of time as required by the manufacturer before applying the penetrant/sealer, typically 28 days.

All proposed cement concrete sidewalks and curb ramps shall include wire mesh and fiber mesh reinforcing, plus sealant to protect the concrete from deicing compounds.

Wire mesh shall be 6" x 6", #10 mesh, installed in the middle of the concrete slab. Support blocks shall be placed under the mesh to control the location, followed by the placement of the concrete with the mesh fixed in position.

Fiber mesh shall be SIKA® FIBERMESH® 650-e3 or Specter Monofilament Fiber or approved equivalent.

Detectable Tactile Warning Surface (Detectable Warning Panels) shall conform to the requirements of MassDOT Department as shown on the 2014 Massachusetts Department of Transportation Highway Divisions Construction Standard Details, Drawing Number E 107.6.5 and shall be "Federal Yellow" in color.

Detectable warning panels conforming to the plans shall be securely incorporated into the work by means acceptable to the Engineer. Detectable warning panels identified on the plans to be installed without full reconstruction of the concrete curb ramp shall be paid for under Item 701.3 and may be secured to the existing curb ramp by means determined acceptable to the Engineer. No separate payment will be made for the detectable warning panels installed with concrete curb ramp reconstruction paid under Item 701.2, but all costs in connection therewith shall be included in the unit price bid.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Items 701 and 701.2 will be measured and paid for at the contract unit price per Square Yard which shall include all labor, equipment, and materials required to complete the work. Payment for the penetrant/sealer and wire mesh will be incidental to the work and no additional compensation will be made.

Item 701.3 will be measured and paid for at the contract unit price per Each which shall include all labor, equipment, and materials required to complete the Work.

ITEM 706. BRICK SIDEWALK SQUARE YARD
ITEM 706.1 BRICK SIDEWALK REMOVED AND RELAID SQUARE YARD

Work under this item shall conform to the relevant provisions of Section 701 of the MassDOT Standard Specification and the following:

GENERAL

The work under these items shall include furnishing and installing new brick sidewalk, removed and re-laid existing brick walk, and constructing new brick steps to match existing or as shown on the plans or as directed by the Town.

The existing brick sidewalks will be removed and all bricks stockpiled for reuse.

Do not reuse bricks with chips, cracks, or other visible defects. Individual bricks that are in poor condition will be replaced with new bricks of the same color and style by the Contractor and considered incidental to this item AND WILL BE PAID FOR UNDER Item 706.

New clay bricks in the same color and style will be required to be purchased and installed by the Contractor to complete the areas of brick sidewalks indicated on the drawings and are included in Item 706.1. New bricks shall be evenly distributed and integrated into the new walkways so that areas of new brick are not segregated.

Brick walkways will be re-laid to match the patterns as shown in the Drawings and as directed by the Landscape Architect.

Brick sidewalk areas shall be constructed to conform to the latest Americans with Disabilities Act (ADA) regulations, MassDOT Construction Standard Detail dated October, 2017, and as directed by the Town, with the information contained in Massachusetts Department of Transportation Wheelchair Ramp Standards, and the following:

The AAB Rules and Regulations specify maximum slopes and minimum dimensions required for construction acceptance. There is no tolerance allowed for slopes greater than the maximum slope nor for dimension less than the minimum dimensions.

All wheelchair ramp transition sections which define grade changes shall be staked and checked prior to placing subbase for bricks. The Contractor is responsible for ensuring that all wheelchair ramps are designed to conform to AAB/ADA and are approved by the Town. All wheel chair ramps shall have detectable warning panels permanently embedded into the brick at the bottom of the ramp. In order to achieve the required wheelchair ramp design standards, saw cutting of bricks at changes in slope within ramps will be required and considered incidental to the brick sidewalk remove and re-laid item.

Detectible warning panels for brick curb ramp shall be installed as shown on the Plans and as details in MassDOT Construction Standard Details E 107.6.5 dated October 2017. The tile shall conform to Americans with Disabilities Act (ADA) requirements and color shall be federal yellow or as directed by the Town and Landscape Architect. The contractor shall provide a sample of the panels to the Town for approval. The cost for detectible warning panels shall be incidental to the brick walk removed and re-laid item. No additional payment is anticipated for the detectable warning panels.
New brick steps shall be constructed in kind of style, method, and brick types to match the existing stairs at the same location or as directed by the Town.

CONTRACTOR EXPERIENCE

A working knowledge of the specified technology is required. Accordingly, the contractor will be required to verify that he/she is an accredited, licensed installer of the material/process with a minimum of five (5) years of related experience for laying clay brick pavers over asphalt for approval by the Engineer and the Town.

Contractor will be required to furnish the Town in the following space provided; with a minimum of five (5) completed projects utilizing this specialized, specified class of work.

SUBMITTALS

- Manufacturers Product Data: Submit manufacturer's material descriptions and installation instructions for all manufactured items and materials.
- A 6 foot long x 6 foot wide mockup sample of the walkway must be provided by the Contractor for the Landscape Architect's & Owner's approval prior to ordering materials. The mockup will be evaluated for both color and match of the new brick proposed, and how the new brick will be integrated with the existing brick and overall pattern.
- List of Contractors experience of 5 similar brick pavers over bituminous projects with locations, client, references, contact information and photographs.
- The Contractor is responsible to provide construction design of the brick step construction and brick samples to the Town for approval prior to any work.

INSTALLATION

This item shall include the bituminous binder course, gravel subbase and full installation detail as described in the drawings and described below. The contractor may proceed with the existing subbase and binder course when resetting brick pavers if it is determined to be appropriate and in compliance with the details in the drawings and described below, following inspection and approval from the Town.

The subgrade should be brought to the proper level and cleared of organic material. Compaction should comply with ASTM D698 to 95 percent maximum dry density for clay and 100 percent maximum dry density for sand/ gravel. The subbase should be coarse aggregate (gravel) of varying gradation and compacted using mechanical tamping or vibration. A geotextile should be placed on the compacted subgrade, below the subbase in areas with clay soils. Aggregate subbase materials should comply with ASTM D2940, Standard Specification for Graded Aggregate Material For Bases or Subbases for Highways or Airports, and be compacted in accordance with ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3 (600 kN-m/m3)), to 95 percent maximum density.

Clay pavers should be set in an adhesive on a compacted bituminous setting bed ¾ in. (19.1 mm) in thickness. A tack coat to adhere the bituminous setting bed to the base should be used with an asphalt base use a minimum 4 in. (102 mm) of asphalt with an 8 in. (203 mm) subbase or gravel. Asphalt base materials should meet ASTM D3515-01, Standard Specification for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures. Asphalt base materials should be installed before they cool to temperatures below 200 ºF (93 ºC). The maximum variation of the base under the setting bed should be ±3Ú16 in. (4.8 mm) when a 10 ft (3.05 m) straightedge is laid on the surface. The minimum slope of the base surface should be 1 in. (25.4 mm) in 4 ft (1.22 m), a 2 percent grade, to allow for drainage.

The pavers are bonded to the bituminous setting bed using an adhesive of neoprene modified asphalt. Typical proprietary materials contain 75 percent solids in a mineral spirit solvent. The solids consist

of 2 percent neoprene, 10 percent asbestos free fibers and 88 percent asphalt. The adhesive should have a density of 8.0 to 8.5 lb per gal (0.94 to 1.0 kg per liter). The adhesive is typically supplied in pails or drums. The material should be stored in accordance with the manufacturer's recommendations and be thoroughly mixed before application. Typical highway tack coat materials can be used, including emulsified asphalts and cutback asphalts. The type of tack coat will be based upon the prevailing environmental conditions and the procedure used by the installer. Emulsified asphalt is a mixture of asphalt and water. The water will evaporate once the emulsion is exposed to the atmosphere, leaving the asphalt cement solids behind. This process is known as breaking. Emulsified asphalt should comply with ASTM D977, Specification for Emulsified Asphalt, Type SS-1 or SS-1h [Ref. 1]. Rapid curing cutback asphalt is a mixture of asphalt and solvent and should comply with ASTM D2028, Specification for Cutback Asphalt (Rapid-Curing Type) [Ref. 1]. The solvent will evaporate in a process known as curing. In most cases, the tack coat material will be supplied in pails or drums. They should be stored in accordance with the manufacturer's directions and be thoroughly mixed before application.

The tack coat should be installed when the ambient temperature is above 50 °F (10 °C). The surface of the base material should be thoroughly clean and dry before application. The tack coat should not be applied if rain is likely before placing the setting bed. The tack coat should be thoroughly mixed and heated to the appropriate application temperature, taking all necessary safety precautions. The tack coat should not be diluted. It should be uniformly applied by spraying, brushing or squeegeeing to the top of the base and to all surfaces that will be in contact with bituminous setting bed. The application rate should be established before the work starts. As work progresses, the rate can be verified by marking out the area that one pail or drum will cover. The installer should not apply more tack coat at any time than can be covered with the bituminous setting bed during the same day. Emulsified asphalt tack coats are typically applied at a rate of 0.6 to 1.0 gal per 100 ft^2 (2.5 to 4.1 liters per 10.0 m^2) to asphalt bases. Cutback asphalt tack coats are typically applied at a rate of and 1.0 to 1.3 gal per 100 ft^2 (4.1 to 5.3 liters per 10.0 m^2) to asphalt bases. Apply per the manufacturer's instructions. Once applied the tack coat should not be disturbed and should be allowed to cure or break before covering with the setting bed material. This may take a few hours dependent on weather conditions. The tack coat should be applied to the base in a thin, continuous, uniform layer. If it is applied too thin or so that some areas of the base remain uncoated, the setting bed will not bond properly, creating a weakness or layer separation in the pavement. This can be detrimental if water accumulates and freezes in the separated area. If too much tack coat is applied, the thicker areas can create a slip plane, or the tack coat can penetrate the bituminous setting bed material and reduce its stability.

The bituminous setting bed bonds the pavers to the base to resist horizontal movement and uplift. The pavers are adhered to the setting bed with an adhesive of neoprene modified asphalt. A tack coat of emulsified or cutback asphalt is used between the base and setting bed. The bituminous setting Bed, adhesive and tack coat are viscous at construction temperatures, but stiffen as they cool. During hot weather, these materials will become slightly viscous, potentially increasing paver creep due to horizontal traffic loads compared to a pavement with a sand setting bed. For this reason, brick walkways shall only be installed when temperature is between 45 – 70 degrees F.

The temperature should be above 40 °F (4 °C) before placing setting bed material. Depth-control rails should be set on the existing surface to proper line and level using shims to account for surface irregularity. Allowance should be made for compaction of the bituminous mix, not only during construction but also in service. An experienced contractor will increase the thickness for different conditions to achieve the correct long-term surface profiles. Without additional recommendations, the setting bed thickness should be established so that when the pavers are fully set on the adhesive

layer, their top surface will be about ⅛ in. (3.1 mm) above the required grades to allow for future settlement. Setting bed material should be delivered to the job site in trucks with steel linings that are clean and have not been treated with materials (e.g., gasoline, kerosene, etc.) detrimental to the asphalt mix. To retain heat, the bituminous mixture should be covered prior to use. The temperature of the setting bed material at the time of delivery should not be less than 260 °F (127 °C) or more than 320 °F (160 °C). The installer should work quickly to spread and roll the material before it cools below 180 °F (82 °C). When installing by hand, small orders of 1 or 2 tons (900 to 1800 kg) are generally all that can be handled before the mixture cools. Aggregate particles within the mixture ⅜ in. (9.5 mm) or larger should be removed during installation. Steel depth control rails, typically 12 ft. (3.6 m) long, are set up at 8 to 12 ft (2.4 to 3.6 m) centers on shims to achieve a uniform profile. The compacted setting bed should be within ±⅛ in. (3.2 mm) of ¾ in. (19.1 mm) in thickness.

Care should be taken to ensure that release agents applied to the screed rails and tools do not cause damage to the bituminous setting bed. The hot bituminous material should be spread over the tack-coated base and screeded to the appropriate profile between the depth control rails. The screeded panels should be advanced across the pavement as each screed rail length is completed. To minimize foot traffic on the screeded material, alternate panels should be constructed so that the screed rails and shims can be removed without disturbing the screeded material. The infill panel is screed using the edges of the two outside panels to set the thickness. Fill low spots and depressions with additional hot material as the work progresses to produce a firm even surface.

Prior to filling, a depth of at least ¼ in. (6.3 mm) should be formed around the edges of low spots to avoid creating feather edges that could deteriorate prematurely. Low spots must not be filled with other materials. During installation of the setting bed the levels and surface profiles should be verified by fully compacting a small area of the setting bed.

Neoprene modified asphalt adhesives are proprietary materials that should be prepared in accordance with the manufacturer's instructions. The adhesive should be applied by trowel, brush or squeegee to achieve a uniform coat of adhesive no more than 1Ú16 in. (1.6 mm) thick over the top of the bituminous setting bed. Typical application rates are between 2 and 3 gal per 100 ft^2 (8.2 to 12.3 liters per 10.0 m^2). To ensure that sufficient adhesive is being applied, occasionally lift random pavers during installation to verify complete coating of the underside with adhesive. If too much adhesive is used it may ooze up to the surface through the joints. The adhesive should be permitted to become tacky before placing the pavers. This may take two to three hours after spreading, dependent on climatic conditions. While the adhesive is becoming tacky the installer may establish string lines to maintain the pattern.

The extent of the bituminous bed installed can be equal to two to three days of subsequent paver installation. Setting bed that is not covered by pavers should be protected from rain, dust and traffic. If any contamination or damage occurs, the affected areas of setting bed shall be removed and replaced to their full depth.

A pavement with a bituminous setting bed can provide a high level of moisture protection to the underlying materials. Initially, the bituminous setting bed will allow some water to seep through until it is fully compacted. The neoprene modified asphalt adhesive under the pavers prevents most of the surface water from penetrating into the bedding material; however, some will enter and must be able to drain out of the system. Install weeps through the asphalt base, at inlets and other low points in the pavement. The asphalt mixture is semi-permeable and should allow migration of water to weeps. Drainage openings shall be formed by drilling 1 in. (25.4 mm) diameter holes through the asphalt

base at 24" OC. Drainage openings should be filled with an open-graded aggregate to prevent their filling with setting bed material.

The pavers are laid on the adhesive working away from an edge restraint or the existing laying face while following the pattern lines that have been established. Pavers should be laid to the required pattern with 1/16 to 3/16 in. (1.6 to 4.8 mm) wide joints. The optimum joint width for vehicular traffic is between 1/16 and ⅛ in. (1.6 and 3.2 mm), but some wider joints may be required with Application PS pavers, and particularly with Application PA pavers. Application PX pavers more easily accommodate the narrower joints and herringbone pattern recommended for vehicular traffic. Lugs enable the correct joint width to be achieved when the pavers are placed in contact with one another. Pavers without lugs should not be forced together, resulting in excessive contact, because this may cause the pavers to chip during installation or use. At least two cubes of each color of pavers should be drawn from at one time, and the manufacturer's recommendations on color blending should be followed. String or chalk grid lines should be used to establish straight pattern lines. The contractor should expect the size of pavers to vary slightly from the specified size and adjust the laying module accordingly. A laying module can be established by installing a small section of pavers, adjusting the pavers for proper joint width and pattern alignment and then measuring the pavement over several feet to determine the variation from the nominal paver size. Parallel and perpendicular grid lines should be established and adjusted for the difference, set every 3 to 10 ft (0.9 to 3 meters) as needed to ensure proper pattern alignment. Closer grid line spacings should be considered when complex bond patterns are used, installers are unfamiliar with laying clay pavers, or pavers with greater dimensional variation are selected.

The pavers should be aligned before they are bonded to the tack coat or pressed into the tack coat as the installer walks on them. Cut pavers should be placed only after several square feet of surrounding whole pavers have been installed. Bench-mounted masonry saws are the best means of cutting the pavers to achieve a neat edge and a vertical cut face. Use of a wet saw or dust collection system is recommended, as the dust generated by dry sawing brick may contain silica and may be a potential health hazard. Guillotine cutters also may be used, but their cuts typically are not as straight and neat. Convex curves can be formed using multiple cuts, but this requires a skilled craftsman to meet allowable joint tolerances. Concave curves are very difficult to form and should be avoided when possible.

The spaces between pavers should be filled with sand as soon as possible after the pavers have been placed. To ensure full penetration of the jointing sand, the joints should be cleaned of all debris by using power air blowers or vacuums. To fill the joints, sweep dry joint filling sand over surface of paving until all joints are completely filled. Once the initial filling of the joints is completed, the surface of the pavers may be rolled to fully compact the pavers into place. This should be undertaken with a light rubber-tired roller with sufficient pressure to achieve a full bond to the setting bed. The roller should not be used in a vibrating mode, as this may cause cracking of the pavers. If there is significant lipping of the pavers, the surface may be protected with plywood or other suitable materials to prevent damage to the edges of the pavers. Rolling should be undertaken at the warmest part of the day, but prior to final set of the adhesive. Care should be taken to ensure that the alignment is not altered. After rolling, dry sand should be added to the joints as necessary to ensure that the sand has penetrated to the bottom of the joints. Do not vibrate the pavers after they or the sand have been placed on the setting bed. When the sand shows no sign of further settlement roll the surface prior to applying sand stabilizer. Add additional sand as necessary.

The paver manufacturer's recommendation regarding joint sand stabilizers should be followed. Jointing sand that is pretreated with a stabilizer product should be brushed or blown off the

pavement surface as soon as possible and not be allowed to become stuck in the surface texture of the pavers. If pretreated sand or a joint sand additive is used, then the stabilizer should be activated by lightly misting the surface with water. If a liquid joint sand stabilizer is used, it should be sprayed onto the pavement surface and forced into the joints with squeegees. It may be necessary to fill the tops of the joints with the liquid several times before it sets to achieve adequate penetration. The stabilizer manufacturer's instructions should be followed closely, because each stabilizer is slightly different. Probing several joints to verify that the sand is stabilized to an adequate depth of approximately two times the joint width — rather than just forming a crust — is recommended.

Base and Subbase Base and subbase materials should be placed per the design. Aggregate subbase should be compacted in accordance with ASTM D698 to 95 percent maximum density. Concrete base materials should be allowed to cure for a minimum of three days prior to paver installation and seven days prior to vehicular loads. Asphalt base materials should be installed before they cool to temperatures below 200 ºF (93 ºC). The maximum variation of the base under the setting bed should be ±3/16 in. (4.8 mm) when a 10 ft (3.05 m) straightedge is laid on the surface. The minimum slope of the base surface should be 1 in. (25.4 mm) in 4 ft (1.22 m), a 2 percent grade, to allow for drainage.

The edge restraint on the inside side of the sidewalks shall be pavers bonded to a concrete footing.

BASIS OF PAYMENT

The work under these items shall be paid at the Contractor bid prices for Item 706. And 706.1 which payment shall constitute full compensation for all equipment, tools, removal of existing brick, stacking, furnishing, subgrade and subbase, joint sand, leveling, and all components labor, and materials to perform the work described above including the addition of any new bricks required, replacement of individual bricks in poor condition.

ITEM 706.9 TEXTURIZED SYNTHETIC PAVEMENT SQUARE YARD

The work under these items shall conform to the relevant provisions of Section 701 of the Standard Specifications. The work under this item shall consist of preparing pavement surfaces and installation of ten-foot-wide Texturized Synthetic Pavement at all proposed crosswalk locations in accordance with the following:

Preparation of Asphalt Surface

The section of pavement to be replaced shall be sawcut in neat lines ten feet apart in the direction of the proposed crosswalk. The final surface pavement shall then be milled to an approximate depth of 0.75 inches. The Contractor shall immediately remove all residual material resulting from this work. All excavated material shall be disposed of by the Contractor offsite.

Installation of Texturized Synthetic Pavement

The Contractor shall be responsible for the preparation, placement and patterning of Texturized Synthetic Pavement. This synthetic paving material shall be composed of a hot-applied, resin-based compound formulated with a color stable pigment throughout that can be surface textured to simulate a brick pattern. Said pattern shall be oriented such that the continuous lines of the brick pattern shall be perpendicular to the parallel edges of the proposed crosswalk. The Contractor will be required to overlay in previously prepared recessed pavement surfaces as described above, and as required and approved by the Engineer.

The Contractor must be a manufacturer authorized applicator, experienced with this specialized system, satisfactory to the Engineer. Contractor shall furnish shop drawings, from manufacturer, to confirm design intent. A manufacturer representative shall be present at all times during the placement and curing of the textured synthetic pavement materials.

Using manufacturer prescribed methods and equipment, the Contractor shall adequately heat and uniformly mix the synthetic material(s) together. The contractor shall provide samples of all applicable colors, from the available pigments supplied by the manufacturer, to the Town for approval prior to installation. **The color shall be a brick red.** Maximum heating temperature of the completed formulation is 440 degrees Fahrenheit.

The Contractor shall then apply the heated, mixed synthetic material to the surface of the hardened, structurally sound, asphalt pavement. The synthetic material shall be spread and leveled to the desired build thickness of 0.75 inches, using manufacturer's specialized ironing tools, heated sufficiently to smooth the surface to a state of readiness for texturing. No material shall be applied when precipitation is present. No underlayment of any type shall be placed between the prepared surface to receive the overlay and Texturized Synthetic Pavement Material. The Texturized Synthetic Pavement shall be applied directly to the prepared surface to ensure a good bond.

The color and surface pattern shall be a red colored brick pattern. A 3 foot by 3 foot cured "mock up" shall be constructed for review and approval by the Engineer in consultation

with the Town.

Texturing will begin immediately after leveling has occurred, while the material is still hot enough to allow the mold selected, to adequately penetrate the surface and create the desired pattern or form.

Once the finished surface has cooled completely and has hardened to the manufacturer's specification to support vehicular and pedestrian traffic, the application area may be opened to vehicular and/or pedestrian traffic.

Any residual material resulting from this work shall be removed and disposed of in a proper manner offsite. The completed work area shall be left in a neat and clean condition, satisfactory to the Engineer.

The products used in this surfacing system shall meet the material specifications outlined below and conform to the minimum following physical and performance properties: hot-applied resin-based compound developed specifically for use on asphalt or cement concrete, with superior adhesion, flexibility and abrasion resistance characteristics, as well as color stability, chemical resistance and scrub ability.

The Contractor, during the operation of work, to save from harm and injury, any structure, public or private, situated above or below the surface and lying within the scope of the project. If during the execution of the work, the Contractor, through willfulness or carelessness, permits or causes any damage, the cost of satisfactory repair or replacement shall be the financial responsibility of the Contractor.

Synthetic Pavement Material:

The material to be utilized in the Texturized Synthetic Pavement shall conform to the following physical properties:

Grade 45

Average Temp. Range:	-5 - 110 degrees F
Wheel Tracking @ 113 F:	less than 1 mm/ hr
Wheel Tracking @ 140 F:	N/A
Density:	2.12
Cone Flow Test (5 hours @ 194 F):	15% maximum
Plane Test (5 hours @ 194 F):	5% maximum
Indent @ 194 F:	25 dmm maximum
Indent @ 122 F:	N/A
Ash Content:	90% maximum
Skid Resistance Value (**ASTM E303**):	82.6 BPN
Flash Point (**ASTM D92-05a**):	540 degrees F
Impact Resistance (**ASTM D256-06**):	13.39 in. lbs.
Durometer Hardness (**ASTM D2240-05**):	60
Specific Gravity/Density (**ASTM D790-03**):	2.15
Softening Point (**ASTM D36-00**):	295 degrees F

Equipment Required:

Contractor shall possess and be familiar with the specialized machinery necessary to perform the procedures as outlined and contained within this technical specification package, including, but not limited to, appropriate trucks, compressors, miscellaneous asphalt equipment, dispensers, applicators, cutters and/or specialized tools etc.

Method of Measurement and Basis of Payment

Texturized Synthetic Pavement shall be paid for at the Contract unit price per square yard in place, which price shall include all labor, materials, equipment and incidental costs required to complete the work as described above and to the satisfaction of the Engineer.

Sawcutting and milling of the asphalt pavement will be considered incidental to this item.

No separate payment will be made for the preparation of the “mock up”, shop drawings or attendance of the manufacturer's representative during construction. All costs in connection therewith shall be included in the unit price bid.

ITEM 707.8 BOLLARDS - STEEL EACH

DESCRIPTION

The work of this Section consists of providing and installing steel bollards as indicated on the Drawings and/or as specified herein and includes, but is not limited to, the following:

Galvanized and concrete filled steel bollards with footings, completely installed.

Excavation for bollards and footings and concrete in conformance with Section 476 of the Standard Specifications.

SAMPLES AND SUBMITTALS

At least 60 days prior to fabrication, the Contractor shall submit to the Engineer, manufacturer's shop drawings with material specifications, manufacturers literature and (where applicable) installation instructions attesting that the materials meet the requirements specified. No material shall be ordered until the Engineer has approved submittals. The Engineer shall retain the right to reject castings not conforming to this specification and/or approved submittal drawings. Delivered materials shall match approved materials.

MATERIALS

GENERAL

Steel bollards shall be fabricated from hot-dipped galvanized schedule 80 or thicker steel pipe fabricated to dimensions shown on the Drawings and indicated herein. Bollards shall be 6" nominal diameter, concrete filled steel pipe with a rounded concrete top. The bollards shall have an exposed height of 48" and shall have a 48" buried section.

Hot-dipped galvanize, priming, and galvanized paint materials for bollards shall be compatible and specified for use and application under controlled shop conditions and according to Section M7 PAINTS AND PROTECTIVE COATINGS of the Standard Specifications.

FINISH

Bollards shall be hot-dipped galvanized, primed, and painted in OSHA SAFETY YELLOW color galvanized paint

All welds and burrs shall be ground smooth and all steel hot-dipped galvanized and prepared according to manufacturer's instructions for priming and painting.

CONSTRUCTION METHODS

INSPECTIONS

Obtain inspection and approval of Engineer for of bollards at delivery to the project site and again, at layout and installation.

INSTALLATION

Bollards shall be installed even, plumb and to locations, dimensions, and elevations as shown in the Drawings, and coordinated with the Owner.

COMPENSATION

METHOD OF MEASUREMENT

Bollards will be measured PER EACH, installed complete-in-place including all labor, materials, shipping costs and equipment required or incidental for the satisfactory completion of the work, including concrete footings.

BASIS OF PAYMENT

Bollards will be paid for at the Contract Unit Price and shall include all labor and materials required until Final Acceptance.

ITEM 765. SEEDING SQ YD

Work under this item shall consist of furnishing the mix(es) specified below in the required quantity.

SUBMITTALS

1) Pre-Verification of Seed Availability. Within 30 days after the Notice to Proceed, the Contractor shall submit to the Landscape Architect the supplier's verification of availability of seed species in the required quantities and for the anticipated date of seeding. Verification shall be on the supplier's letterhead and notarized by the supplier's notary. Species not expected to be available should be noted and substitutions recommended.

2) Final Verification of Seed Availability. No earlier than 21 days prior to ordering, the Contractor shall submit to the Landscape Architect the supplier's verification of availability of seed species and in the required quantities. Verification shall be on the supplier's letterhead and notarized by the supplier's notary. Substitutions or changes in the mix at this time must be approved by the Landscape Architect.

3) Seed Worksheet provided herein shall be submitted to the Engineer prior to ordering seed to determine the number of pounds of Pure Live Seed required.

4) Seed Tags. The contractor shall submit original seed tags from each bag of seed used on the project or ensure that each tag is photo documented by the Landscape Architect while on the unopened bag.

   Number of tags submitted must correspond to number of bags delivered.

   Species listed on the seed tag shall match the Final Verification of Seed Availability (Submittal #2) unless approved otherwise. Tag must include: variety and species name; lot number; purity; percentage of inert matter; percentage of weeds, noxious seeds, and other crop seeds; germination, dormant or hard seed; total viability; origin of seed; germination test date, net weight, and name and address of seller. The origin of seed must be listed on the seed tag for all species in the mix to provide verification of original (generation 0) seed source. The smallest known geographic area (township, county, ecotype region, etc.) shall be listed. Ecotypes and cultivars shall be as close to Massachusetts as possible and appropriate to the site conditions.

   A copy of this submittal shall be forwarded to the Landscape Architect.

5) Verification of Seed Delivery. Prior to payment, contractor shall submit the Seed Delivery Verification form contained within the contract or the Supplier's Verification on company letterhead or a bill of lading. Supplier verification must include all information requested on the Verification form within this contract. The bill of lading must include variety and species name, lot number, net weight shipped, date of sale, invoice, project or seeding location, and name and address of Supplier. All information must be filled in and complete for acceptance. Information must match the seed tags and quantity of seed used on the job. A copy of this submittal shall be forwarded to the Landscape Architect.

6) Seed Sample. If requested or if seed is from a previously opened bag, the contractor may be asked to submit to the Landscape Architect a sample of seed from the seed bag (1-2 cups) at the time of seeding.

SEEDING SEASON

The appropriate seeding seasons are:

Spring: April 1 - May 15
Fall: October 1 - December 1 for dormant seeding

PERMANENT SEED MIX(ES)

Calculating Pure Live Seed (PLS)

Quantities specified are PURE LIVE SEED. Greater quantities of ordered seed may be required to achieve actual specified seeding rates.

Pure Live Seed (PLS) is defined as a percentage calculated by multiplying the percent of pure seed by the percent of viable seed (total germination, hard seed, and dormant seed). For example:

If a seed label indicates 90% purity, 78% germination, 10% hard seed, and 2% dormancy, it is calculated to be 90% x [78 + 10 + 2]% = 81% PLS.

Therefore, each pound of PLS would need 1 pound / 0.81 = 1.2 pounds of seed with a 90% purity and 90% total germination

Seed Mix(es) shall be as specified below. Ecotypes and cultivars shall be as close to Massachusetts as possible and appropriate to the site conditions.

General Lawn Area Seed Mix

Name	Minimum proportion by weight	Percent purity	Percent germination
Kentucky bluegrass	30%	87%	90%
Red Chewings Fescue	30%	98%	90%
Perennial Ryegrass	40%	98%	90%

a. Application Rate: 6lbs/ 1,000 SF or 260lbs./acre, or as recommended by supplier.

Any species substitutions shall be with a species having similar characteristics and function. Substitutions must be approved by Landscape Architect Section per the documentation submittal process.

50% Increase Adjustment for Field Conditions

Seeding under the following conditions requires a 50% increase in the permanent mix at the time of construction:

- Seeding out of season
  OR
- Seeding after Compost Blanket has been applied (unless already increased for out of season).

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

General Lawn Area Seed Mix will be measured for payment by the pound of Pure Live Seed delivered and complete in place.

General Lawn Area Seed Mix will be paid at the contract unit price per pound of Pure Live Seed delivered upon approval of all Seed Submittal Documentation. Overseeding required to correct poor germination or establishment shall be incidental to the item.

Cover crop not included as part of the permanent mix composition will be paid for under Item 765.21, Annual Cover Crop.

NATIVE SEED WORKSHEET

Project Description: _____ Project No: _____

Contractor: _____ Contract No: _____

Seed Mix Number & Description: _____

Contractor: Complete Prior To Ordering

Pounds of Seed Required Per Contract:

_____lbs./acre for _____Acre(s) OR _____ SY

Additional 50% increase if required (out of season or seeding over compost blanket):

_____**lbs. Total Seed Required**

Calculated Quantity for **P**ure **L**ive **S**eed (PLS[1]):

_____ **Total Pounds PLS**

Engineer: Verification at Time of Application

Number pounds delivered to site[2]: _____ Date(s): _____

Actual Seed Bag Tag/s Received or photo documented by Engineer: _____

[1] *PLS=% pure seed x % viable seed (total germination, hard seed, and dormant seed).*
[2]*Quantity delivered should match pounds* ***Total Pounds PLS*** *and* ***Verification of Seed Delivery****. Pounds should be shown on each Seed Tag.*

SUPPLIER VERIFICATION OF SEED DELIVERY FOR MASSDOT PROJECTS

Date_____

We hereby certify that (*Seed Supplier*):_____

Furnished to (*Contractor*): _____

For use on: (*Project Description*) _____

Project #: _____ Contract #: _____

Pounds of Pure Live Seed: _____

Of Mix (*Description*): _____

Lot Number _____

The material was delivered on (*Date*)_____.

The labels and contents meet all State and Federal regulations. The mixture consists of the following species, including cultivars (as applicable) and ecotype region, and at the following percentages (may be attached separately):

Name (print): _____ Title: _____

Supplier: _____

Signature and Seal: _____

ITEM 767.6 **AGED PINE BARK MULCH** **CUBIC YARD**

DESCRIPTION

This work shall consist of furnishing and placing aged pine bark mulch as detailed in Plans or as directed by Landscape Architect.

MATERIALS

Aged pine bark mulch shall consist of the outer bark of pine trees and a minimum of hardwood bark. Bark shall be processed by removal from the limbs and trunks of trees. Bark mulch shall be shredded pine bark aged a minimum of six months. The mulch shall be dark brown in color, free of chunks and pieces of wood thicker than 1/4 inch and shall not contain, in the judgment of the Engineer, an excess of fine particles. Do not use wood chips, recycled, dyed, wood product, or crumb rubber mulch. Mulch must be free from long stringy material.

COMPENSATION

Aged Pine Bark Mulch will be measured and paid for at the Contract unit price per Cubic Yard which price shall include all labor, materials, equipment, site preparation, and all incidental costs required to complete the work. Payment will be full compensation for furnishing, transporting, handling, and stockpiling the material specified and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

ITEM 770	**LAWN SODDING**	**SY**
ITEM 775.141	**LINDEN - AMERICAN 3-3.5 INCH CALIPER**	**EACH**
ITEM 776.545	**MAPLE - RED - OCTOBER GLORY 3-3.5 INCH CALIPER**	**EACH**
ITEM 777.037	**OAK - NORTHERN RED 3-3.5 INCH CALIPER**	**EACH**
ITEM 785.735	**INKBERRY - COMPACT 3-4 FEET / #5**	**EACH**
ITEM 795	**SEEDING**	**SY**
ITEM 796.201	**CONEFLOWER 2 GALLON**	**EACH**
ITEM 796.203	**SWITCH GRASS 1 GALLON**	**EACH**
ITEM 797.001	**COMMON YARROW - 1 GALLON**	**EACH**
ITEM 797.002	**NEW ENGLAND ASTER - 1 GALLON**	**EACH**

DESCRIPTION

The work under these Items shall conform to the applicable requirements of Section 700, Subsection 771, PLANTING TREES, SHRUBS AND GROUNDCOVER, of the Standard Specifications, except as amended and supplemented as indicated on the drawings and as specified below.

For the above items the Contractor shall provide and install plant material of genus, species, variety, size and quantities in locations as required by the Engineer. The work of this section includes, but is not limited to, the following:

A. Purchasing and transporting plant material to construction sites
B. Installation of plant material
C. Plant care during 60-day Maintenance Period and one-year Establishment Period
D. Replacement of defective or dead plants at End of Maintenance Period
E. Replacement of defective or dead plants at End of Establishment Period

Cooperation By Contractor (Supplementing Subsection 5.05)

The Landscape Contractor shall have five years continuous experience and expertise in management, handling and installation of ornamental plant material in large scale landscape construction projects. Site foreman shall have at least five years experience and shall be on-site during all times of plant installation.

Samples and Submittals

Plant Material: At least 180 days prior to anticipated planting, the Contractor shall submit a confirmation of availability for all plants on the list, accompanied by nursery sources. When the specified types and sizes of plants are not available, substitutions may be made upon request by the Contractor, if approved in writing by the Engineer. Substitutions proposed by the

Contractor shall have equivalent overall form, height, and horticultural characteristics and must be approved in writing by the Engineer prior to tagging. At least 30 days prior to planting, the Contractor shall submit a schedule for tagging material to the Engineer.

For all other materials, at least 30 days prior to ordering, the Contractor shall submit to the Engineer material specifications and (where applicable) installation instructions attesting that the following materials meet the requirements specified. No materials shall be ordered until submittals have been approved by the Engineer. Delivered materials shall match the samples.

All material samples shall include supplier's literature and certification stating that material meets specifications. Submittals, including samples, material specifications, and installation specifications are as follows

Fungal mychorrhizae: Submit sample with supplier specifications and certification.

Loam: The Contractor shall submit two 10-lb samples of loam to be used as backfill per the requirements of Section 751 of the Standard Specifications, accompanied by laboratory certified test results per the requirements of Section 751.

Backfill Mix: The contractor shall submit a 10 lb. representative sample of existing soil, which shall then be mixed with loam and tested according to the requirements specified herein. Mixing shall be done in the presence of the Engineer.

Water: Submit a watering schedule, including sources of water, methods of irrigation, and any incidental work required to provide water for the plants.

Testing Methods: The Contractor shall submit to the Engineer for his inspection and approval, equipment and methods for testing soil moisture and soil pH.

The Contractor shall provide to the Engineer two new functioning moisture gauges, including instructions for use and batteries if required, for his use during the duration of the Contract. The meters shall be hand held and shall be capable of measuring moisture at a depth of 6 inches. Meter scale shall be sufficient to determine moist, dry, or wet soil. The meters shall be regularly checked for calibration against watered loam, and shall be replaced if found faulty at no additional cost.

References and Standards

The following standards shall apply to the Work of this Section.

ASNS: "American Standard for Nursery Stock," ANSI Z-60.1, latest edition, published by American Association of Nurserymen (AAN).

Manual of Woody Landscape Plants: Their Identification, Ornamental Characteristics, Culture, Propagation and Uses. Michael Dirr. Stipes Publishing Company, latest ed.

Examination of Conditions

The Contractor shall be responsible for judging the full extent of work requirements involved. This responsibility includes, but is not limited to, the following: transportation, purchase, temporary storage and maintenance of plants; plant rehandling prior to final installation; removal

and off-site disposal of existing loam that has been determined unacceptable; purchase, transport, and supply of loam.

MATERIALS

Plant Materials

The Contractor shall furnish all plants as shown on the plans, unless otherwise directed in writing by the Engineer. All plants shall be nursery grown.

All plants shall be legibly tagged with the botanical name. Only plant stock grown within hardiness Zones 1 through 6a, as established by the USDA Plant Hardiness Zone Map, will be accepted. The Contractor's suppliers must certify in writing that the stock has actually been grown under Zone 6a or hardier conditions. Plants not so certified will not be accepted.

All plants shall be typical of their species or variety in growth habit. Plant sizes, habit, rootballs, and containers shall be in accordance with the American Standard for Nursery Stock (ASNS), Standards of the American Association of Nurserymen (AAN) as a minimum requirement for acceptance.

All plants must be moved with the root systems in soil. Balled and burlapped plants shall be wrapped with untreated 8 ounce burlap, firmly held in place by a stout cord or wire. Wire containers of adequate size to allow root development for the plant size as per ASNS requirements. Plants prepared with plastic or other non-biodegradable wrappings will not be accepted. Rootballs shall remain intact during all operations. No plant will be accepted if the rootball has been badly cracked or broken prior to, or during, the process of planting. Rootballs shall be moist upon arrival and shall be kept moist until installation. All balled and burlapped plants that cannot be planted at once must be heeled in by setting them in the ground, covering the rootballs with soil, and watering them adequately.

Container-grown stock shall have been grown in the container long enough for the root system to have developed sufficiently to hold its soil together firmly. No plants shall be loose in the container. Container-grown plants shall not be pot bound, with spiraling roots or roots growing densely against the sides of the container. Score or butterfly cut rootball of all container-grown plants prior to planting.

Each plant shall have plenty of fibrous roots, healthy buds, and shall be free of disease or insect pests, eggs or larvae. All plant parts shall show active green cambium when cut. They shall be densely foliated when in leaf.

The trunk of each tree shall be free from sun scald, frost cracks, or wounds resulting from abrasions, fire or other causes. Pruning wounds shall be no larger than 2 inches and shall show vigorous scar tissue. No trees with double-leaders or twin-heads will be acceptable without the written approval of the Engineer. No plant material from cold storage will be accepted. In regard to shrubs, no single stemmed or thin plants will be accepted. The side branches must be generous and well twigged, and the plant as a whole must be well-branched to the ground. The plants must be in a vigorous condition, free from dead wood, bruises or other root or branch injuries.

Loam Borrow

Loam borrow, sometimes referred to as loam, for planting soil mix shall be in accordance with the requirements of Standard 751 of the Standard Specifications.

Soil Amendments

Soil amendments, including ground limestone, sulfur, gypsum, and organic materials, shall meet the requirement of Loam Borrow, as described herein.

Planting Soil Mix

Planting soil for backfill shall be a mixture of equal parts approved loam and excavated material. Mixed material shall be pH tested by the Contractor in the presence of the Engineer, and adjusted according to particular planting applications, using lime or sulfur as required. For plants that require an acid soil, such as ericaceous plants and broad-leaved evergreens, planting soil shall have a true pH of 4.5 to 5.5. Planting soil for all other plants shall have a true pH value of 6.0 to 6.5. Proposed soil amendments shall be submitted to the Engineer for approval prior to application.

Bark Mulch

Bark mulch shall be shredded pine bark aged a minimum of six (6) months. The mulch shall be dark brown in color, free of chunks and pieces of wood thicker than one-quarter (1/4) inch and shall not contain, in the judgement of the Engineer, an excess of fine particles. Unless otherwise specified in these special provisions, bark mulch shall be incidental to the cost of the planting items. Do not use wood chips.

Water

The Contractor shall be responsible for furnishing his own supply of water to the site at no extra cost. All plants injured or damaged due to the lack of water, or due to the use of too much water, shall be the Contractor's responsibility to correct. Water shall be free from impurities injurious to vegetation.

Fungal Mycorrhizae

Each plant shall be planted with fungal mycorrhizae. Mycorrhizae shall include at least three species of vesicular arbuscular (endomycchorizal) fungi as well as ectomycorrhizal fungi. Mycorrhizae shall be shipped in individual dosage packets.

CONSTRUCTION METHODS

Furnishing and planting of plant material shall include, but is not limited to, the following: digging of the pits and plant beds; amendment of loam as required to produce planting soil mix; provision of soil additives for pH requirements of specific plants; provision of mycorrhizal fungi; furnishing the plants as specified; plant installation; watering and maintenance.

Seasons for Planting

Spring: Deciduous materials - March 21 through May 1

Evergreen materials - April 15 through June 1

Fall: Deciduous materials - Oct. 1 through Dec. 1
Evergreen materials - Aug. 15 through October 15

Requests for exceptions to this schedule shall be submitted in writing to the Engineer for his approval.

Plant Tagging and Approval

The Contractor shall locate, secure, tag, and ship plant material in a sufficiently timely manner to ensure minimal substitution and storage of plants.

Plants shall be tagged at least one month prior to the expected planting date. The Contractor shall be responsible for tagging the material at the nursery and providing a representative. The Contractor shall request that the Engineer provide a representative to approve tagged stock to be planted under this Section. Contractor shall tag or allow the nursery to tag material for approval of the Engineer's representative. In the event that satisfactory material cannot be located, the Contractor shall be responsible for any necessary travel and overnight accommodations for the Engineer's representative during the period of time required to locate, select, and approve plant material.

All trees and a representative sample of each shrub species on the Plant List shall be tagged by the Contractor at the nursery and approved by the Engineer or his representative, prior to digging, for conformity to specification requirements as to quality, size, and variety. Cost of replacement of materials rejected by the Engineer at the site shall be borne by the Contractor.

Approval of tagged material at the nursery shall not prevent the right of inspection and rejection upon delivery at the site or during the progress of the work.

Tree trunks shall be protected during shipping by a heavy walled cardboard sleeve or other suitable material. Plants shall either be shipped in enclosed trucks or all surfaces, leaves and branches shall be wrapped to prevent damage and desiccation.

Plant Delivery and Installation

Locations for all plants shall be approved by the Engineer before any plant pits or plant beds are dug.

The Contractor shall locate all underground utilities within 10 feet of the proposed planting pits and notify the Engineer of any conflicts prior to digging plant pits.

The Contractor shall notify the Engineer 3 working days prior to the proposed arrival of plant material on the site. All plants shall be planted within 5 days of arrival on site or shall be rejected by the Engineer. Plants stored on site shall be shaded from direct sunlight at all times and shall not be stored on paved surfaces. Plants stored on site shall be watered daily.

Planting

Prior to the installation of any plant material, the Contractor shall dig test pits to determine percolation rates. Percolation of less than 1 inch per hour shall require corrective measures as

recommended by the Contractor and approved by the Engineer.

Plant pits shall be excavated as shown on plans and the sides scarified to prevent glazed soils.

Trees and shrubs shall be placed as shown on the plans, with the root crown exposed above finished grade. After placement of balled and burlapped plants and prior to backfilling, remove all rope, wire baskets and burlap from the root balls. For container material, remove pots just before planting, and loosen the perimeter roots and soil before placement. Handle plants carefully to prevent damaging roots or stems.

Add mycorrhizal fungi per manufacturer specifications. After planting, the Contractor shall submit fungi dose packets to the Engineer to certify installation of material.

Prepare planting soil mix as specified above to depths as shown on the drawings. Place backfill mix in layers of not more than 6 inches, and water each layer sufficiently to settle soil before the next layer is put in place. Backfill mix shall meet finished grade after settlement. Shape edge of planting pit to form a saucer for holding water and place mulch as shown in the plans. Do not cover the stem flare of the plants with mulch.

Water plants immediately following planting as necessary to thoroughly moisten rootball and planting soil.

Plants shall not be wrapped after installation. Wounds shall not be painted. Trees shall not be staked unless wind or other local conditions require the additional protection. Staking and guying shall be incidental to tree installation. Use cloth tape rather than wire. The Contractor shall be responsible for removing all staking and guying materials at the end of the Maintenance Period.

Plant Care

Contractor shall provide plant care for the duration of the Maintenance and Establishment periods.

During the 60 day Maintenance Period, plants shall be inspected for watering needs at least twice each week using moisture meters supplied by the Contractor. In addition, during the portion of the Establishment period occurring between May 1 and October 1, the plants shall be inspected weekly using moisture meters.

Plant care shall consist of keeping the plants in a healthy growing condition. Plant care shall include watering, weeding, pruning, re-mulching, removal of dead material, resetting plants to proper grades or upright position, and maintaining the planting saucer.

Trees and shrubs shall be pruned, if necessary, following planting and in accordance with the American Nurserymen's Association Standards for Class I, fine pruning, to preserve the natural character of the plant. All dead wood or suckers and all broken or badly bruised branches shall be removed. Do not cut leaders.

Any decline in the condition of new plantings shall require the Contractor to take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional arborists and/or horticulturists to inspect plant materials and to identify problems and recommend corrective procedures. The Engineer shall be

immediately advised of such actions. Inspection and recommendation reports shall be submitted to the Engineer.

Absolutely no debris may be left on the site. The Contractor shall repair any damage to site as directed by the Engineer, at no additional cost.

Maintenance Period: 60 Days

The Maintenance Period shall begin immediately after each plant is planted and shall continue for a minimum of 60 days following the completion of all planting installations, or until the Conditional Acceptance of all planting work, whichever is a longer period of time.

At the end of the Maintenance Period, the Contractor will request inspection by the Engineer at least 10 days before the anticipated date of inspection.

At the time of inspection, if the plant materials and workmanship are acceptable to the Engineer, the Engineer shall issue a written Certificate of Conditional Acceptance to the Contractor. The date of the inspection shall establish the end of the Maintenance Period and the commencement of the required one-year Establishment Period for planting work.

If in the Engineer's opinion, plant materials and/or workmanship is deficient, acceptance will not be granted, and the Maintenance Period for all the plants shall be extended until plant replacements are made or other deficiencies are corrected. All dead and unsatisfactory plants shall be removed promptly from the project. Replacement plants shall conform in all respects to the Specifications for the original plants and shall be planted in the same manner.

Establishment Period: One Year

The purpose of the Establishment Period is to nurture plants through at least one full growing season and one full winter. All plants shall be inspected by the Engineer one year after Conditional Acceptance and shall be alive and in satisfactory growth at the end of that time. The Contractor is responsible for arranging inspection early enough in the season to allow adequate time to procure and install replacement material.

At the end of the Establishment Period, each plant shall show healthy growth on at least 75 percent of its terminal stems, as determined by the Engineer. Determination of healthy growth shall include, but is not necessarily limited to, viable leaves (in season) and terminal buds, as well as live cambium. Plants found to be unacceptable shall be removed promptly from the site and replaced immediately or during the next normal planting season, as permitted by the specifications.

Planted areas shall be free of weeds and debris, and plantings shall be re-mulched as necessary.

The Engineer will inspect the replacement planting work upon the request of the Contractor. Request for inspection, shall be received by the Engineer at least ten days before the anticipated date of inspection.

Stakes and guying, if any, shall be removed from all plants before Final Acceptance.

Upon acceptance of the work of replacement planting, the Engineer shall issue a written

Certificate of Final Acceptance for all plants installed under this Section to the Contractor.

COMPENSATION

ITEMS listed above will be measured PER EACH. Payment will not be approved until satisfactory completion of the Maintenance Period. The Contract unit prices paid shall be full compensation for providing materials, equipment, labor, and incidentals to provide plant pit excavation, soil preparation, soil amendments, planting mix preparation, loam for planting mix, mycorrhizal fungi planting, plant protection, bark mulch including placement), watering, maintenance, disposal of unsuitable soils, and all other incidentals required for furnishing and installing the plantings in accordance with the drawings, and as directed by the Engineer.

ITEM 797.100 DESIGN-BUILD IRRIGATION LUMP SUM

PART 1 – GENERAL

GENERAL PROVISIONS

Attention is directed to the CONTRACT AND GENERAL CONDITIONS which are hereby made a part of this Section of the Specifications.

DESCRIPTION OF WORK

Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

Design-build irrigation system.

The irrigation system shown on the Drawings and described within these Specifications represents a four controller, turf and landscape irrigation system supplied from a municipal water line within the public right of way. The system is designed for 100 gallons per minute. Minimum 90-psi dynamic pressure at full system flow is required downstream of the pressure regulating valve.

The mechanical point of connection for the irrigation system shall be a municipal water line within the public right of way. Coordinate all valves, meters and backflow preventers with Town requirements.

The electrical point of connection for the irrigation system shall coordinated with the Town as part of the design of the design-build system.

Above ground cabinets shall be provided as required for irrigation system controls, valves and backflow preventers. Final locations to be indicated on irrigation shop drawings for review.

The Drawings and Specifications must be interpreted and are intended to complement each other. The Contractor shall furnish and install all parts, which may be required by the Drawings and omitted by the Specifications, or vice versa, just as though required by both. Should there appear to be discrepancies or question of intent, the Contractor shall refer the matter to the Owner's Representative for decision, and his interpretation shall be final, conclusive, and binding.

All necessary changes to the Drawings to avoid any obstacles shall be made by the Contractor with the approval of the Owner's Representative.

Trench excavation, back filling and bedding materials, together with the testing of the completed installation shall be included in this work.

The work shall be constructed and finished in every respect in a good, workmanlike, and substantial manner, to the full intent and meaning of the Drawings and Specifications. All parts necessary for the proper and complete execution of the work, whether the same may have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

Record Drawing as well as Operating & Maintenance Manual generation, in accordance to these specifications shall also be included in this work.

ORDINANCES, PERMITS AND FEES

The Work under this Section shall comply with all ordinances and regulations of authorities having jurisdiction.

The Contractor shall obtain and pay for any and all permits, tests, and certifications required for the execution of Work under this Section.

Furnish copies of Permits, Certifications, and Approval Notices to the Owner's Representative prior to requesting payment.

The Contractor shall include in their bid any charges by the Utility Company, or other authorities for work done by them and charged to the Contractor.

SUBMITTALS

Shop Drawings: Provide copies of product specification sheets on all proposed equipment to be installed to the Owner's Representative for approval. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper nozzles, sizes, flows, etc. Equipment to be included:

Sprinkler Heads.

Valves: Manual and Automatic.

Controllers.

Irrigation Controller Enclosure

Irrigation Backflow Preventer

Water Meter

Backflow Preventer and Water Meter Cabinet

Valve Boxes.

Pipe and Fittings.

Wire and Connectors.

Quick Coupling Valves.

Rain Sensor.

Grounding Equipment.

Miscellaneous Materials.

Project Record Documents:

The Contractor shall provide and keep up-to-date a complete redlined Record Set of Drawings of the system as the project proceeds. Drawings shall be corrected daily, showing every change from the original Drawings and Specifications. Record Drawings shall specify and exactly locate sprinkler type; pop up height and nozzle for each sprinkler installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controller(s), rain sensor(s), quick coupling valves, isolation valves, and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly different graphic symbols (line types). Prints for this purpose may be obtained from Owner's Representative at cost. This redlined record set of drawings shall be kept at job site and shall be used only as a record set.

This redlined set of documents shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. This record set of drawings shall be available at all times for observation and shall be kept in a location designated by Owner's Representative. Should this record set of drawings not be available for review or not be up-to-date at the time of the observation, it will be assumed no work has been completed. Provide copies of the redlined record set of drawings for Owner's Representative review on a monthly basis.

Make neat and legible notations on this record set of drawings daily as the work proceeds, showing the work as actually installed. For example, should a piece of equipment be installed in a location that does not match the plan, indicate that equipment in a graphic manner in the location of installation and so as to match the original symbols as indicated in the irrigation legend. Should the equipment be different from that specified, indicate with a new graphic symbol both on the drawings and the irrigation legend. The relocated equipment dimensions and northing and easting coordinates should then be transferred to the appropriate drawing in this record set of drawings at the proper time.

On or before the date of final field observation, deliver corrected and completed AutoCAD computer plots of "record drawings" on vellum and AutoCAD electronic files on disk to Owner's Representative as part of contract closeout. Delivery of plots will not relieve Contractor of the responsibility of furnishing required information that may have been omitted from the prints.

QUALITY ASSURANCE

Installer: A firm which has at least five years experience in work of the type and size required by this Section and which is acceptable to the Owner's Representative.

References: The Contractor must supply three references for work of this type and size with their bid including names and phone numbers of contact person(s).

Applicable requirements of accepted Standards and Codes shall apply to the Work of this Section and shall be so labeled or listed:

American Society for Testing & Materials (ASTM).

ASTM: A536 Ductile Iron Castings.

ASTM: D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

ASTM: D1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and Cl200.

ASTM: D2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ASTM: D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

ASTM: D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

ASTM: F477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

ASTM: D2737-99 Polyethylene (PE) Pressure rated tube.

National Plumbing Code (NPC).

National Electric Code (NEC).

National Sanitary Foundation (NSF).

American Society of Agricultural Engineers (ASAE).

Underwriters Laboratories, Inc. (UL)

Occupational Safety and Health Regulations (OSHA).

TESTS

Observation: The Owner's Representative will be on site at various times to insure the system is being installed according to the Specifications and Drawings.

Coverage Test: After completion of the system, test the operation of entire system and adjust sprinklers as directed by the Owner's Representative. Demonstrate to the Owner's Representative that all irrigated areas are being adequately covered. Furnish and install materials required to correct inadequacies of coverage due to deviations from the Drawings or where the system has been willfully installed when it is obviously inadequate or inappropriate without bringing it to the attention of the Owner.

The Owner's Representative shall be notified 72 hours in advance for observations.

During final observation, the contractor shall be responsible for having two-way communication and sufficient personnel to provide instantaneous communication between the observation area and the controller for the system.

DELIVERY, STORAGE AND HANDLING

Store and handle all materials in compliance with manufacturer instructions and recommendations. Protect from all possible damage. Minimize on-site storage.

COORDINATION

The Contractor shall at all times coordinate his work closely with the Owner's Representative to avoid misunderstandings and to efficiently bring the project to completion. The Owner's Representative shall be notified as to the start of work, progression, and completion, as well as

any changes to the drawings before the change is made. The Contractor shall also coordinate his work with that of his sub-contractors.

The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work, workmen, or sub-contractors. Repairing of such damage shall be done by the Contractor who installed the work, as directed by the Owner's Representative.

GUARANTEE

The Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities that the Contractor may have by law.

In addition to the manufacturers guarantees the Contractor shall warrant the entire irrigation system, both parts and labor for a period of one year from the date of acceptance by the Owner.

As part of the one-year warranty the Contractor shall perform the first year-end winterization and spring start-up for the irrigation system.

Should any problems develop within the warranty period because of inferior or faulty materials or workmanship, they shall be corrected to the satisfaction of the Owner's Representative at no additional expense to the Owner.

A written warranty showing date of completion and period of warranty shall be supplied upon completion of each segment of the project.

MAINTENANCE AND OPERATING INSTRUCTIONS

Contractor shall include in their Bid an allowance for four (4) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Owner's Representative office shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3) three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE IRRIGATION SYSTEM, shall be submitted to the Owner's Representative office. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:

Table of Contents.

Written description of Irrigation System.

System drawings:

One copy of the original irrigation plan.

One copy of the Record Drawing.

One reproducible of the Record Drawing.

One copy of the controller valve system wiring diagram.

Listing of Manufacturers.

Manufacturers' data where multiple model, type and size listings are included; clearly and conspicuously indicating those that are pertinent to this installation.

"APPROVED" submittals of all irrigation equipment.

Operation and Maintenance: including complete troubleshooting charts.

Parts list.

Names, addresses, and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each area under "no-rain" conditions.

Winterization and spring start-up procedures.

Guarantee data.

PROCEDURE

Notify all municipal departments and/or public utility owners concerned, of the time and location of any work that may affect them. Cooperate and coordinate with them in the protection and/or repairs of any utilities.

Provide and install temporary support, adequate protection, and maintenance of all structures, drains, sewers, and other obstructions encountered. Where grade or alignment is obstructed, the obstruction shall be permanently supported, relocated, removed, or reconstructed as directed by the Owner's Representative.

PART 2 - PRODUCTS

GENERAL

All materials to be incorporated in this system shall be new and without flaws or defects and of quality and performance as specified and meeting the requirements of the system. All material overages at the completion of the installation are the property of the Contractor and shall be removed from the site.

No material substitutions from the irrigation products described in these specifications and shown on the drawings shall be made without prior approval and acceptance from the Owner's Representative.

PVC IRRIGATION PIPE

All pipe shall bear the following markings: Manufacturer's name, nominal pipe size, schedule or class, pressure rating in psi, and date of extrusion.

All lateral pipe, 1-1/2 inch and 2-inch in size, as indicated on the drawings shall be PVC, Class 200, Type 1120, SDR 21, Solvent-Weld PVC, conforming to ASTM No. D2241 as manufactured by Certainteed, Cresline, JM or equal.

All mainline pipe, 3-inch in size, shall be PVC, Class 200, Type 1120, SDR 21, Gasket-Joint PVC, conforming to ASTM No. D2241 as manufactured by Certainteed, Cresline, JM or equal.

The pipe insertion mark shall be visible to show the proper depth into spigot.

PVC IRRIGATION FITTINGS

Fittings for solvent weld PVC pipe, 2-1/2 inch and smaller in size, shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.

Fittings shall bear manufacturer's name or trademark, material designation, size, and applicable I.P.S. schedule.

All PVC threaded connections in and out of valves shall be made using Schedule 80 toe nipples and Schedule 40 couplers or socket fittings. Schedule 40 threads will not be approved for installation.

PVC solvent shall be NSF approved, for Type I and Type II PVC pipe, and Schedule 40 and 80 fittings. Cement is to meet ASTM D2564 and FF493 for potable water pipes. PVC solvent cement shall be Rectorseal Gold, IPS Weld-ON 711, Oatey Heavy Duty Cement or equal, and shall be used in conjunction with the appropriate primer. Primer shall be NSF approved, and formulated for PVC and CPVC pipe applications. Primer is to meet ASTM F 656. Primer shall be Rectorseal Jim PR-2, IPS Weld-ON P-68 Clear, Oatey Clear Primer for PVC and CPVC, or equal.

Fittings for PVC main line pipe, for all directional changes, pipe reductions and plugs 3-inch and larger in size shall be deep bell push-on gasket joint ductile iron fittings for PVC pipe. Fittings shall be manufactured of ductile iron, grade 70-55-05 in accord with ASTM A536 and gaskets shall meet ASTM F477. Fittings shall be as manufactured by Harrington Corporation, Harco, or equal. For main line pipe to zone valve / lateral pipe connections, Harco or equal push-on gasket joint ductile iron service tees shall be used. Saddles, (strap, bolt down or snap) will not be approved for installation.

All nipples to be schedule 80 PVC.

POLYETHYLENE IRRIGATION PIPE

Lateral piping, 1-1/4 inch and 1-inch in size, as indicated on the drawings shall be polyethylene (PE3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Oil Creek or equal. Polyethylene pipe shall only be used in landscape areas.

POLYETHYLENE IRRIGATION FITTINGS

Fittings for polyethylene pipe shall be insert PVC or Nylon type fittings. Fittings shall conform to NSF standards and be attached with two (2) dog-eared stainless steel clamps. Clamps shall be as manufactured by Oetiker or approved equal.

Supply only pipes and fittings that are marked by the manufacturer with the appropriate ASTM designations and pressure ratings and are free from cracks, wrinkles, blisters, dents or other damage. Fittings shall be per ASTM D2609 as manufactured by Dura, Lasco or approved equal.

PVC PIPE SLEEVES

All pipe sleeves beneath non-soil areas shall be PVC, Class 160 water pipe as manufactured by Certainteed, Cresline, JM or equal. Minimum sleeve size to be 3-inch.

WIRE CONDUIT

Conduit for wiring beneath non-soil areas shall be PVC, SCH-80 conduit with solvent-weld joints, as manufactured by Certainteed, Cresline, JM or equal.

Sweep ells shall be standard electrical type PVC schedule 40 long sweep elbows. Cap sweep ell with tri-plug with the ring for securing nylon pull rope.

Conduit for above ground wiring to rain sensors or controllers shall be galvanized, rigid metallic conduit.

SPRAY SPRINKLERS

Full and part circle pop up spray sprinklers shall be pressure regulating, plastic construction with ratcheting riser, removable nozzle and check valve. Nozzle size shall be as indicated on the drawing and in the legend. Pop-up height shall be 4 inches for turf and 12 inches for ground cover, shrubs, and annual beds.

Sprinkler shall carry a minimum 3-year exchange warranty against defects. Sprinklers shall be manufactured by Rain Bird, model 1800-SAM-PRS or approved equal.

ROTARY SPRINKLERS

Full and part circle small rotary sprinklers to be plastic in construction equipped with drain check valve, adjustable arc and ratcheting riser. Pop up heights shall be 4 inch. Nozzles to produce radius and flows indicated on the "Approved Performance Chart" below. Sprinklers shall have a one hundred percent warranty for three years minimum against defects in workmanship.

The nozzle assembly shall elevate minimum four inches when in operation and retraction shall be achieved by a stainless steel spring. Riser assembly shall be plastic. A nozzle wiper seal shall be included in the sprinkler for continuous operation under the presence of sand and other foreign material.

All sprinkler parts shall be removable through the top of the unit through the removal of a heavy-duty threaded cap. The sprinkler shall have a three quarter-inch (3/4") IPS water connection on the bottom of the sprinkler.

Sprinklers shall be manufactured by Hunter Industries model I20-ADV and I-20-36V or approved equal.

Approved Performance Chart:

Model	Pressure	Arc	Nozzle	Flow	Radius
Hunter I20-ADV	50psi	90 Deg.	.75SR	0.75	25’
Hunter I20-ADV	50psi	180 Deg.	1.5SR	1.5	25’
Hunter I20-36V	50psi	360 Deg.	1.5SR	1.5	25’
Hunter I20-ADV	50psi	90 Deg.	2.0LA	2.1	28’
Hunter I20-ADV	50psi	180 Deg.	2.5LA	2.8	33’
Hunter I20-36V	50psi	360 Deg.	2.5LA	2.8	33’
Hunter I20-ADV	50psi	90 Deg.	2.0	2.0	36’
Hunter I20-ADV	50psi	180 Deg.	3.5	3.4	40’

SWING JOINTS

Spray sprinklers and rotary sprinkler shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

ELECTRIC CONTROL VALVES

Electric control valves shall be one, one and one half and two-inch remote control, diaphragm type, fiberglass, or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 200 psi pressure rating.

Valves shall be manufactured by Rain Bird model PEB, Hunter Industries model ICV or approved equal.

PRESSURE REGULATING DIALS

Pressure regulating dials for electric zones valves shall have the same manufacturer as the electric control valves. Rain Bird model PRS-D, Hunter model Accu-Set or approved equal.

QUICK COUPLING VALVES

The valve body shall be of cast brass construction with a working pressure of 125 psi. The valve seat disc plunger body shall be spring loaded so that the valve is normally closed under all conditions when the key is not inserted.

The top of the valve body receiving the key shall be equipped with a single slot and smooth face to allow the key to open and close the valve slowly with a one-half turn. The quick coupling valve shall be equipped with a vinyl cover.

The valve body construction shall be such that the coupler seal washer may be removed from the top for cleaning or replacement without disassembling any other parts of the valve.

Keys shall be single lug with 1-inch male thread and 3/4-inch female thread at the top.

Contractor shall provide two (2) keys for quick couplers and two (2) 1-inch x 1-inch swivel hose ells.

Quick coupling valves, keys and swivels shall be manufactured by Bird models 5RC, 55K-1 and SH-2, Hunter Industries, model QCV-100, QCV-100K and HS-100 or approved equal.

QUICK COUPLING VALVE SWING JOINTS

Quick coupling valves to be installed on one-inch brass swing joint, minimum 12-inches in length with Leemco model LS-120 stabilizer (unless stabilizer is an integral part of the quick coupling valve). Brass swing joints are not prefabricated and shall be assembled with nipples and street elbows.

Brass fittings shall be cast bronze, screwed, 125lb. Class.

ISOLATION VALVES

Isolation valves, 3 inches in size, shall be cast iron epoxy coated inside and outside, long bell length ring-tite valves, 200 psi rated, ductile iron gland flange, bronze stem-seal box, o-ring stem seal replaceable under pressure, stainless steel stem, 2 inch operating nut and replaceable disc conforming to AWWA C-509 as manufactured by Nibco, Model P-619-RW or approved equal.

VALVE BOXES

All valve boxes shall be manufactured from unformed resin with a tensile strength of 3,100-5,500 psi conforming to ASTM D638. All boxes and lids shall be green in color.

Valve boxes for single electric valves, isolation valves and quick coupling valves shall be 10-inch round valve boxes with metal detection and bolt down covers.

Valve boxes for dual electric valves shall be 12-inch standard valve boxes with metal detection and bolt down covers.

Valve boxes for wire splices shall be 10-inch round valve boxes with metal detection and bolt down covers. All splices shall be in separate valve boxes and not included with isolation valves.

Valve box extensions shall be provided and installed as required for proper box depth. Valve box extensions shall be made by the same manufacturer.

Valve boxes shall be manufactured by Highline Products (formerly Armor) or approved equal.

AUTOMATIC CONTROLLER

Controller shall be electronic in construction with capability of up to 10 hour run times per zone in increments of 1 or 10 minutes. Controllers to have minimum two independent programs, auto/off switch and be capable of manual, semi-automatic and automatic operation. Controller shall have water budgeting feature, sensor input terminal, locking, weather resistant plastic cabinet and internal transformer. Terminal strip connection shall be easily accessible. The controller shall be U.L. listed, 120 volt, 60 Hertz, A.C. type.

Controller shall be as manufactured by Hunter Industries model ICC-xxxxM or approved equal.

CONTROLLER ENCLOSURE

Irrigation controller shall be installed in new cast aluminum cabinet. Cabinet shall be constructed of aluminum allay with composition A356-2, primed and painted, with minimum wall thickness of 3/16-inches.

Cabinet door shall be weatherproof with a neoprene gasket, cemented in recess groove in the body.

Minimum required cabinet dimensions shall be 29"Wide x 15"Deep x 48"High.

Cabinet shall be as manufactured by Allay Castings Company, Inc. (East Bridgewater, MA), model ACCC-1.

WATER METER

Water meter shall be sized as per the drawings and per Town requirements.

BACKFLOW PREVENTION DEVICE

Back flow prevention device shall be sized as per the drawings and as per Town requirements. Back flow prevention device shall have maximum 12-psi pressure loss at system flow.

Back flow prevention device shall be as manufactured by Watts model LF009-QT-S or approved equal.

BACKFLOW ENCLOSURE

Backflow prevention device/meter enclosures shall be of a vandal and weather resistant nature manufactured entirely of epoxy coated steel with a minimum wall thickness of one-eighth inch. Box color shall be black. Painting process shall include sand blasting, followed by epoxy primer and then painted with a black urethane enamel top coat paint.

Enclosure shall anchor to the concrete and have a lockable front access panel for equipment servicing as per the installation details.

Enclosure shall be approximately 36 inches high, 24 inches wide and 38 inches long with a 2-inch internal base lip for anchoring with ¾-inch x 2-3/4 inches long 304 stainless steel wedge anchors. Unit shall be as manufactured by Welch Manufacturing, Chelmsford, Mass or equal.

GROUNDING EQUIPMENT

Each controller shall include factory-installed and factory-recommended lightning protection and shall be connected to a 5/8-inch diameter x 10-foot long copper clad grounding rods with minimum #6 AWG, solid, bare copper wire, and 4-inch x 96-inch x 0.0625-inch copper grounding plates as outlined below. Minimum 20-foot separation between rod and plate. Minimum 12-foot separation between controller and ground rod. All connections to rods shall be with Cadweld connectors as specified. All connections to plates shall be performed by the plate manufacturer (Paige #182199L) with 25-feet of bare copper wire already attached. Each grounding rod is to be covered by a 4-inch round, grated top, plastic valve cover with metal detection and six inches of 4-inch ADS drainage pipe. Plates shall be installed in ground enhancement material. Plates shall be covered with 4-inch plastic grated cover with detection and minimum 36 inches of 4 inch ADS drainage pipe. Ground rods and plates shall be UL listed.

Each controller shall be grounded to one rod and one plate. The 10-foot rod shall be installed penetrating into the soil to its full length. Plate shall be installed at a 36-inch depth with 50 lbs of Power Set ground enhancement material spread evenly below the plate and 50 lbs spread evenly above the plate in accordance with manufacturer's requirements. The grounding electrodes shall be installed at least 10 feet from wires connected to the controllers. Each controller shall have a separate grounding system.

WIRE

All wire shall be single strand, solid copper, UL- approved direct burial AWG-U.F. 600V and shall meet all state and local codes for this service. Valve control wire shall be minimum #14-awg, common wire shall be minimum #12-awg. *Individual wires must be used for each zone valve.*

All common wire shall be white in color with colored stripes as indicated below. White wire shall be used only for common wires.

Control wire for Controller "A" shall be red in color, spare wires for Controller "A" shall be pink in color and common wire for Controller "A" shall be white with a red stripe.

Control wire for Controller "B" shall be brown in color, spare wires for Controller "B" shall be yellow in color and common wire for Controller "B" shall be white with a brown stripe.

Control wire for Controller "C" shall be dark blue in color, spare wires for Controller "C" shall be light blue in color and common wire for Controller "C" shall be white with a dark blue stripe.

Control wire for Controller "D" shall be purple in color, spare wires for Controller "D" shall be yellow in color and common wire for Controller "D" shall be white with a purple stripe.

In ground wire connections shall be UL listed, manufactured by 3M, model DBY-6 splice kits. All wire splices shall be made in valve boxes, at controller, or at valves.

Wire type and method of installation shall be in accordance with local codes for NEC Class II circuits of 30-volt A.C. or less.

AUTOMATIC RAIN SENSOR

Rain sensor shall be plastic in construction with adjustable interruption point, 1/2-inch IPS threads, and stainless steel vandal resistant guard. Rain sensor shall be manufactured by Hunter Industries, model Rain-Clik or approved equal with sensor guard.

CRUSHED STONE

Crushed Stone, for use under valve boxes: Refer to Earthwork specifcation.

SAND

Sand, for backfilling of trenches, under, around and over PVC lines: Refer to Section 02300, Earthwork.

THRUST BLOCKS

Standard concrete mix shall be in accordance with ASTM C150, ASTM C-33, and ASTM C-94 with a compressive strength (28 days) of 3,000 psi.

All bell and gasket mainline pipe and fittings shall have thrust blocks sized and placed in accordance with pipe manufacturer's recommendations for standard concrete mix. Thrust blocks shall be installed at all tees, elbows, crosses, reducers, plugs, caps, and valves. Contractor shall be responsible to insure the stability of all thrust blocks.

SPARE PARTS

Contractor shall supply the following tools and equipment to the Owner's Representative before final observation:

Two wrenches for disassembling and adjusting each type of sprinkler head provided.

Four quick coupler key assemblies.

One of each type of gate valve used in the project.

Two of each type sprinkler head and pattern (PC & FC) used in the project.

Two of each type nozzle used in the project.

Before final observation can occur, written evidence that the Owner's Representative has received the tools and equipment must be shown to the Owner.

PART 3 – EXECUTION

GENERAL

Before work is commenced, hold a conference with the Owner's Representative to discuss general details of the work.

Examine all contract documents applying to this Section noting any discrepancies and bringing the same to the attention of the Owner's Representative for timely resolution.

All work indicated on Drawings shall be provided whether or not specifically mentioned in the Specifications.

If there are ambiguities between Drawings and Specifications, and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by Owner's Representative and Contractor shall comply with the decisions. In the event the installation contradicts the directions given, the installation shall be corrected by Contractor at no additional cost to Owner.

Verify dimensions and grades at job site before work is commenced. Do not proceed with installation of the landscape irrigation system when it is apparent that obstructions or grade differences exist or if conflicts in construction details. Legend or specific notes are discovered. All such obstructions, conflicts, or discrepancies shall be brought to the attention of the Owner's Representative.

Make all field measurements necessary for the work noting the relationship of the irrigation work to the other trades. Coordinate with other trades (landscaping and other site work trades). Project shall be laid out essentially as indicated on the Irrigation Plans, making minor adjustments for variations in the planting arrangement. Major changes shall be reviewed with the Owner's Representative prior to proceeding.

Layout of sprinkler lines indicated on Drawings is diagrammatic only. Location of sprinkler equipment is contingent upon and subject to integration with all other underground utilities. Contractor shall employ all data contained in the Contract Documents and shall verify this information at the construction site to confirm the manner by which it relates to the installation.

Coordinate installation of all sprinkler materials, including pipe, to avoid conflict with the trees, shrubs, or other plantings.

During progress of work, a competent superintendent and all assistants necessary shall be on site. All shall be satisfactory to the Owner's Representative. The superintendent shall not be changed, except with the consent of the Owner's Representative, unless that person proves unsatisfactory and ceases to be employed. The superintendent shall represent the Contractor in his absence and all directions given to the superintendent shall be as binding as if given to the Contractor.

At all times, protect existing irrigation, landscaping, paving, structures, walls, footings, etc. from damage. Any inadvertent damage to the work of another trade shall be reported at once.

Replace, or repair to the satisfaction of the Owner, all existing paving disturbed during course of work. New paving shall be the same type, strength, texture, finish, and be equal in every way to removed paving.

PIPE AND FITTINGS INSTALLATION

Using proper width trencher chain, excavate a straight (vertical) and true trench to a depth of 2-inch of pipe invert elevation.

Loam or topsoil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is

excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

Pipe shall be laid on undisturbed trench bottom provided suitable base is available - no rock larger than 1-inch or sharp edges; if not, excavate to 2-inch below pipe invert and provide and install sand base or crushed stone upon which to lay pipe.

Back filling shall be accomplished as follows: the first 10-inch of backfill material shall contain no foreign matter and no rock larger than 1-inch in diameter. Carefully place material around pipe and wire and tamp in place. Remainder of backfill shall be laid-up in 6-inch (maximum) lifts and tamped to compaction with mechanical equipment. Compact backfill in trenches to dry density equal to the adjacent undisturbed soil, and conform to adjacent grades without dips, sunken area, humps, or other irregularities. Frozen material shall not be used for backfill.

Do backfilling when pipe is cool. During hot weather keep pipe cool by backfilling in the early part of the morning before the heat of the day.

Do not, under any circumstances, use truck wheels or flooding for compacting soil.

Restore grades and repair damage where settling occurs.

Clean bell and spigot ends and make all gasketed joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of lubricant, and wiping off any excess lubricant from each connection. Maximum deflection per joint shall not exceed manufacturer's recommendations.

Make all solvent-weld joints in strict accordance with manufacturer's recommendations, making certain not to apply an excess of primer or solvent, and wiping off excess solvent from each connection. Allow welded joints at least 15 minutes set-up/curing time before moving or handling. When the temperature is above 80º F, allow connections to set minimum 24 hours before pulling or pressure is applied to the system. When temperature is below 80º F, follow manufacturer’s recommendations. Provide and install for expansion and contraction as recommended. Wire shall be laid in same trench as mainline and at pipe invert (see Wire Installation).

Mainline pipe shall have minimum 22 inches of COVER (excavate to invert as required by pipe size). Lateral pipe shall have minimum 16 inches of COVER for PVC and 12 inches of cover for Polyethylene (excavate to invert as required by pipe size).

Cut plastic pipe with handsaw or pipe-cutting tool, removing all burrs at cut ends. All pipe cuts are to be square and true. Bevel cut end as required to conform to Manufacturer's Specifications.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. At times, when installation of the piping is not in progress, the open end(s) of the pipe shall be closed by a watertight plug or other means. All piping, which cannot temporarily be joined, shall be sealed to make as watertight as possible. This provision shall apply during the lunch hour as well as overnight. Pipe not to be installed that day shall not be laid out. Should water enter the trench during or after installation of the piping, no additional piping may be installed or back filled until all water is removed from the trench. Pipe shall not be installed when water is in the trench, when precipitation is occurring, or when the ambient temperature is at 40º F or below. Pipe installed at temperatures below 40º F shall be removed

and replaced at no cost to the Owner. PVC pipe shall be snaked in the trench to accommodate for expansion and contraction due to changes in temperature.

In installing irrigation pipe the Contractor shall route the pipe as necessary to prevent damage to tree roots. Where trenching must occur near trees, the Contractor shall provide proper root pruning and sealing methods to all roots 1-inch and larger.

Maintain 6-inch minimum clearance between sprinkler lines and lines of other trades. Do not install sprinkler lines directly above another line of any kind.

Maintain 1-inch minimum between lines which cross at angles of 45 to 90 degrees.

Exercise care when excavating, trenching, and working near existing utilities.

Throughout the guarantee period it will be the responsibility of the Contractor to refill any trenches that have settled due to incomplete compaction.

Pulling of pipe will be allowed provided soil is suitable and specified depth of bury can be maintained.

THRUST BLOCKING

All ringtite bell-end fittings shall be blocked with an adequately sized thrust block as per ASAE Standard S376.1 and as depicted in the details. Blocking shall be in accordance with pipe and fitting manufacturer's recommendations. Thrust blocks shall be required at all changes in size and direction of bends, reducers, plugs, and tees. Thrust blocks shall be installed against undisturbed soil in all cases. Concrete thrust blocks shall utilize 3,000-psi standard concrete mixture. Bricks, stones, boulders, etc. will not be accepted as thrust blocks or thrust block material. Sackcrete will not be permitted as a thrust blocking material. Contractor to supply all material needed for thrust blocking.

Size of thrust block shall be determined by working pressure, size, and type of fitting, and soil conditions. Calculate area required for concrete thrust block in contact with soil. Refer to fittings manufacturer’s thrust block sizing table to determine size of thrust block for each condition.

Ensure stability of thrust blocks.

Under no circumstances will concrete block be approved for thrust blocks including for 2-inch fittings.

PIPE SLEEVING INSTALLATION

Sleeving shall be installed wherever piping is going under a non-soil area, generally where indicated on the Drawings. Minimum cover over all sleeving pipe shall be 24 inches as shown on the detail.

Sleeving shall extend 18 inches beyond edges of walls and pavement.

ELECTRICAL WIRE CONDUIT INSTALLATION

Electrical conduit shall be installed in all non-soil areas, as well as for all above ground wiring where wire passes under or through walls, walks and paving to controllers and rain sensor.

Conduit shall extend 18 inches beyond edges of walls and pavement.

SPRINKLER INSTALLATION

Spray sprinklers, small rotary sprinklers and medium rotary sprinklers shall be installed flush (perpendicular) to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

Large rotary sprinklers shall be installed flush to grade on 1-inch prefabricated PVC unitized swing joint assemblies with integral o-rings, minimum length 12 inches.

Sprinklers shall not exceed maximum spacing indicated.

Adjust sprinkler zone after installation using flow control device on valve.

ELECTRIC CONTROL VALVE INSTALLATION

Control valves shall be installed on a level crushed stone base. Grade of bases shall be consistent throughout the project so that finish grades fall within the limits of work. Valves shall be set plumb with adjusting handle and all bolts, screws and wiring accessible through the valve box opening. Valves shall be set in a plumb position with 24-inch minimum maintenance clearance from other equipment.

Install at sufficient depth to provide more than 6-inch, nor less than 4-inch cover from top of valve to finish grade.

INSTALL PRESSURE REGULATING DIAL ON ALL ROTARY SPRINKLER ZONES.

Adjust zone valve operation after installation using flow control device on valve.

QUICK COUPLING VALVE INSTALLATION

Provide and install quick coupling valves where indicated on the Drawings.

Quick coupling valves to be mounted on 1-inch brass swing joint with stabilizer as per details.

ISOLATION VALVE INSTALLATION

Install isolation valves per detail where indicated on the Drawings. Install all isolation valves on a level crushed stone base so that they can be easily opened or closed with the appropriate valve wrench. Install specified valve box over each isolation valve.

Check and tighten valve bonnet packing before valve box and backfill installation.

Provide and install thrust blocks for ring-tite valves as per detail.

VALVE BOX INSTALLATION

Furnish and install a valve access box for each electric valve, quick coupling valve, isolation valve, flushing valve, air relief valve and wire splice.

All valve access boxes shall be installed on a minimum 4-inch crushed stone base. Finish elevation of all boxes shall be at grade. All crushed stone to be supplied by the Contractor and installed before valve box. Crushed stone shall not be poured into previously installed valve boxes.

AUTOMATIC CONTROLLER INSTALLATION

Contractor to install controller on wall in garage generally where shown on the drawings. Contractor to wire valves and rain sensor into controller and set proper program.

Wire controller to 120-volt electrical supply provided and installed to the controller locations by Division 16, Electrical.

Keys shall be turned over to Owner's Representative.

GROUNDING INSTALLATION

Each grounding rod shall be driven into the ground its full length within 8-feet of the controller and connected via a Cadweld connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch grated cover as specified, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe. Plates shall be installed 36 inches below grade with 50 lbs of Power Set ground enhancement material spread evenly below the plate and 50 lbs of Power Set ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plates shall also be covered with a 4 inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe.

Each controller shall have separate grounding. Grounding rods shall be separated a minimum of 20 feet between grids. Grids shall be installed in an irrigated area.

WIRING INSTALLATION

Wiring shall be installed along with the main line. Multiple wire bundles shall be cinched together at maximum 12-foot centers using plastic cable cinches and shall be laid beside, and at the same invert as, the irrigation lines. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box. Each valve shall have a separate wire back to the controller.

All wire shall be laid in trenches and shall be carefully back-filled to avoid any damage to the wire insulation or wire conductors themselves. In areas of unsuitable material, the trench shall have a 2 inches layer of sand or stone dust on the bottom before the wires are laid into the trench and back-filled. The wires shall have a minimum of 12 inches of cover. Wire not to be installed that day shall not be laid out.

An expansion curl shall be provided and installed within 6 inches of each wire connection to a solenoid and at least every 100 feet of wire length on runs more than 100 feet in length. Expansion curls can be formed by wrapping five turns of wire around a 1-inch diameter or larger pipe and then withdrawing the pipe.

Service wiring in connection with Drawings and local codes for 24-volt service. All in-ground wire connections shall be waterproofed with 3M DBY-6 splice kits. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box-valve box shall be used.) Splice locations shall be shown on the Record Drawings.

Contractor shall provide a complete wiring diagram showing wire routing for the connections between the controller and valves. See section one for the inclusion of wiring diagram in operation and maintenance manuals.

RAIN SENSOR INSTALLATION

Install rain sensor on exterior building wall, generally where indicated on the drawings. Coordinate final location of rain sensor with Owner's Representative. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray.

Each controller shall have one rain sensor.

Install rain sensor wiring within 1/2-inch conduit where exposed. All above ground wires shall be installed in conduits.

WATER METER INSTALLATION

Water meter and curbside shut off valve shall be coordinated with Town requirements. All charges, fees and coordination for this installation are the responsibility of the Company performing the work under contract.

BACKFLOW PREVENTION INSTALLATION

Install reduced pressure back flow prevention assembly in above grade enclosure as specified. Back flow installation shall be in accordance with the Town requirements.

BACK FLOW / CONTROLLER ENCLOSURE INSTALLATION

Install enclosures on concrete pads as indicated on the detail, generally where indicated on the drawings. Final location of enclosures shall be coordinated with the Owner's Representative as to best screen the enclosure and deter vandalism. Final location shall also be coordinated with utility department to ensure proper placement of water supply line.

Concrete pad for back flow enclosure shall be 48 inches long by 36 inches wide by 8 inches deep.

Concrete pad for controller enclosure shall be 38 inches long by 24 inches wide by 6 inches deep.

Install one (1) 1-inch sweep elbow (power), one (1) 1-1/2-inch sweep elbow (ground), and one (1) 3-inch sweep elbow (field wiring) through concrete pad into controller enclosure as per detail.

CHECK/TEST/START-UP/ADJUST

Flushing:

After all piping, valves, sprinkler bodies, pipe lines and risers are in place and connected, but prior to installation of sprinkler internals, open the control valves and flush out the system under a full head of water.

Sprinkler internals and nozzles shall be installed only after flushing of the system has been accomplished to the full satisfaction of the Owner's Representative.

Contractor shall be responsible for flushing the entire system after installation is complete and will be responsible for any clogged nozzles for 30 days after substantial completion of this portion of the landscape irrigation system.

Testing:

Leakage test: test all lines for leaks under operating pressure. Repair all leaks and re-test.

Coverage test: perform a coverage test in the presence of the Owner's Representative (notify Owner's Representative at least seven (7) days in advance of scheduled coverage test). Representative will determine if the water coverage is complete and adequate. Readjust heads and/or head locations as necessary or directed to achieve proper coverage.

All testing shall be at the expense of the Contractor.

CLEANING AND ADJUSTING

At the completion of the work, all parts of the installation shall be thoroughly cleaned. All equipment, pipe, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge which may have accumulated by the operation of the system for testing.

Adjust sprinkler heads, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by mowing operations.

Continue sprinkler coverage adjustment as required by settlement, etc., throughout the guarantee period.

Each control zone shall be operated for a minimum of 5 minutes and all heads checked for consistency of delivering water. Adjustments shall be made to sprinklers that are not consistent to the point that they match the manufacturer's standards. All sprinklers, valves, timing devices or other mechanical or electrical components, which fail to meet these standards, shall be rejected, replaced and tested until they meet the manufacturer's standards.

ACCEPTANCE AND OPERATION BY OWNER

Upon completion of the work and acceptance by the Owner, the Contractor shall be responsible for the training of the Owner's Representative(s) in the operation of the system (provide minimum 48 hours written notice in advance of test). The Contractor shall furnish, in addition to the Record Drawings and operational manuals, copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system. The Contractor shall guarantee all parts and labor for a minimum period of one year from date of acceptance.

Conditions for acceptability of work for start of maintenance by Owner issued by Owner or Owner's Representative shall include but not be limited to:

Punch list items complete and approved by Owner or Owner's Representative.

Landscape irrigation system complete and in place.

Record drawings complete.

Maintain installation and watering schedules until all conditions noted above have been completed.

CLEAN UP

Upon completion of all installation work, Contractor shall remove all leftover materials and equipment from the site in a safe and legal manner.

Contractor shall remove all debris resulting from work of this section.

Contractor shall regrade, lightly compact, and replant around sprinkler heads where necessary to maintain proper vertical positioning in relation to established grade.

Contractor shall fill all depressions and eroded channels with sufficient soil mix to adjust grade to ensure proper drainage. Compact lightly, and replant filled areas in accord with Drawings requirements.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Payment shall be based on the unit price bid for this item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods for the completion for the Design Build Irrigation System. This work includes, but is not limited to, the scope of work described in Parts 1-3 of this specification above for a new, complete, and automatic irrigation system as required.

END OF SECTION

ITEM 813.521 WIRE TYPE 10 NO. 10 GROUNDING AND BONDING FOOT

ITEM 813.522 WIRE TYPE 10 NO. 6 GROUNDING AND BONDING FOOT

Work under this Item shall conform to the applicable provision of Section 800 and the following:

Grounding and boding conductors shall be copper conforming to the requirements of ASTM-B3 for soft or annealed copper wire.

Where wire is provided with an individual covering, the covering shall be finished a continuous green color or a continuous green color with one or more yellow stripes. The insulation on the grounding and bonding conductors shall be XHHW-2 With XLP Jacket.

METHOD OF MEASUREMENT

Wire type 10 No. 10 Grounding and Bonding and Wire type 10 No. 6 Grounding and Bonding shall be measured by the foot complete-in- place.

BASIS OF PAYMENT

The unit price bid shall be full compensation for all labor, tools, equipment, materials, testing, and all incidentals required to do the work of this section as indicated on the Contract Documents per unit foot installed, as specified herein and as required by the Engineer.

ITEM 813.80 SERVICE CONNECTION (OVERHEAD) LOCATION NO. 1 LUMP SUM

Work under this Item shall conform to the applicable provisions of Section 800 and the

following:

This item is for street lighting load center service connection only.

The work shall include the installation of 3-inch non-metallic (PVC) conduit unless otherwise required, Type H handhole (if required), disconnect switch & pedestal (if required), service riser, and service conductors from the load center to the disconnect switch to the Eversource utility pole as shown on the drawings. Co-ordination with Eversource is required to secure riser conduit to the Verizon utility pole and coordinate connection of service conductors. Contractor shall connect conductors at load center. Electric utility shall connect the service conductors at the utility pole.

Highway Lighting Load Center #	Load Center Location	Eversource Work Order #
1	OCEAN ST AT SOUTH ST	TBD

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Item 813.80 shall be measured and paid at the contract unit bid price per Lump Sum per location, which price shall constitute full compensation for all labor, materials and equipment including disconnect switch & pedestal, conduit, Type H handhole, conduit, riser conduit, service wiring and utility company back charges necessary to complete each of the service connections.

ITEM 816.01 TRAFFIC SIGNAL RECONSTRUCTION LOCATION NO.1 LUMP SUM

The work to be done under this Item shall conform to the relevant provisions of Section 815 and the following.

The work to be done under this item consists of modifying and installing a traffic control signal system components at Location 1 – Main Street at Center Street and Old Colony Road, and adjustments to the existing traffic signal equipment, phasing and timings.

The Contractor shall coordinate with the Town of Barnstable to obtain access to the affected traffic signal control cabinet.

The traffic signal controller and the existing cabinet shall be retained and reconfigured as needed to install the new traffic signal equipment and maintained such that the existing traffic signal equipment and conduit are not damaged by construction operations.

A list of major items required is included on the Traffic Signal Plans for Location 1.

The existing signal installation to be modified under Item 816.01 shall be maintained in operation throughout the construction period and until the reconstructed/new traffic signal equipment is installed, tested and ready for operation.

Also included in the work is the dismantling and stacking of the existing traffic signal control equipment to be transported to the Town of Barnstable Maintenance Yard, as required by the Engineer. If the Town decides not to accept this equipment, it shall become property of the Contractor.

Within 30 days following the date of the Notice to Proceed, the Contractor shall submit shop drawings for signal supports, a list of equipment, and manufacturer's equipment specifications to the Engineer in accordance with the relevant provisions of Section 815. All equipment shall be listed on MassDOT's Qualified Construction Materials List.

No work shall be commenced by the Contractor until approval of the shop drawings and manufacturer's data has been received in writing from the Engineer. Approval of these drawings will be general in character and shall not relieve the Contractor from the responsibility of, or the necessity of, furnishing materials and workmanship conforming to the plans and specifications.

The Contractor shall deliver to the Engineer a certificate of compliance by the manufacturer for all materials purchased from the manufacturer.

REGULATIONS AND CODE

All electrical equipment shall conform to the standards of the NEMA and U.L. wherever applicable. In addition to the requirements of the Contract Drawings, Standard Specifications, and Special Provisions, all materials and workmanship shall conform to the requirements of the NEC, NESC, ASTM, OSHA and/or ANSI, all applicable State and Local codes and Department of Public Safety regulations.

FINE TUNING, ADJUSTMENT AND TESTING PERIOD

After the Contractor has finished modifying the controller and installing all other associated signal equipment to operate as specified in the contract documents, the fine tuning, adjusting and testing period shall begin. During this period, the Contractor under the direction of the Engineer, will make necessary adjustments and conduct tests to insure safe and efficient operation of the equipment. This

period shall not last for more than 30 days. No request for final acceptance will be considered until successful completion of the testing period.

MAINTENANCE OF TRAFFIC SIGNALS

It shall be the responsibility of the Contractor to provide all labor, equipment and material required for the maintenance of the proposed traffic signal control equipment within the project limits, including damage by automobile accident from the date of written notice given to the Engineer that the Contractor will begin work on the proposed traffic signal control system until the date when the Town of Barnstable, Town Engineer shall recommend acceptance of the completed project. This written notice must be given before the Contractor may proceed with any traffic signal system work.

GUARANTEES OF THE TRAFFIC SIGNAL SYSTEM

The Contractor shall diagnose (troubleshoot) the system and at his own expense replace any part of the traffic signal control equipment installed by the Contractor that is found to be defective in workmanship, material, or manner of functioning within six months from date of final acceptance of the installation under this Contract.

The one-year warranty period on equipment stipulated in Subsection 815.20 of the Standard Specifications still applies.

AS-BUILT PLANS & WIRING DIAGRAMS

The Contractor shall provide as-built traffic signal plans and wiring diagrams to Town of Barnstable, Town Engineer in AutoCAD 2023 DWG, DWF and PDF formats.

ENTERING PRIVATE UTILITY COMPANY FACILITIES

The electrical service conduit and cable from the utility pole, to the traffic signal control cabinet is not intended to be replaced.

CONTROLLERS AND CABINETS

Any traffic signal equipment including but not limited to the controllers, malfunction management units, detector amplifiers, bus interface units and all other ancillary traffic signal control components included in the traffic control cabinet shall comply with the National Electrical Manufacturers Association (NEMA) Standard No. TS 2, Traffic Controller Assemblies.

The top of the concrete base for the controller cabinet shall be 18 inches above grade if replaced. Controller cabinet foundations shall be located such that an accessible sidewalk width is maintained. Anchor bolts shall be internal to the cabinet. A concrete work pad 3 feet wide by the length of the controller cabinet shall be installed.

Traffic Signal Controller and Cabinet Assemblies

The traffic signal controller units (CU) malfunction management units (MMU), cabinet power supplies, bus interface units (BIU), and all other ancillary traffic signal control components included in the traffic control cabinet shall comply with the National Electrical Manufacturers Association (NEMA) Standard No. TS 2-2003 (R2008) v02.06 and Amendment 4-2012 Traffic Controller Assemblies with National Transportation Communications for ITS Protocol (NTCIP) Requirements.

Controller

The existing signal controller and cabinet is not intended to be replaced. It is assumed that the existing Controllers conforms to Section 3, Controller Units of NEMA No. TS 2, Traffic Controller Assemblies.

The controller units shall utilize an interface conforming to Subsection 3.3 of the NEMA TS 2 Standard. The controller unit shall utilize an input/output interface conforming to Section 3.3.1 of the NEMA TS 2 Standard for all input/output functions with the Terminals and Facilities (TF), the Malfunction Management Unit, detector rack assemblies and auxiliary devices. The controller unit shall also meet the requirements of Section 3.3.6 of the NEMA TS 2 Standard.

The controller unit is assumed to include a temperature compensated, 8 line by 40 character display with LED backlight. The controller operating system (OS) shall be Linux and contain a Flash File System to allow for controller software upgrades.

Controller cabinets shall conform to the NEMA TS 2 Standards, M or P cabinet.

A lamp with an on/off switch shall be installed in the controller cabinet if one does not already exist..

The Contractor shall program each programmable local hardware component according to the "Time of Day Schedule" as follows:

TIME OF DAY SCHEDULE

	7 AM-10 AM	**10 AM-4 PM**	**3 PM-6 PM**	**6 PM-7 AM**
Mon - Fri	Max1	Max 1	Max 1	Max 1
Sat	Max1	Max 1	Max 1	Max 1
Sun/Hol	Max1	Max 1	Max 1	Max 1

The work shall include re-programming the existing traffic signal controllers at Location 1 to adjust traffic signal phasing and timing. The work shall include, but not limited to, implementing signal phasing Max1, Yellow, Red, and pedestrian timings according to the Drawings and any other work necessary to maintain operations.

Spare Equipment

The Contractor shall provide the following spare signal equipment in the traffic signal controller cabinet if it is not provided:

1. A full complement of load switches to accommodate each available position of the back panel;
2. A full complement of flash transfer relays to accommodate each available position of the back panel;
3. Two (2) Bus Interface Units (BIU)

Vehicle Detection

The existing video detection system is intended to be retained and the zones modified to match the Traffic Signal Plan. If the existing camera needs to be adjusted to account for all of the detection zones, then the camera adjustment shall be considered incidental to this item.

The Contractor shall adjust and modify the existing vehicle detection systems that detect vehicles on a roadway by processing images sent from a sensor to an interface board with detector outputs that can be received by the traffic signal controller. These traffic sensors shall be installed at the locations shown on the plans and in accordance with these specifications.

The detection system also, at a minimum, shall be able to:

- Stop bar detection; and;
- NEMA TS 2 compatibility

The camera equipment mounting locations if changed, shall be provided as a submittal to the design engineer for review and approval prior to ordering. The contractor will be responsible for any structural analysis of the existing signal structures used to mount equipment.

Components of the detection system shall all be the same as to make and model.

Mounting Bracket - The mounting brackets associated with the detection system shall be per the manufacturer's recommendations.

Vehicle Detection Zones - The Contractor shall be responsible setting the vehicle detection zones as shown on the plans. The Contractor may be required to adjust and readjust the location of existing and proposed vehicle detection zones in the presence of the Engineer, at no additional cost, to properly set the detection areas.

Installation and Training - The manufacturer of the vehicle detection system, or their representative, shall design sensor layout, placement and lens size, and supervise the installation and testing of the equipment. A factory certified representative from the supplier shall be on-site for a minimum of one day.

Under Items 816 that have video detection the Contractor shall provide up to eight (8) hours of personnel training in the use of the vehicle detection system and software. This training is to be conducted with the Town of Barnstable. The Contractor is to coordinate with the Town of Barnstable as to the exact location and time of the training. It is the responsibility of the Contractor to provide training manuals, class notes, and other instructional materials for up to six attendees at the training session.

No training shall begin unless and until the final inspection process indicates, in the opinion of the Engineer, that the vehicle detection system is sufficiently complete and operational such that training would be useful at the time.

The manufacturer shall provide three (3) complete sets of maintenance manuals for the installed equipment. These manuals shall have complete set-up, maintenance and troubleshooting procedures presented in an organized format.

Warranty, Maintenance and Support - The traffic sensor is replaced then it shall be warranted by its supplier for a minimum of ten (10) years.

The vehicle detection system shall be warranted by its supplier for a minimum of two (2) years.

During the warranty period, the supplier shall provide technical support by telephone during normal

business hours and request for support by telephone shall be answered by factory certified personnel within one (1) hour.

During the warranty period, certified personnel from the supplier shall be on site within seventy- two (72) hours if required.

Vehicle Detection Communications Cable

If replaced, the vehicle detection communications cable shall be supplied and installed per the manufacturer's recommendations.

Surge Suppression

The cabinet shall have each input & output surge protected except signal outputs from cabinet load switches. (The load switches act as surge suppressors.)

The surge protector must be electrically connected to the nearest grounded metal structure or nearest ground rod.

Surge protection for power service shall conform to the current NEMA TS-2 standard except surge capacity shall be 80 kA. The product complies when a lab report summary from an independent test laboratory stating the product passes the current NEMA TS-2(5.4.2.4) specification (with the additional surge capacity of 80 kA) is submitted with the shop drawings.

Surge protection for all loop, pedestrian button, and pre-emption connections should have peak surge current protection of at least 10kA with a response time of less than 5 nanoseconds. The product complies when a lab report summary from an independent test laboratory stating the product passes this specification is submitted with the shop drawings.

Units shall be unconditionally warrantied for at least 10 years. The following manufacturers have a 10 year warranty: Atlantic Scientific, Ditek, Intermatic and others.

Labels

All time settings, switches, harnesses, relays, terminals and fuses shall be clearly and permanently labeled.

Optical Emergency Preemption System

The work consists of furnishing and installing optical traffic signal preemption system components to complement the existing preemption system and to be ready for operation, as described herein and shown on the plans. Included in the work are the furnishing and installing of traffic signal preemption unit and related equipment, optical detection equipment and all necessary connections to the traffic signal controller. A separate cable shall be installed for the emergency preemption equipment, apart from the traffic signal cable. The equipment provided should be compatible with the equipment in currently in use by the Town of Barnstable.

The emergency preemption system shall consist of a data-encoded phase selector to be installed within a separate side cabinet affixed to the main traffic control cabinet. This unit will serve to validate, identify, classify, and record the signal from the optical detectors located on support structures at the intersection. Upon receiving a valid signal from the detector, the phase selector shall generate a preempt call to the controller initiating a preemption operation as shown on the plans.

The phase selector if required, shall be a rack-mounted plug-in two or four channel, dual priority device. Programming the phase selector shall be via a PC-based computer utilizing unit specific

software. One copy of software on a disk shall be supplied and licensed to the Town as part of this contract. A hard copy of final programming data shall be left in the control cabinet. The Contractor shall supply a complete set of interface cables for phase selector to laptop connection.

Emergency vehicles equipped with optical emergency emitters transmit optical impulses to optical detectors mounted at the intersection. When optical impulses are received at the intersection, control of the signals shall transfer from the local controller to show a selected display shown on the plans to assist the vehicle through the intersection without conflict. After the vehicle has passed through the intersection, control of the signals shall then return to the local controller which shall restore the appropriate timings that were in effect prior to preemption.

1. General Operation and Description of Work

The following description of work specifies the responsibilities involved in the installation of optical preemption equipment.

The Contractor is required to supply material and labor, required or shown for the complete installation of optical preemption equipment at the specified location in this project. Intersection preemption equipment required includes optical detectors, phase selectors, card rack, preemption indicator lights, cable, interfacing of preemption equipment to the local and system master, making electrical connections and all required incidentals.

The following are the operational requirements of the optical preemption system:

- Operating sequence, as specified, shall be initiated when detector receives optical infrared transmission of the required repetition rate from an emitter.
- Detector shall transform the optical signals into electrical signals and transmit the electrical signal to the phase selector for processing.
- Phase selector shall cause the local or closed loop system master to show a selected display identical to one of the color interval displays normally available in the controller which will assist the emergency vehicles through the intersection without conflict. Concurrent to this display, a confirmation strobe mounted at the intersection shall illuminate to notify drivers that the system is in pre-emption mode.
- Phase selector shall allow the controller to release from hold and resume normal operation after optical infrared transmission is lost provided the desired green display has already been obtained. The controller shall not allow service following released to normal operation to any phase where an active call from a waiting vehicle or pedestrian does not exist. Detector cable for optical preemption equipment shall meet specifications of the system manufacturer.

2. Installation

The preemption equipment manufacturer shall be responsible for preemption system design and documentation.

Preemption System Design and documentation shall include the following:

- Provide the installing agency with locations for detector installation. Suggested detector locations are shown on the plans and may be changed to improve the operation. Notice shall

be given to the Engineer prior to any change.

- Provide the controller manufacturer, Engineer and owner with electrical diagrams.

The installer shall install the equipment consistent with the preemption equipment manufacturer's recommended installation procedures and electrical diagrams in a neat and workmanlike manner.

Operating checkout includes the following:

- Verifying that the pre-emption system is properly installed as per the pre-emption equipment manufacture's recommendations and the electrical diagrams as provided by the pre-emption equipment manufacturer.
- Verifying that the priority system timing and range are property set. Pre-emption equipment warranties are put into effect.
- Instructing the vehicle drivers or their representative(s) in the operation of the pre-emption system.

3. Warranty

All components of the preemption system specified herein, shall be warranted by the manufacturer to be free of defects in materials and workmanship for a period of two years from the date of delivery or one year from the date of installation, whichever occurs first.

The Contractor shall repair or replace, free of charge to Town of Barnstable, any part that fails in any manner during the warranty period, and six months after final acceptance of the project by the Town of Barnstable.

Preemption Confirmation Light

The existing confirmation light is sufficient.

SIGNAL HOUSINGS

ALL NEW SIGNAL HOUSING SHALL MATCH THE EXISTING SIGNAL HOUSINGS IN COLOR AND LED MODULE STYLE.

MATERIALS

Vehicle Signal Heads - All indications shall be equipped with a cut-away visor, and red, yellow, and green LED signal modules.

Pedestrian Signal Heads - All indications shall be equipped with a hood visor, and lunar white and portland orange LED signal modules.

CONSTRUCTION METHODS

The final adjustment of the facing of signals shall be made as required by the Engineer after all the signals at an intersection are operating, but prior to installing the through bolt above.

LIGHT EMITTING DIODE (LED) SIGNAL MODULE

Any LED signal module that has been type-tested and approved and listed on MassDOT's Qualified Traffic Control Equipment list, according to section 815.21 of the Standard Specifications, prior to the date of award of this Contract will be considered as meeting these Specifications.

Backplates

Backplates shall be aluminum with a louvered profile. Backplates shall have a 5 inch border width and which includes a 3 inch reflectorized yellow border. The border shall be made from

an adhesive-backed retroreflective yellow micro-prismatic sheeting, Type III or IV, and cover the entire perimeter of the backplate.

Visors

All vehicular traffic signal indications shall come equipped with tunnel visors.

Pedestrian signal heads shall come equipped with cut-away visors. (none anticipated_

Pedestrian Signal Heads – Heavy duty blind clamp fittings are required for mounting hardware. (none anticipated)

Where mast arm mounting is required, including at intermediate arm locations, signal heads shall be all vertically fixed-mounted.

The final adjustment of the facing of signals shall be made as required by the Engineer after all the signals at an intersection are operating, but prior to installing the through bolt above.

TRAFFIC SIGNAL POSTS AND BASES (NONE ANTICIPATED)

Octagonal transformer bases with steel collar inserts shall be of aluminum alloy permanent mold casting. Hardware shall include templates, ¾ inch anchor bolts, nuts, washers and shims. The height of base shall be approximately 14 inches, and the height of the base is included in the height of the shaft. The bottom of the base shall be designed for anchorage on a 12-3/4 inch bolt circle. The bases and posts shall be aluminum with a satin brush finish. Bases shall be provided with a door opening and a cast aluminum door, complete with a cap screw fastening device and a tapped hole for a grounding lug.

All signal bases shall match existing signal bases and posts.

CONCRETE BASES (NONE ANTICIPATED)

Foundations for 8 foot and 10 foot traffic signal posts shall be provided at locations shown on the Contract Drawings and shall be in conformance with the Standard Specifications and the Standard Drawings.

All sweeps to be installed in concrete bases shall be ¾ inch steel sweeps with sufficient three inch steel riser to project above the finish grade of the base.

One spare sweep and riser, capped at both ends, shall be poured in place in each signal support foundation or base. The Engineer shall determine the location of the spare sweep. In any case no more than three sweeps shall be in any foundation.

TRAFFIC SIGNAL INTERSECTION CABLE

Intersection Cable - All traffic signal cable placed underground in conduit shall be stranded copper No. 12 AWG per IMSA 20-1. All traffic signal cable placed from the transformer base to the signal shall be stranded copper No. 14 AWG per IMSA 20-1.

Circuit protective device for the tap from No. 12 AWG to No. 14 AWG at the signal base shall not exceed 15 amps and shall comply with the N.E.C.

All traffic cables shall be labeled with suitable, durable, permanently legible tags or markers. Individual conductors, when not enclosed by the cable outer jacket, shall be bundled by phase and labeled with the appropriate phase designation.

A single cable shall be used in all conduit runs requiring up to 30 conductors. No more than 2 cables may be used for runs of 31 to 60 conductors, and no more than 3 cables may be used for runs of 61 to 90 conductors. These shall be the only cables carrying signal or pushbutton circuits in any one conduit.

A minimum of five (5) spare conductors shall be provided in the base of each signal post, mast arm pole and strain pole. Openings, where cables enter the base of a cabinet, shall be sealed with an approved elastic sealing compound. The open ends of conduits entering or leaving mast arms, posts and pull boxes shall also be sealed with the approved elastic sealing compound.

SERVICE CONNECTION

No modifications to the service connection are anticipated.

Wiring Diagrams

Five sets of modified wiring diagrams for the control cabinet and all accessories shall be furnished including one mylar reproducible copy for the control cabinet when installed. All actual and potential terminal strip connections shall be shown. Accessory equipment includes flashers, switches, relays, logic modules, detectors, etc. All identification on the diagrams shall be as installed, and all field labeling shall be consistent with the diagrams. Furthermore, the format symbols, identifications, operating sequence, etc., common to all the intersection wiring diagrams shall be standardized and consistent with appropriate MassDOT standards. Before acceptance of the job, the five copies of all operating and maintenance manuals and complete and accurate parts lists shall be supplied.

All tests and any necessary repairs and replacements required to produce a fault-free system shall be included in the lump sum price bid for this Item.

Pedestrian Signal Heads (None anticipated)

The pedestrian signal heads shall be 16 inch countdown pedestrian signals. The signal shall consist of international symbols of an LED upright hand symbolizing “DON’T WALK” and a walking person symbolizing “WALK”. The internal countdown module shall be comprised of two 7 segment digits, 8 inches high and made of 88 red LED’s. The countdown module shall display the number of seconds remaining throughout the flashing “DON’T WALK” pedestrian, and blank out when not activated. All LED indications on the pedestrian signal shall have an automatic dimming circuit for night illumination to reduce long-term degradation to the LED’s.

PEDESTRIAN PUSH BUTTONS (NONE ANTICIPATED)

Pedestrian push buttons shall be located as close as practicable to the sidewalk curb ramp serving

the controlled crossing and shall permit operation from a clear ground space. If two crosswalks, oriented in different directions, end at or near the same location, the positioning of pedestrian push buttons and/or legends on the pedestrian push button signs should clearly indicate which crosswalk signal is actuated by each pedestrian push button.

Pedestrian pushbuttons shall be installed on a saddle of cast aluminum with the approved MassDOT, Highway Division instructional legend, firmly attached to the casting. The saddle shall have a clear coat finish. The plunger shall be a maximum of 42 inches above the finished sidewalk and a minimum of two inches in the smallest dimension. The force required to activate controls shall be no greater than 5 lbs. This sign and saddle shall be used in locations where a pushbutton is shown on the plans.

Any pushbuttons that can't be located within 10 inches of the wheelchair ramps shall be equipped with push-button extenders at no additional cost to the project.

Accessible Pedestrian Signals (None Anticipated)

Accessible pedestrian signals shall be provided at the locations shown on the Contract Drawings. The accessible pedestrian signals/pedestrian push button shall provide visually impaired pedestrians with a locator tone that will allow them to find the push button to actuate the walk signal. Once the push button call has been placed, the button will provide both an audible and a tactile response during the WALK phase of the cycle. The push buttons shall clearly indicate by means of tactile arrows which crosswalk signal is actuated by each push button. Audible pedestrian signals shall be of the type which produces a percussive tone during the walk signal. The assemblies shall be capable of adjusting audible volume to ambient noise levels. Audible pedestrian signals shall conform to the requirements of the MUTCD, including sound level requirements for locator tone and percussive tone during the walk signal. Audible messages shall be provided as an option for no additional cost.

Equipment Finish and Color

All traffic signal equipment including but not limited to signal posts, bases, signal heads, visors (outside), doors, mast arms, pushbutton saddles, controller cabinets, service meter socket boxes, hardware, and rigid mounting brackets for signals and signs shall be the color shall match the existing signal equipment from the MassDOT Bottleneck Project.

The work performed under this Item shall conform to the requirements for lead paint presented in sections 961.65 through 961.69 of Standard Specifications.

Grounding

All existing and proposed pull box frames and covers shall be grounded to a bond wire that runs through the conduit system. The Contractor shall drill and tap the frames and covers if needed and the ground wires shall be connected with Burndy connectors.

<u>BASIS OF PAYMENT</u>

Traffic Signal Reconstruction Location No. 1, will be paid for at the Contract Lump Sum price for Item 816.01, which payment shall be considered as full compensation for all labor, materials, equipment, and incidental costs to complete the work, including work to re-program and re-wire the existing traffic signal controller.

Electrical conduit shall be paid for separately under Item 804.3 - 3 inch Electrical Conduit Type NM - Plastic - (UL).

Pull Boxes shall be paid for separately under Item 811.31 - Pull Box 12 X 12 Inches - SD2.031.

The cost of maintenance of the proposed traffic signal equipment shall be deemed to be included in the lump sum bid price for this item, and no additional payments shall be made therefor, except as provided by the Standard Specifications.

All costs associated with maintaining the existing signal system during construction shall be considered incidental.

The work performed under this item shall conform to the requirements for lead paint presented in sections 961.65 through 961.69 of the Standard Specifications.

All tests and any repairs and/or replacements required to produce a fault-free system shall be included in the Lump Sum bid price for this Item.

ITEM 816.90 TRAFFIC CONTROL SIGNAL REMOVED AND TRANSPORTED LUMP SUM

Work under this item shall be in accordance with the provisions of Section 800 and 900 of the STANDARD SPECIFICATIONS FOR HIGHWAY AND BRIDGES and the following:

The work under this Item includes removing existing traffic control signals and appurtenances at the locations designated on the Plans and as required by the Engineer. The existing traffic control signals and appurtenances, if determined to be in suitable condition, shall remain the property of the Town of Barnstable. The Contractor shall advise the owner that the material is available and arrange for transport. Traffic control signals to be removed and transported shall be removed and transported to the Town Department of Public Works yard and placed per the direction of the Town Engineer without additional compensation.

The work shall include the Traffic control signals and appurtenances to be removed and transported at the following intersections:

Main Street at Sea Street
Main Street at High School Road
Main Street at Ocean Street and Barnstable Road
South Street at Ocean Street and Old Colony Road

If the Engineer determines that any part of the traffic control signals and appurtenances are unsuitable for reuse, or if the owner decides to abandon part or all such materials, said materials shall become the property of the Contractor, and he shall dispose of them away from the site. Compensation for the removal and disposal of unsuitable or abandoned material shall be included under this Item.

Existing traffic control signals and appurtenances shall only be removed once the proposed traffic control signal is operational, or provision made for temporary traffic control and the Engineer has given approval for their removal.

MEASUREMENT AND PAYMENT

Measurement and payment for this Item shall be made at the Contract Unit Price Bid per Lump Sum for traffic control signals to be removed and transported. The Contract Unit Price Bid shall include all materials, excavation, labor, equipment, and incidentals required to complete the work.

ITEM 821.16 ORNAMENTAL LIGHTING POLE 16.5 FOOT WITH 2-FT CROSS ARM EACH

All work performed under this item shall be in accordance with the relevant provisions of Section 820 of the Standard Specifications, as detailed on the contract drawings and the following:

GENERAL

Work under this item shall consist of furnishing and the installation of Lighting poles at the locations as shown on the plans or as required by the Engineer, complete in place. All materials and construction procedures shall conform to the specifications contained herein, the contract drawings, and to the requirements and standard practices of the Town of Barnstable.

Manufacturer's data shall be submitted for the following: Lighting poles, mounting brackets, and anchor bolts.

Shop drawings shall be submitted for the following: Lighting poles, including foundation details, dimensions, wind loading calculations, pole deflection and other applicable information. Wind loading calculations shall be stamped by a Registered Professional Structural Engineer in the Commonwealth of Massachusetts.

Shop drawings for lighting poles shall include a table showing all light poles included in the Contract. The table shall include pole number, bolt circle diameter, pole dimensions, bracket arm dimensions, anchor bolt size, and station number.

Lighting poles shall be provided and designed in accordance with AASHTO LTS-6 while supporting the luminaire.

Lighting poles shall be designed in conjunction with offset luminaires and shall conform to the criteria set forth above for the luminaires.

The complete structures with all luminaires and appurtenances attached thereto shall be designed and constructed in accordance with the requirements of AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals for the following AASHTO criteria: 1) Fatigue Category No. 1, 2) Design Wind Speed 130 MPH and 3) 50 Year Design Life.

MATERIALS

Lighting Poles:

Pole Shaft: Ornamental lighting poles shall be a one section, 5” round extruded 6061-T6 aluminum tubing, having a 0.170 wall thickness, welded to the pole base.

Joint Cover: One-piece round joint cover made from cast 356 aluminum, mechanically fastened with stainless steel screws.

Pole Base: Shall be made from round fluted cast 356-T6 aluminum base having a 0.375” wall thickness, complete with cast-in anchor plate.

Maintenance Opening: The pole shall have a 3-3/8" to 7" wide x 6 1/2" long maintenance opening centered 16 1/2" from the bottom of the anchor plate, complete with a weatherproof cast 356 aluminum cover and a copper ground lug.

Pole Options: (BA) Two-way (180°), single arm(s) with eyelet mechanically assembled to the pole, fixed standard type, made of galvanized steel tubing, 1-1/16" outside diameter, mechanically assembled to the pole, complete with a standard cast aluminum decorative ball. Banners complete with cast stoppers near pole, securing banner arms inside flutes.

(G) Galvanization

(IP) The pole inner wall will be painted.

(PRMA) External surface of the pole including

the options and components will be complete with a primer.

(IP), The pole inner wall

will be complete with a primer.

(PW) Separate wires for fixture and GFI receptacle. Wiring included without connector.

(VPA) Vandalproof screw(s), Allen-type vandalproof screw(s), with pin-in-socket

tamper-resistant head.

Note: A tenon will be provided when the luminaire or bracket does not fit directly on

pole shaft. Tenon not shown on the drawing.

Pole Options: (Special Option) Banner arms are galvanized.

Wiring: Gauge (#14) SOOW wires for luminaire, Gauge (#12) AWG wires for GFI, wiring included without connector.

Separate wire length supplied from luminaire and from GFI to the pole base with 18" (457mm) minimum exceeding from

maintenance opening. Wiring will be shipped in a separate box and will be installed by others.

Hardware: All exposed screws shall be stainless steel with Ceramic primer-seal basecoat to reduce seizing of the parts. All seals and sealing devices are made and/or lined with EPDM and/or silicone.

Finish: Color to be black textured (BKTX). Application of a polyester powder coat paint. (4 mils/100 microns). The

chemical composition provides a highly durable UV and salt spray resistant finish in accordance to the ASTM-B117-03 standard and humidity proof in accordance to the ASTM-D2247-68 standard.

Quality Control: The manufacturer must provide a written confirmation of its ISO 9001-2008 and ISO 14001-2004

International Quality Standards Certification.

Galvanization: All steel parts of pole will be galvanized as per CSA G164M standards. Please note that due to a possible rough surface resulting from the galvanization process, we cannot guarantee a finish without imperfections (e.g. welded seams that seem more apparent, or areas where galvanization has pooled up.

Mechanical resistance: In order to ensure the mechanical resistance of the poles, the projected area should be calculated according to latest AASHTO.

Poles shall be as specified on the Contact Drawings.

A grounding connection for receiving a 1/2" by 13 NC threaded bolt shall be provided on the inside of the shaft. Grounding connection shall be accessible from the handhole in the base.

Fuses for light fixture are to be located in light pole base.

Stainless steel components, fasteners and mounting hardware shall be Type 304 or Type 316.

CONSTRUCTION METHODS

The Drawings show in general, the location of the roadway lighting systems. They are diagrammatic only but shall be followed as closely as actual conditions that the site will permit.

All lighting standards shall be set plumb, with vertical plane of arms perpendicular to the roadway centerline. The factory furnished protective wrapping shall not be removed until the Engineer so directs.

Poles shall be erected and secured to foundations in a manner as described herein.

The Contractor shall exercise special care in erecting fluted galvanized steel light posts to ensure that they are firmly secured to the concrete foundation and plumbed in accordance with the details shown on the plans and to the satisfaction of the Engineer. The post is erected in sections: The fluted galvanized steel post, the cast aluminum base section, and the bracket arm, slipover adapter assembly. The shims furnished with the pole shall be used if necessary. The street light pole shall not be installed until the related control cabinet and related underground wiring has been completed and tested.

The bonding lug shall be attached to the inside of handhole at the base of the pole and the incoming green bond shall be secured to it. All bonding leads from the luminaires and bracket arms (when specified) shall be crimped together and a single green lead shall be secured to the bonding lug.

The bracket arm shall be secured to the light standard shaft in accordance with manufacturer's recommendations. The bracket arm shall be oriented so that it is perpendicular to the centerline of roadway with which it is associated.

A luminaire of the size and type indicated on the Drawings shall be installed on its respective lighting standard as shown. The luminaire shall be installed on the bracket arms with the luminaire parallel to the roadway grade. Pole and bracket cable shall be installed through the pole bracket arm and connected to the luminaire terminals. Adequate slack pole and bracket cable shall be left at the base of the pole to permit connections to the roadway lighting circuits. A lamp of the type and size specified shall be installed in each luminaire. Install fuse and fuse holder at base.

MEASUREMENT AND BASIS OF PAYMENT

Measurement shall be made per each unit complete in place, tested, and accepted by the Engineer within their respective bid items.

Payment shall be at the respective contract unit bid price for each unit, complete in place, which price shall include all labor, materials, equipment, the bracket arm(s), all dampeners, hardware, brackets, fasteners, pull box covers, anchor bolts, breakaway devices, pole wiring, fuses, street light fuse connectors, touch up painting, and all incidental costs required to complete the work.

ITEM 823.07 ORNAMENTAL LUMINAIRE 70 WATT EACH

GENERAL

The work under this item consists of the furnishing and installing a luminaire mounted to a tenon at the locations as shown on the plans or as directed, complete in place.

All work performed under these items shall be in accordance with the relevant provisions of Section 820 of the Standard Specifications and the following:

Submittals for all lighting equipment shall include photometric data, shop drawings, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting systems specified.

Manufacturer's data shall be submitted for the following:

A. General submittal content shall include
    1. Luminaire cutsheets
    2. Cutsheets for LED light sources
    3. Cutsheets for LED driver(s) some products will only have a power supply or power source.
    4. Cutsheets for surge protection device
    5. Instructions for installation and maintenance
B. LM-79 luminaire photometric report(s) shall be produced by the test laboratory and include
    1. Name of test laboratory
        a. The test laboratory must hold National Voluntary Laboratory Accreditation Program (NVLAP) accreditation for the IES LM-79 test procedure or must be qualified, verified, and recognized through the U.S. Department of Energy's CALiPER program.
    2. Report number
    3. Date
    4. Complete luminaire catalog number
        a. Provide explanation if catalog number in test report(s) does not match catalog number of luminaire submitted
            i. Clarify whether discrepancy does not affect performance, e.g., in the case of differing luminaire housing color.
            ii. If nominal performance of submitted and tested products difference, submit additional LM-79 report(s) and derivation as indicated in Appendix C.
    5. Description of luminaire, LED light source(s), and LED driver(s)
C. Calculations and supporting test data indicating a lumen maintenance life of not less than 100,000 operating hours

Luminaires and accessories shall be shipped securely packaged and labeled for safe handling in shipment and to avoid damage. Luminaires and accessories shall be stored in a secure and dry facility and in original packaging in a manner to prevent soiling, physical damage, wetting or corrosion prior to installation.

MATERIALS

See contract drawings for manufacturer and catalog number. Luminaire is proprietary, matching adjacent installation.

Luminaire shall meet the specifications for output, wattage, color temperature and distribution type indicated in the details of single light poles on the contract drawings.

All luminaires specified in this section shall be delivered and clearly marked with the manufacturer's name and catalog number, voltage, maximum wattage, distribution type and lumen output.

Luminaire shall be manufactured in the USA.

Electrical - Each luminaire to be furnished with (1) internally mounted driver for operation at 120, 208, 240, 277 volt. The driver assembly shall be removed and installed Tyco quick disconnect plug resisting to 221 degrees Fahrenheit on a unitized removable tray.

Rotomatic tool-free system composed of 4 main components: Heat Sink / LED Module / Optical System / DriverElectrical components are RoHS compliant. The LED life rating data shall be determined in accordance with Illuminating Engineering Society of North America (IESNA) Lumen Maintenance (LM)-80-08.

The LED Light engine shall produce a color temperature as indicated on the contract drawings.

The distribution of the luminaire shall be the Type indicated on the contract drawings. The Type shall be as defined per ANSI/IESNA RP-8-22. Type 3 and Type 5. Composed of high-performance acrylic lenses to achieve optimized distribution and get maximum spacing. Target lumens will create a perfect lighting uniformity. Performance shall be tested per LM-63, LM-79 and TM-15 (IESNA)

Finish - Color to be in accordance with the AAMA 2603 standard. Application of polyester powder coat paint (4 mils/100 microns) with ± 1 mils/24 microns of tolerance. The Thermosetting resins provides a discoloration resistant finish in accordance with the ASTM D2244 standard, as well as luster retention in keeping with the ASTM D523 standard and humidity proof in accordance with the ASTM D2247 standard. The surface treatment achieves a minimum of 2000 hours for salt spray resistant finish in accordance with testing performed and per ASTM B117 standard.

Warranty - The manufacturer shall repair or replace at no cost any failed LED light engines, drivers, surge modules or any mechanical component defects for a minimum of five years from date of installation.

Submittals - Luminaire manufacturer's submittal data shall be submitted for the following:

LEDs (LM-80) and drivers

Certified LM-79-08 Photometric Test Report from a NVLAP certified independent testing laboratory.

Electronic version of certified photometric files in IES format.

Photometric report shall conform to the requirements of IES-LM-79-08.

Integrating Sphere Test - Color Rendering Index (CRI) shall be 70 (minimum)

Surge Protector: Surge protector tested in accordance with ANSI/IEEE C62.45 per ANSI/IEEE C62.41.2 Scenario I Category C High Exposure 10kV/10kA waveforms for Line Ground, Line Neutral and Neutral Ground, and in accordance with U.S. DOE (Department of Energy) MSSLC (Municipal Solid State Street Lighting Consortium) model specifcation for LED roadway luminaires electrical immunity requirements for High Test Level 10kV / 10kA..

All materials and construction procedures shall conform to the specifications contained herein, and as shown on the contract drawings or as required by the Engineer.

The complete luminaire shall conform to and meet all the current requirements of the National Electrical Manufacturers Association; American Standards Association; The Illuminating Engineering Society of North America; and the National Electric Code, wherever such standards shall apply, and in addition, the following specification shall apply.

Luminaires shall be of the IESNA distribution type, style, and appearance specified on the contract drawings.

INSTALLATION

The luminaire shall not be installed until the related control cabinet and underground wiring has been completed and tested.

All wiring shall be complete and shall only require attachment of the power supply leads. All power supply leads shall be clearly identified by means of a permanently attached metal tag. A color lead for bonding the luminaire shall be furnished with each unit in addition to the power supply leads. Any required splicing in the luminaire shall be accomplished with insulated, compression type connectors. Under NO CONDITIONS shall wire nuts or non-compression type connectors be allowed.

Luminaires shall be wired with #10 AWG cable as per specification with a fused street light connector, with appropriate fuse in the power lead with ampere rating as per luminaire manufactures recommendation. Luminaire pole installations shall be fused in the pole handhole.

All cables shall be identified with the appropriate colored marking tape. Neutral and Bonding leads shall be connected using insulated pressure connectors. Power leads from the handhole to the luminaire shall be rated for 600-volts only.

Upon completion of the installation, an operating test shall be conducted to demonstrate that the roadway lighting systems and associated equipment operate in accordance with the requirements of this Section.

The Contractor shall measure horizontal foot-candles on roadways and at other locations designated by the Engineer. Sufficient measurements shall be made to assure that distribution characteristics of luminaires conform to accepted luminaire photometric data. The photometer used for measurements shall measure illumination from 0.1 to 20.0 foot-candles. Instrument shall be calibrated by an accepted testing laboratory within 30 days of the test. Roadway illumination tests shall be performed in accordance with IES LM 50.

Prior to acceptance, the Contractor shall conduct a performance test involving operating the roadway lighting system, sunset to sunrise, for ten (10) consecutive days without interruption or failure. If a luminaire or driver fails, it shall be immediately replaced. This shall not require a restart of the test. The Contractor shall record each fault, the method and date of correction of each, and the beginning and end of the ten (10) day test.

If the performance test is conducted prior to all other tests, the Contractor shall energize and manually operate the entire lighting system, including control equipment for a minimum period of one hour to ensure that all connections were restored after testing.

The Contractor shall arrange to supply the electric power required to conduct the performance test if the permanent power is not available.

The luminaire shall be aimed so that the “street side” is toward the centerline of the adjacent roadway.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Measurement shall be made per each unit complete-in-place, tested, and accepted by the Engineer.

Payment shall be at the contract unit bid price for EACH unit, complete-in-place, which price shall include all labor, tools, equipment, materials, lamps, drivers, all wiring, connections, testing and all incidental expenses required to complete these items as required.

ITEM 823.61 HIGHWAY LIGHTING LOAD CENTER NO. 1 LUMP SUM

All work performed under this Item shall conform to the relevant provisions of Sections 813 and 820 of the Standard Specifications for Highways and Bridges, as amended, and the following:

GENERAL

The work to be done under this item shall consist of furnishing and installing a Highway Lighting Load Center and an electric service connection to the utility company's pole, of the type specified herein, and as detailed on the drawings. Highway Lighting Load Center shall be provided at the location shown on the plans or as required by the Engineer. The Contractor shall provide the Highway Lighting Load Center enclosure, concrete foundation, all electrical equipment, wiring, conduit, meter socket, and raceways, within the enclosure as specified herein and shown on the contract drawings.

A warranty for the electric service connection shall be provided to the utility company that all of the materials and workmanship meet the utility company's specifications and shall be free from defects for a period of five (5) years from the date the line is ready to be energized.

MATERIALS

The lighting control cabinet shall be constructed by the manufacture and factory wired to include all the components listed herein. The lighting control cabinet shall be UL 508 listed. The lighting control cabinet shall be Milbank, Myers Power Products (MEUG16), VIT Strong Box, or approved equivalent.

The lighting control cabinet shall be NEMA 3R and shall be constructed of aluminum or stainless steel to the minimum dimensions shown on the contract drawings. All seams shall be welded solid and ground smooth. Door hinges shall be continuous and constructed of stainless steel. The enclosure shall be provided with all required mounting hardware and anchor bolts to be mounted to the specified concrete foundation. Refer to contract drawings for paint finish.

The lighting control cabinet shall be provided with a customer compartment and a separate, lockable section for Electric Utility Metering equipment and electric service terminations. The distribution equipment in the customer compartment shall be behind an internal door.

The doors on the enclosure shall be constructed from the same material as the enclosure. The external door for the customer compartment shall be provided with louvers in the lower section and with filter frame and paper filter element on the inside of the enclosure. Additional hardware shall include a brass padlock, directory frame and eight sets of keys. Two sets of keys shall be sent to Eversource and six sets of keys shall be sent to the Town of Barnstable.

Anchor bolts shall be provided with the enclosure. The anchor bolts shall be galvanized steel. Galvanized steel nuts, lock washers, and flat washers shall be provided with the anchor bolts.

The Lighting Control Cabinet shall include the meter socket, panelboard, lighting contactor, HOA switch, receptacle, internal light fixture, and photo-electric switch control. All required electrical equipment shall be provided in the Lighting Control Cabinet by the manufacturer. All electrical equipment shall be factory wired. The Lighting Control Cabinet shall be shipped to the site ready for installation by the Contractor.

The lighting control cabinet shall be suitable for use for a 120/240 Volt, one (1) phase, three (3) wire electric service. The service and distribution equipment located within the cabinet shall be rated for 100 Amperes, minimum, with a fault current interrupting capacity of 10,000 Amperes

symmetrical.

The Highway Lighting Load Center shall be labeled as follows:

ROADWAY

LIGHTING

CONTROL

The label shall be factory stamped into the door of the Highway Lighting Load Center or aluminum placard. Text height shall be 1-inch tall.

INSTALLATION

All work shall be constructed as shown on the plans or as required by the utility company and required by the Engineer. The Contractor shall give adequate notice to the utility company for scheduling of work by utility.

Highway Lighting Load Center foundation shall be constructed as detailed on the Contract Drawings and to the relevant provisions of Section 801 of the Standard Specification for Highways and Bridges.

The Highway Lighting Load Center shall be installed atop the foundation as noted in this Specification and the Contract Drawings. The cabinet door shall face away from the roadway, or as required by the Engineer. It shall be determined that no obstruction, including a light pole, will interfere with opening, closing, or access to the controller.

Each location, as shown on the plans, may be diagrammatic only, and the location shall be such as to not interfere with access to private property or to detract from the general appearance of the area. The location shall not also inhibit pedestrian travel of the public way, including minimum obstruction free access of 3 feet. The Contractor shall call to the attention of the Engineer a location that may look objectionable before commencing work at the controller site.

The electrical equipment to be installed in each controller shall be securely fastened to the backboard in a neat and workmanlike manner. Electrical equipment shall be arranged in the controller and wired in accordance with the wiring diagrams on the detail sheets, or as specified herein.

Within the controller, the Contractor shall bind wire groups together with cable ties; and all conductors shall be permanently identified with circuit numbers using vinyl cloth, plasticized card stock tags with pre-printed legends. Tags shall be fastened to cables with cable ties.

The Contractor shall submit for approval a wiring diagram of the controller interior.

The photoelectric switch (cell) shall be located on the load center facing north.

METHOD OF MEASUREMENT

The Highway Lighting Load Center shall be measured as a complete installation, ground rods, concrete foundation, and two ground rods, fully operational, tested, and approved by the Engineer.

BASIS OF PAYMENT

Payment for the Highway Lighting Load Center shall be complete with all components, meter socket, conduit and wire, which shall be paid at the Contract Unit Price per LUMP SUM, complete, operational, tested, and accepted in place, and all equipment, tools, labor and work incidental

thereto, including concrete foundation, two ground rods, and photocell. The electric service connection shall be paid under Item 813.80.

ITEM 864.04 PAVEMENT ARROW AND LEGENDS (THERMOPLASTIC) SQUARE FOOT

The work under this item shall conform to the relevant provisions of Section 860 of the Standard Specifications and the following:

This item includes installing the yield symbols, bicycle lane symbols, turn arrows, and lettering where specified on the plans and/or as directed by the Engineer.

BASIS OF PAYMENT

Payment for work under this item shall be made at the contract unit price bid per square foot for Item 868.04 Pavement Arrow and Legends.

ITEM 864.1 COLOR SURFACE TREATMENT FOR PAVEMENTS SQUARE FOOT

The work shall be in accordance with the Standard Specifications for Highways and Bridges and Section 860 and the following. This work shall consist of furnishing and placing a Color Surface Treatment for pavements (CST) for bicycle safety, for bike boxes and approaches, lanes and other areas such as driveway crossings, at intersections and as identified in the Contract Drawings.

The CST shall be comprised of furnishing and installing a green or red color surface per Manual of Uniform Traffic Control Devices (MUTCD), and as shown on the plans.

The acceptable manufacturers and products and/or an equal manufactured product are as follows:

DBI Services
Epoxy binder with recycled & colorized aggregates (Green or Red)
Description: Installer of bicycle lanes using epoxy binder system with green for bicycle lanes or red for transit lane systems.
Contact: Richard Baker (rbaker@dbiservices.com)
(804) 213-0335
100 North Conahan Drive
Hazleton, Pennsylvania 18201
http://www.dbiservices.com/demarcation-colorized-pavement

Traffic Calming USA
TrafficGrip (Coated Stone – Color Coated Aggregates)
Resin-based binder with color aggregate binding system
Description: TrafficGrip bike lane green stone is applied using epoxy. Our product is warranted for 4 years against UV fading (*Link: TrafficGrip Colored aggregate data sheet pdf).*
Contact: Glyn Owen (glyn@trafficcalmingusa.com)
(770) 550-4044
317 A, NorthPoint Parkway
Acworth, Georgia, 30102
http://trafficcalmingusa.com/coloredstone.html

Ennis-Flint
CycleGrip®MMAX
Methyl-Methacrylate (MMA)
Description: Color lane surface ideal for long lane areas with low to high vehicle traffic including cross-over points such as parking lot entries/exits along the corridor.
Contact: Scott Seeley (sseeley@ennistraffic.com)
(800) 331-8118 ext. 3619
115 Todd Court
Thomasville, NC 27360
http://www.ennisflint.com/Products/Colored-Bike-Lanes/Cyclegrip

Ennis-Flint
PreMark
Pre-formed Thermoplastic
Description: Color lane surface ideal for intersections, bike boxes, and conflict points with high volumes of vehicle traffic and lane crossings.
Contact: Scott Seeley (sseeley@ennistraffic.com)
(800) 331-8118 ext. 3619
115 Todd Court
Thomasville, NC 27360
http://www.ennisflint.com/Products/Colored-Bike-Lanes/PreMark-Bike-Lane-Green

Transpo Industries, Inc.
Color-Safe®
Methyl-Methacrylate (MMA)
Description: Color-Safe® is your solution for long lasting bike paths, bus lanes, crosswalks, and pedestrian areas. It is an MMA based material that outperforms paint and epoxies in color retention and durability. Color-Safe® is available in standard and custom PMS colors and capable of full cure in a wide range of temperatures.
Contact: Michael S. Stenko (Mstenko@transpo.com)
(914) 636-1000
20 Jones Street
New Rochelle, NY 10801
http://www.transpo.com/color-safe/index.html

QUALITY CONTROL

General

The installer shall submit a minimum of three projects with the owner's contact information on which CST has been placed within the past three years. An installer who does not meet this minimum shall be allowed if they are certified by the manufacturer to install and a manufacturer's representative is onsite during installations.

Quality Control (QC) Plan

The QC plan for furnishing and installing the CST shall detail installer's key personnel, equipment, materials, proposed methods of installation, materials blending procedures, monitoring of ambient temperature, proposed methods of curing and corrective action plan. The Contractor shall submit a QC plan with any pertinent shop drawings and product literature and materials safety data to the Engineer for approval at least 30 days prior to placement of the Control Section.

Control Section

The Contractor shall construct a control section with a minimum area of one square yard for each color indicated on the Contract Drawings to represent the CST. The color, the surface texture, materials and installation, shall be presented for acceptance and approval by the Engineer and the Town of Barnstable Transportation Department prior to installation. The control section may be constructed as a CST on the project and if accepted may remain as part of completed work.

EQUIPMENT AND APPLICATION REQUIREMENTS

Construction Requirements

A manufacturer's representative shall be present at the jobsite during construction of the control section. All construction operations shall meet the manufacturer's recommendations. Final approval will be given by the Engineer.

Weather Limitations

CST shall not be placed on any wet surface or when the ambient temperature and humidity or the pavement temperature is below the manufacturer's recommendations or when the anticipated weather conditions would prevent the proper application and curing of the surface treatment as directed by the manufacturer's representative.

Surface Preparations

The surface shall be clean, dry and free of all dust, oil, debris and any other material that might interfere with the bond to the existing surface as recommended by the manufacturer's representative. The manufacturer's specification shall control the installation on any new HMA pavement paved in the previous 30 days with motor vehicle traffic or 60 days without motor vehicle traffic.

The contractor shall pre-treat any joints and cracks per the manufacturer's recommendation.

All existing edge line pavement markings that are adjacent to the CST location shall be covered and protected as approved by the Engineer prior to performing surface preparation. CST shall not be placed over existing pavement markings or rumble strips. Lane line pavement markings that conflict with the CST installation shall be removed by methods approved by the manufacturer's representative. Any existing edge line pavement markings that are damaged during the CST application process shall be replaced at the contractor's expense per direction of the Engineer.

CST shall be allowed to cure for the minimum duration as recommended by the binder component supplier's specifications and during that time the application area shall be closed to all vehicles and contractor's equipment traffic. After placement and cure of the CST, the Contractor shall test the finished surface to detect unbonded areas.

Excess and loose aggregate shall be removed from the traveled way and shoulders in such a way that the CST is not damaged or disturbed. Excess aggregate that can be reused shall be clean, uncontaminated and dry, if it is to be re-used in the CST application.

Utilities, drainage structures, curbs and any other structures within or adjacent to the treatment location shall be protected against the application of the CST materials.

Surface Friction

The Contractor shall meet as a minimum the friction value for the surrounding pavement surface.

Application Methods

CST shall be applied in accordance with the manufacturer's recommendations. The CST can be applied by either mechanical or manual techniques.

COMPENSATION

Method of Measurement

Item 864.1 will be measured for payment by the total square foot area of Color Surface Treatment for Pavements and shall be the actual number of square feet furnished and installed as directed and approved by the Engineer.

Basis of Payment

Work under Item 864.1 Color Surface Treatment for Pavements shall be paid for at the contract unit price per square foot which shall be full compensation for all labor, materials, tools, equipment, testing and incidental items necessary to complete the described work to the satisfaction of the Engineer.

ITEM 866.106 4-INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC) FOOT

ITEM 866.112 12-INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC) FOOT

ITEM 867.106 4-INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC) FOOT

The work to be done under these items shall conform to the relevant provisions of Section 860 of the MassDOT Standard Specifications and MassDOT Supplemental Specifications.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The work to be done under this contract will be paid for at the contract unit prices under the relevant items.

The accepted quantities of markings will be paid for at the contract unit price, which shall include the cost of furnishing all labor, materials and equipment required or incidental to satisfactorily complete the work. The cost of maintaining and protecting traffic during the marking operations shall be included in the bid price. No payment will be made for the repair or replacement of defective pavement markings.

Measurement of reflectorized lines shall be actual length.

ITEM 874.4 TRAFFIC SIGN REMOVED AND STACKED EACH

The work to be done under this item consists of dismantling, removing, and stacking existing warning and regulatory sign panels, including their supports and all mounting hardware, designated to be removed and stacked on the plans or as required by the Engineer. All signs and supports to be removed shall be transported and carefully stacked at the Department of Public Works Equipment Yard, and placed per the direction of the Town or Engineer.

METHOD OF MEASUREMENT

Each sign removed and stacked, including labor, material and equipment will be measured as one unit.

BASIS OF PAYMENT

The contract unit price paid for each sign removed and stacked shall include full compensation for furnishing all labor, tools, materials, equipment and incidentals, and for doing all the work, involved in removing, transporting and stacking of signs.

ITEM 877.1 SIGN POST REMOVED AND DISCARDED EACH

Work under this Item shall conform to the applicable provisions of Section 850 of the Standard Specifications and the following:

DESCRIPTION

The work shall consist of removing and discarding existing sign supports.

CONSTRUCTION METHODS

The sign supports and existing foundations shall be removed to a depth of at least 6 inches below the existing ground and the holes backfilled with gravel. The surface shall be patched with a material to match the existing ground or as required by the Engineer.

METHOD OF MEASUREMENT

Item 877.1, Sign Post Removed and Discarded, shall be measured per each sign support actually removed.

BASIS OF PAYMENT

Item 877.1, Sign Post Removed and Discarded, shall be paid at the contract unit price bid per each, which payment shall be considered as full compensation for all labor, tools, equipment, and materials required to complete the work as described above. Payment shall include dismantling, loading, transporting, and discarding of the signs supports as designated above, the excavating and disposal of the existing foundation and the supplying and placing of compacted gravel backfill where foundations and posts are removed, and the patching of the existing surface.