

# Town of Lunenburg

## 31 00 00 EARTHWORK

### PART 1 - GENERAL

#### 1.01 GENERAL REQUIREMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Long Form Requirements, apply to the work of this Section.
2. Examine all other Sections of the Specifications for requirements that affect work of this Section, whether or not such work is specifically mentioned in this Section.
3. Coordinate work with trades affecting, or affected by, work of this Section. Cooperate with such trades to assure the steady progress of all under the Contract.

#### 1.02 WORK INCLUDED

- A. Perform all earthwork required to complete the Work. Such work includes, but is not limited to, the following:
  1. Site excavation and filling as required to produce new contours required, including grading work for drainage, pavements, structures and associated facilities.
  2. Regrading and removal of existing site improvements, including paving materials, curbs, fencing, fence posts and footings, unless otherwise shown to be retained on the record drawings.
    - a. Relocate (raise or lower) existing utility covers as required.
    - b. Utilities and structures to be abandoned shall be removed to a depth of three (3) feet below grade minimum.

- c. Protect all utilities, trees, buildings and structures to remain.
  - d. Notify "Dig Safe" before excavating.
- 3. Perform special excavation as required to accommodate paving and structures, as necessary and/or as shown to complete the Work.
- 4. Provide required erosion, sedimentation and environmental controls necessitated by site, governing codes and as shown.
- 5. Do all rough grading, final grading, shaping, and compaction for required site work. Also, complete all landscaping, seeding, and site structures shown and/or required for the completion of the work.
- 6. Excavate and grade for all new pavement and all other items noted or required for the completion of the work. All excavations shall be checked and approved by the Engineer prior to backfill and compaction.
- 7. Backfill all excavations with suitable excavated material as defined herein. Provide any and all additional fill material as may be required at no additional cost to the Owner.
- 8. With the exception of excess loam which shall remain the property of the owner, dispose of all surplus excavated and unsuitable materials off the project site in legal and licensed disposal facilities.
- 9. Provide all required protection, enclosures and other temporary construction required by conditions, ordinances, etc., including all fences, barricades, guard rails, street plates, warning lights and other items as necessary and required by (life) safety codes. The Contractor shall use steel plates to cover all excavated areas open to vehicular traffic prior to final paving.
- 10. Perform all required pumping, dewatering, etc., necessary to maintain excavated spaces free of accumulated water.
- 11. Provide all shoring, bracing, sheet piling and similar protective construction as required to insure safe/secure operations.
- 12. Provide all other items of excavation, filling and related work reasonably inferred by the Drawings to make the work of this Section complete.

### 1.03 RELATED WORK

- A. Earthwork 31 00 00
- B. Site Clearing 31 10 00
- C. Dewatering 31 23 19
- D. Erosion Controls 31 25 00
- E. Asphalt Paving 32 12 16
- F. Hydroseeding 32 92 00
- G. Plants 32 93 00
- H. Storm Utility Drainage Piping 33 41 00
- I. Guard Rail 600-00
- J. Subsection 628: Impact Attenuators
- K. Culverts, Storm Drains and Sewer Pipes 230-00
- L. Precast Concrete Systems 03416
- M. Temporary Steel Plating
- N. Miscellaneous Specifications

### 1.04 REFERENCES

- A. The following standards and definitions are applicable to the work of this Section to the extent referenced herein:
  - 1. MassDOT Specifications: The Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, including latest revisions.
  - 2. ASTM: American Society for Testing and Materials.
  - 3. AASHTO: American Association of State Highway and Transportation Officials.
  - 4. MassDEP Stormwater Handbook dated February 2008

### 1.05 EXAMINATION OF SITE CONDITIONS

- A. The Contractor shall fully inform himself of existing conditions at the site before submitting his bid, and shall be responsible for carrying out all site work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the General Conditions
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct to the best of the Architect's knowledge, but the Contractor

- C. shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

#### 1.06 PERMITS, CODES, AND SAFETY REQUIREMENTS

- A. Comply with all rules, regulations, laws and ordinances of the City and State, and all other authorities having jurisdiction over the Project site. All labor, materials, equipment and services necessary to make the Work comply with such requirements shall be provided by the Contractor without additional cost.
- B. Comply with the provisions of the Manual for Accident Prevention in Construction of the Associated General Contractors of America, Inc., and the requirements of the Occupational Safety and Health Administration, United States Department of Labor.
- C. Procure and pay for all permits and licenses required for the complete work specified herein and shown on the Drawings.
- D. The Contractor shall not close or obstruct any street, sidewalk, or passageway without written permission from authorities having jurisdiction. The Contractor shall so conduct his operations as to interfere as little as possible with the use ordinarily made of roads, driveways, or other facilities near enough to the Work to be affected thereby.

#### 1.07 LAYOUT AND GRADES

- A. Maintain and/or reestablish benchmarks and survey monuments shown on the Drawings or found to exist on the site to provide a base reference for the construction. Replace any which may become destroyed or disturbed. Employ and pay all costs for a registered Civil Engineer or Surveyor who is licensed within the jurisdiction of the Project site to lay out all lines and grades in accordance with the Drawings and Specifications, and as necessary or required for construction.
- B. The words "finished grade" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, Project site areas shall be given uniform slope between points for which finished grades are indicated or between such points and existing established grades.

#### 1.08 PROTECTION OF EXISTING CONDITIONS

- A. All rules and regulations governing the respective utilities shall be observed by the

- B. Contractor in executing work under this Section. All work shall be executed in such a manner as to prevent any damage to existing buildings, streets, curbs, paving, service utility lines, structures and adjoining property.
- C. Locate and mark underground utilities to remain in service before beginning the work. Protect all existing utilities to remain during operations. Do not interrupt existing utilities except when authorized in writing by authorities having jurisdiction.
- D. When an active utility line is exposed during construction its location and elevation shall be plotted on the Record Drawing by the Contractor and both the Architect and the Utility Owner notified in writing.
- E. Provide barricades, fences, lights, signs, and all other safety devices required for the protection of the public.

#### 1.09 SAMPLES AND TESTING

- A. All operations under this Section of the Specifications shall be subject to observation of the Owner's Representative, and of a soils testing laboratory, engaged and paid directly by the Owner except as described herein. The laboratory will determine conformance of materials and workmanship, particularly compaction, to the requirements of these Specifications.
- B. The laboratory shall make such tests of materials and compaction as the Engineer directs. Costs of such tests shall be borne by the Contractor only when they indicate noncompliance of materials or compaction to the requirements of these Specifications. Cost of tests shall be borne by the Owner when they indicate compliance of materials or compaction to the requirements of the Specifications.
- C. Contractor shall provide a sieve analysis sample of each fill material from each proposed source including on-site. Additional samples shall be provided if a change in material type occurs at the borrow source. Allow a minimum of three working days for testing evaluation before material is needed. Submit samples from alternate sources if intended for use.
- D. The laboratory will defer testing of an area until the Contractor states that he has reached the specified compaction on the particular area. The laboratory will make a reasonable number of tests or visual examinations of materials proposed for fill at no charge to the Contractor, but the owner reserves the right to make charges for such tests where Contractor repeatedly proposes marginal materials for test or examination.

- E. Areas for which tests indicate insufficient compaction shall be re-compacted and retested until the areas conform to the requirements of the Specifications. Cost shall be borne by Contractor.

#### 1.10 RECORD DRAWINGS

- A. The Contractor shall submit to the Owner a set of as-built drawings for work covered under these Specifications. The drawings shall be prepared upon reproducible copies of the Contract Documents supplied by the Owner, both paper and an electronic file shall be supplied.
- B. As-built drawings shall record all changes made during construction with respect to materials, layout, grading contours and spot elevations, all as compared to the original Contract Drawings.

#### 1.11 DUST CONTROL

- A. During the construction period, the Contractor shall take special measures including, but not limited to, wetting down to control dust on site, in order to prevent annoyance/and or damage to adjacent property, whether public or private. Calcium chloride or any other chemical material may not be used on subgrades of areas to be seeded or planted.
- B. The Contractor shall take all necessary measures to keep streets over which equipment and service for project travel, clean and free from dirt, dust, mud and debris resulting from construction operations. The actions taken shall meet the requirements of all parties having jurisdiction.

### PART 2 - PRODUCTS

#### 2.01 FILL MATERIALS

- A. Fill materials shall conform to the following material descriptions. Gradation requirements shall be determined by AASHTO T11 and T27. All fill materials shall meet the following requirements:
  - 1. GRAVEL, also referred to as “free draining gravel” and “crushed bank run gravel”, shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings, and deleterious materials. Gradation shall conform to MassDOT Specification Designation, M1.03.1, and the following:

<u>U.S. Sieve No.</u>	<u>Percent Passing by Weight</u>
3"	100
1 1/2"	70-100
3/4"	50-85
#4	30-60
#200	0- 10

Maximum size of stone in gravel shall be two inches (2") largest dimension.

2. CRUSHED STONE shall consist of inert angular material derived from a stone quarry that is hard, durable, washed stone, free of deleterious materials. Gradation shall conform to MassDOT Specification Designation, and the following:

<u>U.S. Sieve No.</u>	<u>Percent Passing by Weight</u>
2"	100
1 3/4"	90-100
1 1/2"	10- 50
1 1/4"	0- 20
1"	0- 5

3. ORDINARY BORROW: Well-graded, natural, inorganic soil approved by the Engineer and meeting the following requirements:
  - Ordinary Borrow shall have no more than 2% organic matter, be free of weak, compressible or frozen materials, and of stones larger than eight inches in dimension. It shall not contain granite block, concrete, masonry rubble, roots, stumps or other similar materials.
  - It shall be of such nature and character that it can be compacted to the specified densities.
  - Topsoil and the zone directly below the topsoil indicated on the drawings as "subsoil" shall not be considered Ordinary Fill nor shall topsoil or subsoil stockpiled on the site. Where subsoil is encountered, it shall be stripped separately from the topsoil and the granular material directly beneath the subsoil. This excavated material shall only be utilized in lawn areas, or other non-structural areas, and shall be placed in these areas at

- distances away from adjacent site improvements as specified herein or as directed by the Engineer.
  - It shall have a minimum dry density of not less than 115 pounds per cubic foot.
  - Material from excavations on the site may be used as Ordinary Fill if it meets the above requirements.
- B. Uses of Fill Materials: Fill materials listed above shall be utilized as follows and as otherwise indicated on the Drawings, specified or directed.
1. Gravel:
    - a. Base for all walkways, pavements, pipe cover and as required by drawings.
    - b. Backfill beneath structures and/or pavement.
  2. Crushed Stone:
    - a. Pipe bedding and as fill around perimeter/infiltrator drains.
  3. Ordinary Borrow:
    - a. Raise in grade or fill condition as outlined in the drawings.

## 2.02 EROSION AND SEDIMENTATION CONTROL MATERIALS

- A. Straw bales shall be wire or nylon bound bales of straw. Provide two inch by two inch (2" x 2") hardwood stakes to secure bales.

## PART 3 - EXECUTION

### 3.01 GRADES AND ELEVATIONS

- A. The Drawings indicate, in general, alignments, grade elevations and invert elevations. Establish the lines and grades in conformity with the Drawings. The Engineer, however, may make such adjustments in the field in grades and alignments as are found necessary in order to avoid interference with any special conditions encountered.
- B. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas shall be given uniform slopes between points for which finished grades are indicated or between such points and existing established grades.



- C. Establish and maintain suitable stakes over all areas to be graded as directed, specified or required. Maintain sufficient reference points at all times during construction to properly perform the work of this Section.

### 3.02 EXCAVATION

- A. Excavation shall include the removal of all materials of every description, including ledge, rock or boulders throughout the limit of work.
- B. Materials to be excavated shall include organic and inorganic silts, peat, clays, sand, and gravel; pavement, cobbles, and boulders; soft or disintegrated rock; brick and concrete masonry; and all other obstructions not included in other Sections.
  - 1. Unsuitable materials for use as backfill are defined as organic matter, silt, peat, or any combination thereof having unsuitable in-situ bearing properties; and all materials that are too loose or saturated to provide satisfactory bearing when used for backfill.
  - 2. If unsuitable material is encountered at the depths indicated on the Drawings for bottom limit of excavation, the Contractor shall immediately notify the Owner and shall not proceed further until instructions are given.
- C. The ground adjacent to all excavation shall be graded to prevent running in. The Contractor shall remove by pumping or other means as approved by the Engineer, any water accumulated in excavation and keep the trench de-watered until the bedding is complete. No extra payment will be made for any pumping that may be required.
- D. The Contractor shall provide all bracing, sheathing and shoring necessary to perform and protect all excavation as indicated in the Drawings, as required for safety, or to conform to governing laws and as required by a certified engineer. No extra payment will be made for any bracing, sheathing or shoring.
- E. All unsuitable material shall be removed from beneath slabs-on-grade and footings. Excavation subgrades shall be proof-rolled by four coverages of a vibratory roller or plate compactor having a centrifugal force of at least 2 tons.
- F. No excavation shall be deposited or stockpiled at any time so as to endanger portions of the new or an existing structure, either by direct pressure or indirectly by overloading banks contiguous to the operation. Material, if stockpiled, shall be stored so as not to interfere with the established sequence of the construction. If there is not sufficient area available for stockpiling within the limits of the project, the Contractor will be required

to furnish his own area for stockpiling. No excavation shall be deposited within existing tree protection zones.

- G. Comply with local safety regulations and with provisions of "Accident Prevention in Construction" published by the Associated General Contractors of America, Inc. as well as OSHA Safety and Health Guidelines.
- H. When the Drawings require excavation in areas in close proximity to existing roads, structures and utilities it shall be the responsibility of the Contractor at his expense to construct suitable drainage ditches or use other satisfactory means and methods to protect and maintain the stability of such roads, and structures located immediately adjacent to but outside the limits of excavation.

### 3.03 DEWATERING

- A. Keep excavation continuously free of water from all sources without extra cost to the Owner. Provide, maintain and operate pumps and related equipment, including standby equipment of sufficient capacity to keep excavations free of all water at all times and under any and all contingencies that may arise until the completion of the Contract.
- B. Dispose of water through temporary pipelines or ditches with discharge to suitable outfall points. Prevent erosion of surrounding areas. Protect roads and other improvements on the site. Build temporary culverts if required. At completion of dewatering, remove temporary facilities and restore subgrade, and damaged areas.

### 3.04 SHEETING AND SHORING

- A. Provide necessary shoring, bracing and sheeting as required to assure against collapse of excavation sides. Comply with local safety regulations and with provisions of "Accident Prevention in Construction" published by the Associated General Contractors of America, Inc. as well as OSHA Safety and Health Guidelines.
- B. All sheeting, shoring, and bracing involved shall be removed by the Contractor after the completion of the permanent structure, in a manner so as not to disturb or mar the structure. Sheeting may be left in place only by written permission from Engineer, subject to such conditions as the Architect may require. No payment will be made by the Owner for such sheeting and shoring and bracing so left in place.
- K. Do not excavate to full depth in freezing weather unless concrete or backfill can be placed immediately. Following the pouring of concrete footings, the soil beneath these footings shall be protected from frost to the satisfaction of the Architect.

### 3.05 ROCK EXCAVATION

#### A. Limits of Rock Excavation:

1. Pipe trenches to limits outlined in below.
2. Two feet below finish grade, or to the normal excavation depths as indicated on the drawings, unless otherwise determined by the Architect to facilitate footings, etc.
3. All ledge or boulder excavation encountered and required to be removed for the construction of work defined on the Drawings and required under this Contract, as being within the Contract limits.

#### B. Blasting:

1. No blasting shall be allowed on site.

#### C. Pay Limits for Rock Excavation: The cost of rock removal shall be paid to the Contractor as an additional cost if the quantities meet the following criteria.

1. Boulders greater than 2 cubic yards in open excavation.
2. Boulders greater than 1 cubic yard in trench excavations.
3. Intact rock that cannot be excavated using dozer having a ripper attachment or equivalent, or a pneumatic ram hammer.

### 3.06 FILLING, BACKFILLING AND COMPACTION

#### A. Placing Fills and Compacting:

1. All areas to be filled or backfilled shall be free of construction debris, refuse, compressible or decayable materials and standing water. Do not place fill when fill materials or material below it are frozen. No fill materials containing ice or frozen lumps shall be used.
2. The Contractor shall notify the Engineer when excavation is ready for formal inspection. Filling and backfilling shall not be started until conditions have been approved by the Engineer.
3. The Engineer reserves the right to disapprove of compaction equipment being used for compacting if he deems the equipment in use to be unsuited or inadequate to compact materials to the specified densities and within a reasonable length of time.

4. Compacted subgrade shall be the graded surface prior to any fills. Rough grade shall be the top surface of gravel, crushed stone and ordinary fill ready to receive the final surface material application. Unless stated otherwise, all rough grades shall represent compacted material depths, as specified herein.
5. At the completion of excavation and before placing any fills, proof-roll compact subgrades to the same compaction levels required for placed fills as required hereinafter. Compaction procedure shall be approved by the Engineer. Subgrade compaction shall be tested by the testing laboratory before proceeding further.
6. All fill is to be placed "in-the-dry", to which end dewatering may be required. Spreading and drying of each layer may also be required.
7. Conversely, if the testing laboratory determines that the fill is too dry for proper compaction, water shall be added to provide the specified optimum moisture content, as necessary for proper compaction.
8. Compaction of each lift shall be as specified herein and as determined by ASTM Test, Designation D1556. Fill shall be placed in successive horizontal lifts no thicker than six inches and compacted to the required density as specified herein. Maximum dry density shall be determined in accordance with ASTM D1557, Method D. The following percentages of maximum dry densities shall be achieved for fill materials or prepared subgrades.
  - a. Under structures, footings, paved surfaces, drainage piping, utilities and other improvements:
    1. All fills 95%
    2. Top twelve inches of subgrades in cut 95%
  - b. Within lawn and planting areas:
    1. All fills to within eighteen inches of finished subgrade 90%
    2. Top eighteen inches to finished grade 88%-90%
9. In the case of lawn and planting areas, compaction requirements for subgrades and fills shall be considered minimums and maximums within the density percentages called for, and any over-compaction of subgrades or fills which would be detrimental to lawn or planting objectives shall be corrected by loosening subgrades or fills through tilling or other means and re-compacting to specified compaction limits.

10. The Contractor shall notify the Engineer three (3) days in advance when the rough grades are established and ready for formal inspection.

### 3.07 BACKFILLING OF TRENCHES AND STRUCTURES

- A. All requirements for description, placement, compaction and spreading of fill materials as specified herein shall be applicable to backfilling operations.
- B. Backfill materials as specified herein shall be used as bedding and backfill around drainage pipes, around structures and for other uses as illustrated on the Drawings.
- C. Do not commence backfilling operations for trenches and structures until all piping, etc., has been installed, tested and approved, and the locations of all pipe and appurtenances have been recorded. Backfill carefully by hand around pipe to depth of one foot above top of pipe using material specified herein, and tamping firmly in layers not exceeding six inches, compacting with hand rammers or mechanical tampers.
- D. Backfill materials as specified shall be placed to the full width of the trench as indicated on the Drawings. After a pipe is bedded, the trench shall be filled to the centerline of the pipe with fill as specified except at the joint. After the joint is inspected, that portion shall be filled in. Material under and around the pipe shall be carefully and thoroughly compacted to the densities specified herein.
- E. From the centerline of the pipe to a point twelve inches above the top of the pipe the backfill shall be placed by hand and compacted with mechanical tampers to not less than 95% of maximum density at optimum moisture content of the material. Above this point, backfill may be placed by machine in layers six inches (6") deep and compacted to the densities specified herein. This backfill shall be extended as shown on the Detail Drawings. Backfill simultaneously on all sides of pipe or structure.

### 3.08 ROUGH GRADING

- A. Rough grading shall include the shaping, trimming, rolling, and refinishing of all surfaces of the sub-base, shoulders, and earth slopes, and the preparation of grades as shown on the Drawings. The grading of shoulders and sloped areas may be done by machine methods. All ruts shall be eliminated. Traffic of workers and equipment across soil subgrade areas shall be prohibited following excavation to the required lines and grades.
- B. If, during the progress of the Work, any pipe, drain or other construction is damaged due to operations under this Contract, the Contractor shall repair all damage at no additional cost to the Owner and restore damaged areas to their original conditions.

- C. Do all other cutting, filling and grading to the lines and grades indicated on the Drawings. Grade evenly to within the dimensions required for grades shown on Drawings and as specified herein. No stones larger than four inches (4") in largest dimension shall be placed in upper six inches (6") of fill. Fill shall be left in a compacted state at the end of the work day and sloped to drain.
- D. The Contractor shall bring all areas to grades as shown on the Drawings and in the details. The Architect, however, may make such adjustments in grades and alignments as are found necessary to avoid special conditions encountered.
- E. No rubbish of any description shall be allowed to enter fill material. Such material shall be removed from the site and are legally disposed of.
- F. Wherever items contained within or outside the Limit of Contract lines have been excavated in fulfilling the work required under this Contract, this Contractor shall furnish and install all materials necessary to bring finish surfaces level with the existing adjacent surfaces. All work shall be installed to match the existing conditions in accordance with the governing authority. Notify the proper authorities prior to restoring surfaces outside the Contract Limit Lines.
- G. Placed fill materials which become disturbed shall be regraded and re-compacted. Fill materials which become contaminated shall be removed and replaced, as directed by the Engineer.

### 3.10 FINISH GRADING

- A. Finish grading shall be completed with a laser grading system. Finish grading equipment shall include a computer controlled hydraulic system on rubber flotation tires with a maximum tolerance within one quarter inch (.25") of the grades as specified on the grading plans. The operator(s) completing the finish grading shall be familiar with the equipment and be able to satisfactorily achieve the grades within the specified tolerance.

### 3.10 EROSION AND SEDIMENTATION CONTROL

- A. The Contractor shall provide suitable and adequate means of temporary protection during construction, to prevent erosion, siltation and sedimentation of construction areas, and on-site and off-site undisturbed areas. This work shall be accomplished adjacent to or in the following work areas:
  - 1. Topsoil stockpiles and on-site storage and staging areas.
  - 2. Cut and fill slopes and other stripped and graded areas.
  - 3. Constructed and existing swales and ditches.
  - 4. At all basins and structures.

- B. Means of protection shall be required to provide continuous erosion control protection throughout the construction period.
- C. Installation and maintenance procedures for erosion control devices shall, unless designated otherwise, conform to the "Erosion and Sedimentation Control Guidelines," specified herein.
- D. All materials required for erosion control shall be provided by the Contractor at no additional expense to the Owner.

### 3.11 REMOVAL OF SURPLUS AND UNSUITABLE MATERIALS

- A. With the exception of excess topsoil which will remain the property of the owner, surplus excavated materials not required to complete site construction and unsuitable excavated materials shall, unless directed otherwise by the Engineer, become the property of the Contractor who shall remove and legally dispose of such materials from the site at no additional cost to the Owner. Excess topsoil shall be screened to 3/4" and delivered to a Town of Lunenburg DPW facility.
- B. At the end of all excavation, filling and grading operations and before acceptance of the work, the Contractor shall remove all debris, rubbish, etc., from the site. He shall dispose of them in a manner satisfactory to the Engineer. The premises shall be left clean, presentable, and satisfactory.

END OF SECTION

SECTION 31 10 00  
SITE CLEARING

PART 1-GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Protecting existing trees and vegetation to remain, including temporary fencing for trees in close proximity to construction operations.
  2. Removing existing trees and vegetation indicated to be removed.
  3. Clearing and grubbing.
  4. Stripping and stockpiling topsoil.
  5. Removing above and below grade site improvements.
  6. Protection of Existing Utilities.
  7. Utility Demolition as required to accommodate new construction.
  8. Protection and Abandonment of Utilities.
  9. Disconnecting, capping or sealing of utilities as required.
- B. Alternates: Not Applicable.
- C. Items To Be Installed Only: Not Applicable.
- D. Items To Be Furnished Only: Not Applicable.
- E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 310000 – EARTH MOVING for soil materials, excavating, backfilling, and site grading and removal of site utilities.
  2. Section 312500 – EROSION AND SEDIMENTATION CONTROLS for required erosion and sedimentation control measures.



### 1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.
- B. Tree Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and defined by the drip line of individual trees or the perimeter drip line of groups of trees, unless otherwise indicated.

### 1.4 MATERIAL OWNERSHIP

- A. Except for stripped topsoil or other materials indicated to remain the Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

### 1.5 SUBMITTALS

- A. Refer to SECTION 013300 – SUBMITTALS for submittal provisions and procedures.
  - 1. Schedule indicating proposed sequence of operations for demolition work for review prior to start of work. Include coordination for shutoff, capping, and continuation of utility services as required, together with details for dust and noise protection.
    - a. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations.
    - b. Coordinate with Owner's continuing occupation of portions of existing roadside culvert, building, adjacent buildings, and with Owner's partial occupancy of completed portions of proposed building or additions.
  - 2. Preconstruction survey photographs sufficiently detailed, of existing conditions of existing buildings, trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Refer to Project Close Out section for further information.

### 1.6 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other

- B. adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner's Representative and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on the Owner's premises where indicated.
- D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. Contact 888-344-7233
- E. Do not commence site clearing operations until erosion and sedimentation control measures are in place.
- F. Protection of Existing Improvements: Provide protection necessary to prevent damage to existing improvements indicated to remain in place or outside of the limit of work. Protect improvements on adjoining properties and on the Owner's property.
  - 1. Restore improvements damaged by Contractor's clearing activities to their original condition, at no additional expense to the Owner.

#### 1.7 EXAMINATION OF SITE AND DOCUMENTS

- A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of a lack of knowledge of existing conditions as indicated in the Construction Documents, or obvious from observation of the site.
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

### PART 2-PRODUCTS (NOT USED) PART

#### 3-EXECUTION

##### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.

- B. clearly flag trees and vegetation to remain or to be relocated Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to the Owner's Representative.

### 3.2 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
  - 1. Do not store construction materials, debris, or excavated material within fenced area.
  - 2. Do not permit vehicles, equipment, or foot traffic within fenced area.
  - 3. Maintain fenced area free of weeds and trash.
  - 4. Except as otherwise directed, cutting and trimming of existing trees will not be permitted.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Where excavation for new construction is required within tree protection zones, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
  - 1. Cover exposed roots with burlap and water regularly.
  - 2. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
  - 3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
  - 4. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the Designer.
  - 1. Employ an arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
  - 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the Designer.

### 3.3 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities. The Contractor is responsible for coordinating and scheduling with the authorities having jurisdiction the removal and/or abandonment of existing utilities as required to complete the work.
  
- B. Existing Utilities: Do not interrupt utilities serving facilities occupied by the Owner's Representative or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify the Owner's Representative not less than two days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without the Owner's Representative's written permission.
  
- C. Utility pipes designated to be abandoned in place shall be plugged at their ends with watertight brick masonry or cement mortar with a minimum thickness of 8 inches.
  
- D. Utility pipes designated to be removed shall consist of the complete removal and disposal of the entire length of pipe and backfill and compaction of the void with ordinary borrow. When the void is within the footprint of a new building, gravel borrow shall be used to backfill the void.
  
- E. Utility structures designated to be abandoned in place shall have their cast iron castings removed and disposed, inlet and outlet pipes plugged, the bottom of the structures shall be broken, the void of the structure shall be backfilled and compacted with ordinary borrow, and the top of the structure shall be removed so that it is at least 36 inches below finished grade.
  
- F. Utility structures designated to be removed shall consist of the removal and disposal of cast iron castings, plugging of inlet and outlet pipes, removal of the structure, and backfill and compaction of the void with ordinary borrow. When the void is within the footprint of a new building, gravel borrow shall be used to backfill the void.

### 3.4 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
  3. Grind stumps and remove roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.
  4. Use only hand methods for grubbing within tree protection zone.
  5. Chip removed tree branches and dispose off-site.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

### 3.5 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil, if necessary.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and non-soil materials from topsoil, including trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust or contamination by air-borne weed seed.
1. Limit height of topsoil stockpiles to 72 inches.
  2. Do not stockpile topsoil within tree protection zones.

### 3.6 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- B. Remove paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

### 3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions,

demolished materials, and waste materials including trash and debris, and legally dispose of them off the Owner's property.

1. Burning on site is prohibited.
2. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

### 3.8 CLEANUP AND REPAIR

- A. General: Upon completion of demolition work, remove tools, equipment, and demolished materials from site.
- B. Repair demolition performed in excess of that required. Return elements of construction and surfaces to remain to condition existing prior to start operations. Repair adjacent construction or surfaces soiled or damaged by site demolition work.

END OF SECTION

SECTION 312319  
DEWATERING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Construction dewatering.
- B. Alternates: Not Applicable.
- C. Items To Be Installed Only: Not Applicable.
- D. Items To Be Furnished Only: Not Applicable.
- E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
  - 1. Section 310000 – EARTH WORK for excavating, backfilling, site grading, and for site utilities.

1.3 PERFORMANCE REQUIREMENTS

- A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
  - 1. Delegated Design: Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer registered in the Commonwealth of Massachusetts, using performance requirements and design criteria indicated. All costs for delegated design shall be included in the bid price for the Work of this Section.
  - 2. Test liquids for hazardous waste at the start of construction operations and provide on- site remediation as acceptable to authorities having jurisdiction. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of

excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.

3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.

#### 1.4 SUBMITTALS

- A. Shop Drawings: For dewatering system. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
  1. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
  2. Include a written plan for dewatering operations including control procedures to be adopted if dewatering problems arise.
- B. Delegated-Design Submittal: For dewatering system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation. Dewatering system must be approved by the Town of Lunenburg prior to implementation.
- C. Other Informational Submittals:
  1. Photographs: Show existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by dewatering operations.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer that specializes in dewatering work.
- B. Regulatory Requirements: Comply with governing EPA and Massachusetts Department of Environmental Protection notification regulations before beginning dewatering.



- C. Comply with hauling and disposal regulations of authorities having jurisdiction.
- D. Preinstallation Conference: Conduct conference at Project
  - 1. Review methods and procedures related to dewatering including, but not limited to, the following:
    - a. Inspection and discussion of condition of site to be dewatered including coordination with temporary erosion control measures and temporary controls and protections.
    - b. Proposed site clearing and excavations.
    - c. Existing utilities and subsurface conditions.
    - d. Coordination for interruption, shutoff, capping, and continuation of utility services.
    - e. Construction schedule. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
    - f. Testing and monitoring of dewatering system.
    - g. Control of dewatering equipment during non-work hours.

#### 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by the Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify Owner's Representative no fewer than two days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without Owner's Representative's written permission.

### PART 2 – PRODUCTS

(Not Used)

### PART 3 - EXECUTION

#### 3.1 PREPARATION

- A. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by

dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site and surrounding area.
  2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
1. Do not close or obstruct streets, or other adjacent occupied or used facilities without permission from the Owner's Representative and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Monitor dewatering systems continuously.
- E. Promptly repair damages to adjacent facilities caused by dewatering.
- F. Protect and maintain temporary erosion and sedimentation controls, which are specified in Section 312500 - EROSION AND SEDIMENTATION CONTROLS during dewatering operations.

### 3.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
1. Space well points or wells at intervals required to provide sufficient dewatering.
  2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Before excavating below ground-water level, place system into operation to lower water to specified levels. Operate system continuously until drains and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- C. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
1. Do not permit open sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability

- D. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
  - 1. Maintain piezometric water level a minimum of 24 inches below surface of excavation.
- E. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- F. Provide standby equipment on site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails. If dewatering requirements are not satisfied due to inadequacy or failure of dewatering system, restore damaged structures and foundation soils at no additional expense to the Owner.
  - 1. Remove dewatering system from Project site on completion of dewatering.
- G. Damages: Promptly repair damages to adjacent facilities caused by dewatering operations.

### 3.3 FIELD QUALITY CONTROL

- A. Observation Wells: Provide, take measurements, and maintain at least the minimum number of observation wells or piezometers indicated; additional observation wells may be required by authorities having jurisdiction.
  - 1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.
  - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
  - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

END OF SECTION

SECTION 31 25 00  
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the GENERAL CONDITIONS and all Sections which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Control measures to prevent all erosion, siltation and sedimentation of wetlands, waterways, construction areas, adjacent areas and off-site areas.
  2. Control measures shall be accomplished adjacent to or in the following work areas:
    - a. Soil stockpiles and on-site storage and staging areas.
    - b. At edge of wetlands areas, if applicable, as shown on Drawings.
  3. The Contract Drawings indicate the minimum requirements for sedimentation and erosion control. The Contractor shall install all measures needed to control sediment and erosion as required by the Contractor and Sub-contractor's construction methods and operations, the weather conditions, and as directed by the Engineer.
  4. Additional means of protection shall be provided by the Contractor as required for continued or unforeseen erosion problems, at no additional cost to the Owner.

5. Periodic maintenance of all sediment control structures shall be provided to ensure intended purpose is accomplished. Sediment control measures shall be in working condition at the end of each day.
  6. After any significant rainfall, sediment control structures shall be inspected for integrity. Any damaged device shall be corrected immediately.
- B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
1. Section 311000 – SITE CLEARING for protection of existing trees and other vegetation to remain.
  2. Section 310000 – EARTH WORK for soil materials, excavating, backfilling, and site grading and removal of site utilities.

### 1.3 SUBMITTALS

- A. Refer to GENERAL CONDITIONS for submittal provisions and procedures.
1. (If SWPPP is provided by the Contractor) At least 20 days prior to the start of the project, the Contractor shall submit a Storm Water Pollution Prevention Plan (SWPPP) indicating project phasing, Contractor operation areas, work areas, stockpile locations, construction staging/sequencing, and sedimentation/erosion control measures to be used. The SWPPP shall be prepared to meet the requirements of the United States Environmental Protection's (EPA) National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges From Construction Activities (GCP). The Contractor shall also submit the EPA "Notice of Intent for Storm Water Discharges Associated with CONSTRUCTION ACTIVITY Under a NPDES General Permit." (NOI) form. This form shall be submitted to the EPA at least 14 days prior to the start of any construction activity and placing a signed copy along with proof of mailing in the SWPPP.
  2. As part of the Contract Closeout procedures, the Contractor is responsible for filing a Notice of Termination with the EPA once the project has been completed and is permanently stabilized. Stabilization is complete when all temporary storm water and erosion controls have been removed, all permanent storm water and erosion controls are in place and functional and all vegetated areas are at

least 70% viable.

3. The Contractor shall provide the manufacturer's literature, material specification, and installation instructions for sedimentation and erosion control materials and devices for approval. Do not order materials until approval of certifications or test results has been obtained. Delivered materials shall match the approved submittals.
4. LEED Supporting Documentation: Submit LEED supporting documentation as outlined in Section 018110 SUSTAINABLE DESIGN REQUIREMENTS for materials and products that have been extracted, harvested, or recovered, as well as manufactured within 500 miles of the project site.

#### 1.4 QUALITY ASSURANCE

- A. The specifications and drawings are not represented as being comprehensive, but rather convey the intent to provide complete slope protection and erosion control for both the project site and adjacent property.
  1. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to a sediment and erosion control plan specific to the site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- B. Erosion control measures shall be established at the beginning of construction and maintained during the entire period of construction. On-site areas which are subject to severe erosion, and off-site areas which are especially vulnerable to damage from erosion and/or sedimentation, are to be identified and receive special attention.
- C. The Contractor shall install and maintain sedimentation control devices during construction to prevent the movement of sediment from the construction site to off site areas, into adjacent water bodies via surface runoff or into underground drainage systems. Measures to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at no additional cost to the Owner.
- D. All land-disturbing activities are to be planned and conducted to minimize the size of the area to be exposed at any one time, and the length of time of exposure.
- E. Surface water runoff originating upgrade of exposed areas should be controlled to reduce erosion and sediment loss during the period of exposure.
- F. When the increase in the peak rates and velocity of storm water runoff resulting from a land- disturbing activity is sufficient to cause accelerated erosion of the receiving stream bed, provide measures to control both the velocity and rate of release so as to minimize accelerated erosion and increased sedimentation of the stream.

- G. All land-disturbing activities are to be planned and conducted so as to minimize off-site sedimentation damage.
- H. The Contractor is responsible for cleaning out and disposing of all sediment once the storage capacity of the sediment facility is reduced by one-half.
- I. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- J. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

#### 1.5 REFERENCE STANDARDS

- A. The following standards are applicable to the work of this Section to the extent referenced herein:
  - 1. "Massachusetts Erosion and Sedimentation Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers and Municipal Officials", prepared by the Massachusetts Department of Environmental Protection, Bureau of Resource Protection, dated March 1997, reprinted May 2003.

#### 1.6 EXAMINATION OF SITE AND DOCUMENTS

- A. It is hereby understood that the Contractor has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of a lack of knowledge of existing conditions as indicated in the Contract Documents, or obvious from observation of the site.
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct, but the Contractor shall have examined them for himself during the bidding period and formed his own conclusions as to the full requirements of the work involved.

#### 1.7 PERMITS, CODES AND REGULATIONS

- A. Comply with all rules, regulations, laws and ordinances of the City and State, and all other authorities having jurisdiction over the project site. All labor, materials, equipment and services necessary to make the work comply with such requirements shall be provided by the Contractor without additional cost to the Owner.
- B. Comply with all applicable regulations of the Commonwealth of Massachusetts Department of Environmental Protection (DEP) and the EPA.

## PART 2-PRODUCTS

### 2.1 MATERIALS

- A. Straw Bales: Wire or nylon bound bales of straw, oriented around sides, rather than over and under.
- B. Stakes: Stakes for bales shall be one of the following materials: Wood stakes of sound hardwood 2 by 2 inches in size or steel reinforcing bars of at least No. 4 size. Lengths shall be approximately three feet.
- C. Straw Wattles
  - 1. Straw wattles shall consist of weed free rice straw inside biodegradable netting. Straw wattles shall measure at least nine (9) inches in diameter.
  - 2. Stakes for wattles shall be one of the following materials. Lengths shall be approximately two feet (2').
    - a. Wood stakes of sound hardwood, one inch by one inch (1" x 1") in size.
    - b. Steel reinforcing bars of at least No. 4 size.
- D. Siltation Fence
  - 1. Fabricated or prefabricated unit consisting of the following filter fabric properties:

a. Grab Tensile Strength (lbs)	124	ASTM D4632
b. Elongation at Failure (%)	15	ASTM D4632
c. Mullen Burst Strength (PSI)	280-300	ASTM D3786
d. Puncture Strength (lbs)	60-65	ASTM D4833
e. Water Flow Rate (gal/min/sf)	8-10	ASTM D4491
f. Apparent Opening Size (Sieve)	30	ASTM D4751
g. Ultraviolet Radiation Stability (%)	70-80	ASTM D4355
  - 2. Use only commercially available fabric that is certified in writing by the manufacturer for the purpose intended.
  - 3. Acceptable fabric materials include "Mirafi Envirofence" by Mirafi Construction Products, "Style 2130" by Amoco Fabrics Co., and "IVI 3617C Silt Fence" by



Indian Valley Industries, Inc., or approved equal by the Engineer.

4. Silt fence posts: Posts may be wood or metal. Wood post shall be a minimum 1 1/4 inch by 1 1/4 inch by 5 feet long hardwood stakes commonly used to support siltation fabric. Metal posts shall be a minimum of 1 inch wide and 5 feet long. Posts shall be spaced at a maximum distance of 8 feet on center.
- E. Fencing: Steel posts shall be standard 6-foot-long metal stamped drive stakes commonly used to support snow fences. Fencing shall be new four-foot height wood lath snow fencing. Provide suitable steel staples or heavy nylon cord for securing filter cloth to support system.
- F. Crushed Stone: Crushed Stone: Crushed stone shall consist of durable crushed rock or durable crushed gravel stone, free from ice and snow, sand, clay, loam, or other deleterious or organic material. The crushed stone shall be uniformly blended and shall conform to the following requirements.

<b>Percent Passing by Weight</b>		
<b>Sieve Size</b>	<b>1 1/2-inch Stone</b>	<b>3/4-inch Stone</b>
2-inch	100	---
1 1/2-inch	95-100	---
1 1/4-inch	---	---
1-inch	35-70	100
3/4-inch	0-25	90-100
1/2-inch	---	10-50
3/8-inch	---	0-20
No. 4	---	0-5

- G. Protective Measures: As temporary coverings on ground areas subject to erosion, provide one of the following protective measures, and as directed by the Designer with concurrence of the Owner's Representative:
1. Hay or straw temporary mulch, 100 pounds per 1,000 square feet.
  2. Wood fiber cellulose temporary mulch, 35 pounds per 1,000 square feet.
  3. Tackifier for anchoring mulch or straw shall be a non-petroleum based liquid bonding agent specifically made for anchoring hay or straw.
  4. Temporary vegetative cover for graded areas shall be undamaged, air dry threshed straw or hay free of undesirable weed seed.
- H. Temporary Covers For Drainage Structure

1. Filter fabric for use as temporary covers for drainage structures shall be the same as noted above for siltation fence.
2. Wire mesh for use at temporary drainage structure covers shall be 6" x 6", W2.9 welded wire mesh.
3. Crushed stone shall be as specified herein before.
4. Silt-Sac, Hydro-FloGard + Plus Catch basin Insert, Ultra-DrainGuard Insert, or approved equal, may be used in lieu of hay bales and filter fabric at catch basins.

### PART 3-EXECUTION

#### 3.1 GENERAL REQUIREMENTS

- A. The Contractor shall provide suitable and adequate means of sedimentation and erosion control during construction. Control measures shall prevent all erosion, siltation and sedimentation of waterways, drainage systems, construction areas, adjacent areas and off-site areas. Work shall be accomplished on and/or adjacent to the following work areas:
  1. Earthwork stockpiles and on-site storage and staging areas.
  2. Cut and fill slopes and other stripped and exposed graded areas.
  3. Constructed and existing swales and ditches.
- B. Means of protection as noted on the Contract Drawings indicate the minimum provisions necessary. Additional means of protection shall be provided by the Contractor as required for continued or unforeseen erosion problems, at no additional expense to the Owner.
- C. Periodic maintenance of all sediment control installations shall be provided to ensure intended purposes are accomplished. Sediment control measures shall be in working condition at the end of each day.
- D. After any significant rainfall, sediment control devices shall be inspected for integrity. Any damaged device shall be corrected immediately.
- E. The Contractor shall provide adequate means of control of runoff, as to not detrimentally impact downstream conditions during construction. The Contractor shall plan his operations so that permanent drainage mitigation systems such as detention/retention/infiltration basins and chambers are in place and properly functioning prior to connecting upland drainage flows to these systems. The Contractor

- F. shall plan his operations such that downstream drainage mitigation measures are in place and functioning before attempting to tie in upgradient drainage systems.
- G. In the event that the Contractor is unable to sequence the work so that construction of the permanent drainage mitigation systems precedes the upland work, then the Contractor shall submit a plan indicating his proposed methods of otherwise controlling runoff from the site.
- H. The "Massachusetts Erosion and Sedimentation Control Guidelines for Urban and Suburban Areas" should be consulted as a guide for the selection and installation of Best Management Practices to suit the conditions encountered.

### 3.2 STRAW BALE BARRIERS

- A. Excavation shall be to the width of the bale and the length of the proposed barrier to a minimum depth of 4 inches.
- B. Bales shall be placed in a single row, lengthwise on proposed line, with ends of adjacent bales tightly abutting one another. In swales and ditches the barrier shall extend to such a length that the bottoms of the end bales are higher in elevation than the top of the lowest middle bale.
- C. Staking shall be accomplished to securely anchor bales by driving at least two stakes or rebars through each bale to a minimum depth of 18 inches.
- D. The gaps between bales shall be filled by wedging straw in the gaps to prevent water from escaping between the bales.
- E. The excavated soil shall be backfilled against the barrier. Backfill shall conform to ground level on the downhill side and shall be built up to 4 inches on the uphill side. Loose straw shall then be scattered over the area immediately uphill from a straw barrier.
- F. Inspection shall be frequent and repair or replacement shall be made promptly as needed.
- G. Bales shall be removed when they have served their usefulness so as not to block or impede stormwater flows or drainage.

### 3.3 STRAW WATTLE BARRIERS

- A. Install straw wattles in locations as shown on Contract Drawings and as directed.
  - 1. Wattles shall be placed in a row with ends overlapping a minimum of two (2) feet.
  - 2. Each wattle shall be embedded in the soil a minimum of two (2) and a maximum of six (6) inches.

3. Wattles shall be securely anchored in place by stakes or rebars driven through the wattles and a minimum twelve (12) inches into the soil. Stakes shall be placed four (4) feet on center.

B. Inspection shall be frequent and repair or replacement shall be made as needed.

C. Wattles shall be removed when they have served their usefulness so as not to block or impede stormwater flows or drainage.

### 3.4 STABILIZED CONSTRUCTION ENTRANCE AND STONE BERMS

A. Stone size: Use ASTM designation C-33, size No. 2 (1-1/2" to 2-1/2"). Use crushed stone.

B. Length: As effective, but not less than 50 feet.

C. Thickness: Not less than eight inches.

D. Width: Not less than full width of all points on ingress or egress, but not less than 25 feet.

E. Washing: When necessary, wheels shall be cleaned to remove sediment prior to entrance onto public right-of-way. When washing is required, it shall be done on an area stabilized with crushed stone which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch, or watercourse through the use of sandbags, gravel boards or other approved methods.

F. Maintenance: The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way. This may require periodic top dressing with additional stone as conditions demand and repair and/or cleanout of any measures used to trap sediment. All sediment spoiled, dropped, washed or tracked onto public rights-of-way must be removed immediately.

G. Place crushed stone berms in locations required and as directed. Berms shall have side slopes of 1:3 or less.

H. Inspect stone berms periodically and replace and/or regrade crushed stone as required.

### 3.5 SILT FENCING

A. Excavate a 6-inch trench along the upstream side of the desired fence location.

B. Drive fence posts a minimum of 1'-6" into the ground. Install fence, well-staked at maximum eight-foot intervals in locations as shown on Drawings. Secure fabric to fence and bury fabric end within the six-inch-deep trench cut

- C. Lay lower 12 inches of silt fence into the trench, 6 inches deep and 6 inches wide. Backfill trench and compact.
- D. Overlap joints in fabric at post to prevent leakage of silt at seam.
- E. Inspect siltation fence after major storm events and periodically and remove accumulated sediment and debris. If a breach or failure of the siltation fence occurs, the fence shall immediately be restored.

### 3.6 EROSION CONTROL GRASSING

- A. Grassing shall be applied according to MassDOT Standard Specifications Section 700-subsection 767.

### 3.7 INLET PROTECTION

- A. Install silt fence or straw bales around inlet as specified herein.
- B. Install temporary covers at drainage structure locations that may be subject to erosion infiltration and as directed by the Engineer.
- C. Inspect drainage structures periodically. Remove sediment accumulation and regrade or replace materials as required.

### 3.8 DUST CONTROL

- A. Throughout the construction period the Contractor shall carry on an active program for the control of fugitive dust within all site construction zones, or areas disturbed as a result of construction. Control methods shall include the following: Apply calcium chloride at a uniform rate of one and one-half (1 ½) pounds per square yard in areas subject to blowing. For emergency control of dust apply water to affected areas. The source of supply and the method of application for water are the responsibility of the contractor.
- B. The frequency and methods of application for fugitive dust control shall be as directed by the Designer with concurrence by the Owner's Representative.

### 3.9 TEMPORARY PROTECTIVE COVERINGS

- A. Place temporary soil coverings to control erosion and sedimentation on all disturbed or graded areas as required by the construction methods employed and as directed by the Engineer. Erosion control matting shall be installed in all areas seeded or hydroseeded with slopes of one vertical foot to three foot horizontal, or steeper, immediately after such areas have been seeded and a hay mulch applied as follows

1. The area to receive matting shall have been recently seeded and shall have a smooth surface free from stones, clods or depressions.
  2. Roll out of the matting perpendicular to the slope, do not stretch the fabric. In drainage swales, center the fabric along the flow line. Install the matting in a check slot at the top and bottom of the slope and at the edges of the area to be covered. Check slots shall be six inches deep and six inches wide. Fabric shall extend down one wall of the check slot and across the full width of the base. Overlap edges of matting rolls four (4) inches minimum and overlap the ends eighteen (18) inches minimum.
  3. Install staples in check slots, edges, center and ends of rolls by driving specified steel staples two feet on center over the entire area to be covered except at check slots and ends of rolls, where staples shall be placed six inches on center. All staples shall be driven below finished grade.
  4. Fill check slots with loam and tamp firmly.
  5. Reseed check slots and all disturbed areas per Specifications.
  6. Following matting installation, roll the entire area with a smooth drum roller weighing between fifty and seventy-five (50-75) pounds per linear foot of roller. The finished installation of matting shall be firmly in contact with the seeded area and provide a smooth, finished appearance free from lumps or depressions.
- B. Install erosion control matting as a temporary ground cover in all disturbed or graded areas subject to erosion and as directed by the Engineer. The temporary ground cover shall protect the site from erosion until a full permanent lawn can be installed. Install and anchor in place temporary erosion control matting in accordance with manufacturer's printed instructions or as directed by the Engineer and remove all temporary erosion control matting prior to installation of a permanent lawn.
- C. Inspect protective coverings periodically and reset or replace materials as required.
- 3.10 TEMPORARY PROTECTIVE COVERINGS (AFTER GROWING SEASON)
- A. Place temporary covering for erosion and sedimentation control on all areas that have been graded and left exposed after October 30. Contractor shall have the choice to use either or both of the methods described herein.
  - B. Hay or straw shall be anchored in-place by one of the following methods and as approved by the Designer with concurrence by the Owner's Representative:  
Mechanical "crimping" with a tractor drawn device specifically devised to cut mulch

into top two inches of soil surface or application of non-petroleum based liquid tackifier, applied at a rate and in accordance with manufacturer's instructions for specific mulch material utilized.

- C. Placement of mesh or blanket matting and anchoring in place shall be in accordance with manufacturer's printed instructions.
- D. Inspect protective coverings periodically and reset or replace materials as required.

### 3.11 REMOVAL AND FINAL CLEANUP

- A. Once the site has been fully stabilized against erosion, and with the approval of the Owner's Representative remove sediment control devices and all accumulated silt. Dispose of silt and waste materials offsite. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated.

**END OF SECTION**

SECTION 321216 ASPHALT PAVING  
PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the GENERAL CONDITIONS and all Sections which are hereby made a part of this Section of the Specifications.
  
- B. Please refer to MassDOT Specification subsection 460: Hot Mix Asphalt Pavement For Local Streets for additional information

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
  - 1. Hot-mix asphalt paving.
  - 2. Hot-mix asphalt patching.
  - 3. Pavement-marking paint.
  - 4. Tack Coat
  
- B. Alternates: Not Applicable.
  
- C. Items To Be Installed Only: Not Applicable.
  
- D. Items To Be Furnished Only: Not Applicable.
  
- E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
  - 1. Section 310000 - EARTH WORK for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
  - 1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of



each job mix proposed for the Work.

- B. Material Certificates: For each paving material, from manufacturer.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by the Massachusetts Department of Transportation Highway Division (MassDOT).
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the Massachusetts Department of Transportation Highway Division (MassDOT) for hot mix asphalt paving work.
  - 1. Comply with requirements of the Massachusetts Department of Transportation Highway Division (MassDOT) Standard Specifications for Highways and Bridges, including supplemental specifications and special provisions.
  - 2. Comply with requirements of the Americans with Disabilities Act (ADA) and the Massachusetts Architectural Access Board (MAAB). If these requirements cannot be met with the grades and slopes indicated on the plans, notify the Designer immediately.
  - 3. Comply with requirements of the local authority having jurisdiction concerning the location and construction of accessible curb cuts.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.
  - 1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
    - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
    - b. Review condition of subgrade and preparatory work.
    - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
    - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

#### 1.5 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Tack Coat: Minimum surface temperature of 60 deg F.
  2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
  3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- C. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- B. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
- C. Mineral Filler: ASTM D 242 or AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder, Performance Graded: AASHTO M320 or AASHTO MP 1a, performance grade as required by MassDOT Specifications.
- B. Tack Coat: AASHTO M 140 emulsified asphalt, or AASHTO M 208 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

### 2.3 ASPHALT MIXES

- A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by MassDOT
- B. Specifications and designed according to procedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types".

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
- C. Proceed with paving only after unsatisfactory conditions have been corrected.

### 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.

### 3.3 PATCHING

- A. Existing Hot-Mix Asphalt Pavement: Match Detail- Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a minimum rate of 0.05 to 0.15 gal./sq. yd..
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

### 3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.5 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Spread mix at minimum temperature of 250 deg F.
  - 2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.6 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

### 3.7 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory- plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling

while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: ASTM D 2041, per MassDOT Specifications.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
  - E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
  - F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
  - G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.8 INSTALLATION TOLERANCES

- A. Accessibility: Comply with requirements of Massachusetts Architectural Access Board and ADAAG requirements. Remove and replace paving that does not meet required tolerances, when measured with a 2 foot straightedge.
- B. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  1. Base Course: Plus or minus 1/2 inch.
  2. Surface Course: Plus 1/4 inch, no minus.
- C. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within MassDOT Specification tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas.

### 3.9 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Contractor shall retain the services of an independent testing agency for field quality control activities for the Work of this Section. Performance testing requirements will be per section 460 of the MassDOT Standard Specifications for Highway and Bridges. The means and methods should be per section M3.11.09 of the MassDOT Standard Specifications for Highway and Bridges.
- B. Test the plane of the finished surfaces of base, binder, and surface courses with a 16-foot straightedge, except use a 10-foot straightedge on vertical courses and on the top course of resurfaced streets which contain manhole covers, valve boxes, and the like.
- C. Carefully apply the straightedge immediately after the first compaction by rolling, and from then on as may be necessary until and after the final compaction of the material in place. Hold the straightedge in successive positions parallel to the road centerline and in

contact with the road surface; check the entire area from one side of the pavement to the other.

- D. Correct irregularities which vary 3/8 inch from a true finished surface in base and binder courses, and 1/4 inch in top courses.
- E. Irregularities which may develop before the completion of rolling and while the material is still workable, may be remedied by loosening the surface mixture and removing or adding material as necessary. Should any unsatisfactory irregularities or defects remain after final compaction, correct the defective work by removing and replacing with new material to form a true and even surface.
- F. Thickness: In-place compacted thickness tested in accordance with ASTM D 3549 will not be acceptable if exceeding following allowable variations:

### 3.10 OPENING TO TRAFFIC

- A. No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained, and the material has cooled sufficiently to prevent distortion or loss of fines, and the pavement has achieved a maximum temperature of 140 degrees F.
- B. If the climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Designer.

### 3.11 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION

SECTION 329200  
SEEDING AND HYDROSEEDING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the GENERAL CONDITIONS and all which are hereby made a part of this Section of the Specifications

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes all labor, materials, equipment, appliances and transportation necessary to, provide 4" depth supplemental loam, and establish lawn as indicated on the plans and at any additional disturbed areas.
- B. The Contractor shall coordinate his work with that of other trades affecting or affected by his work, cooperating as necessary with other trades to assure the steady progress of all work under this Contract. The Contractor shall verify that all preceding work has been completed and shall check that grading and all other subsurface work and construction in lawn areas has been completed before installing loam, hydroseeding or seeding.
- C. Grass work season shall be as follows:
  - 1. Seeding/ Hydroseeding: Lawn Mix: April 1 through June 15 or Sept. 1 through Oct. 31.
- D. Hand seeding and hydroseeding shall only be performed when weather and soil conditions are suitable for planting the specified material. Upon written request to the Designer time extensions may be considered if weather permits, but a written authorization is required.

1.3 RELATED WORK IN OTHER SECTIONS

- A. The following areas of related work are specified and indicated in other Sections:
  - 1. Earth Moving - Section 312000
  - 2. Erosion and Sedimentation Control - Section 312500

## 1.4 SUBMITTALS

- A. Submit manufacturer's seed species product data sheet for approval prior arrival on the site. Submit Container labels for each shipment of seed to the site. The submittals shall include the guaranteed percentages of purity, weed content, germination of seed, net weight, and date of shipment.
- A. Submit product data, application rates and application methods for fertilizer to be used to amend topsoil for lawn areas.
- B. Submit product data, application rates and application methods for fertilizer to be used following mowing of lawn areas.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

#### A. Lawn Seed Mix:

1. Grass seed shall be clean new crop composed of the following varieties and tested for minimum percentages of purity and germination:

Seeding Rate 90 lb per acre

New England Wildflower Mix- See New England Wetland Plants, Inc for mix details.

#### B. Topsoil:

1. Topsoil shall be screened loam that meets the gradation in Planting – Section 329300.
2. Topsoil shall be natural, fertile, friable loam typical of cultivated topsoils of the locality, containing at least 2% decayed organic matter (humus). Topsoil shall be free of subsoil, large stones greater than 1/2" in diameter, earth clods, sticks, stumps, clay lumps, roots or other objectionable, extraneous matter or debris.
3. The Contractor shall use on site stockpiled topsoil modified as per this specification to complete the seeding operation.



4. Loam shall be free of Quack grass rhizomes, Agropyron repens, and all other primary noxious weeds. Loam shall not have a pH factor of less than 6.0 or greater than 7.0, nor contain toxic substances which may be harmful to grass growth. Topsoil shall not be handled in a frozen or muddy condition.
- C. Fertilizer: The application of nitrogen or phosphorous is prohibited between October 15 and April 30. Fertilizers containing phosphorous or nitrogen may not be applied during or immediately prior to heavy rainfall events or when the soil is saturated due to intense or extended rainfall. Any single application of nitrogen should not exceed 0.5 pounds of nitrogen per 1000 square feet, and the annual aggregate total application of nitrogen should not exceed 1.0 pounds per 1000 square feet. The application of any nitrogen should be organic, slow-release, water insoluble form. Organic/natural fertilizers and soil supplements shall be used, as necessary, for routine and cyclical applications to turf and plants.
  - D. Lime: Lime shall be standard commercial ground limestone containing at least 50% total oxides (calcium oxide and magnesium oxide) and 50% of the material must pass through a #100 mesh sieve, with 98% passing a #20 sieve.
  - E. Aluminum Sulfate: shall be unadulterated and delivered in unopened containers labeled with the name of the material, name of the manufacturer and net weight of the contents.
  - F. Mulch and Tackifier for Hydroseeding: shall be processed natural wood cellulose or approved Hydro Mulch Material with a non-toxic green marking dye to insure uniform coverage. Tackifier shall be a non-toxic, non-corrosive, nonflammable auxiliary soil chemical formulated to provide safe and economical surface soil stabilization primarily composed of at least 90% high grade latex acrylic (balanced polymers in emulsion form) which is reduced with water to be used in a spray application form with the Hydro mulching process. It shall include their constituent sodium silicate, which facilitates the penetration of the compound into the earth and assists in the bonding of the surface soil particles and shall contain an anti-foaming agent allowing the compound to be mixed with a hydraulic application device without prohibitive foaming.
  - G. Water: shall be suitable for irrigation and free from ingredients harmful to hydroseeded areas.

### PART 3 - EXECUTION

#### 3.1 PREPARING OF SUBGRADE

- A. Sub grade shall be examined to ensure that rough grading and all other subsurface work in lawn areas and other areas to be seeded are done prior to start of seeding and hydroseeding.
- B. Existing sub grade shall be loosened or scarified to a minimum depth of 3 inches prior to

spreading topsoil. Sub grade shall be brought to true and uniform grade, and shall be cleared of stones greater than 3 inch, sticks, and other extraneous material.

### 3.2 TOPSOIL

- A. Bring the surface to finish sub grade (so that when hydroseed is placed, top of turf will be at finish grade), smooth down all lumps and ridges, fill in all holes and crevices. Rolling with a light roller is acceptable if the surface is scarified afterward. In the event of settlement, the Contractor shall readjust to work to the required finished grade.
- B. Topsoil shall be spread to a minimum depth of 4 inches (after settling) over all areas to be seeded with seed mix, where erosion or new construction has disrupted soil profile or as necessary to meet adjacent existing grades or proposed new grades, over prepared sub grade.

### 3.3 APPLICATION OF FERTILIZER

- A. Fertilizer shall be applied as per the approved product and method.
- B. A surface application of fertilizer shall be applied after the second mowing of the lawn area.

### 3.4 SEED APPLICATION

- A. General: Areas for hydroseeding or hand seeding shall be as delineated in Drawings. Seeding shall not be done during windy or inclement weather.
- B. Seed shall be spread by the hydroseeding method, utilizing power equipment commonly used for that purpose. Seed, fertilizer, and mulch shall be mixed and kept in an agitated state, to keep the materials uniformly suspended in water. Hydroseed and fertilizer shall be spread at the same rates, and under the same conditions, as specified for seeding, by spraying evenly over the area. Other provisions specified above shall apply.
- C. The Landscape Contractor shall submit to the Designer for approval, prior to start of work a certified statement as to the number of pounds of fertilizer, amounts and types of grass seed, tackifier and processed fiber per 100 gallons of water.
- D. Following hydroseeding, the entire area shall be watered (but only after 24-48 hour waiting period to allow setup of the tackifier) by use of lawn sprinklers, or other approved means. Initial watering shall continue to assure uniform moisture from surface to minimum of 6" (six inches) depth, or until the equivalent of a 2" (two inch) depth of water has been applied to the entire seeded surface at a rate, which will not dislodge the seed. Watering shall be repeated thereafter as frequently as required to prevent drying of the surface until acceptance, or when the grass attains an average height of 1" (one inch).

- E. Watering methods and apparatus, which may cause erosion of the surface, shall not be permitted.
- F. Hand seeding shall be done with an approved mechanical seeder. Seeding shall be done in two directions at right angles to each other. Hydroseeding as specified under that material item.
- G. Take all necessary precautions not to seed into planting beds or, if seed germinates, rake or scarify to kill grasses.

#### PART 4 - MAINTENANCE

##### 4.1 MAINTENANCE OF PLANTINGS

- A. Maintenance shall begin immediately after installation and shall continue until acceptance as described in 4.2 Acceptance.
- B. Maintenance shall consist of watering, weeding, cutting, fertilizing, aeration, repair of eroded areas and reseeding which in the opinion of the Designer is required to establish a uniform stand of the specified grasses.
- C. All areas of lawn greater than 8 inches square, which fail to show a uniform stand of grass, shall be reseeded until all such areas are covered with a satisfactory growth of grass.
- D. Whenever lawn reaches a height of three inches, it shall be cut back to two inches.
- E. After two mowings, the Contractor shall top dress the turf (areas of seed mix) with an application of fertilizer at the approved rate.

##### 4.2 ACCEPTANCE

- A. Seed area and hydroseed areas will be accepted when in compliance with the following conditions:
  - 1. The roots are thoroughly knit to the soil.
  - 2. All areas show a uniform stand of specified grass in 90% germination.
  - 3. At least 60 days have elapsed since completion of work in this Section.
- B. The Contractor shall submit a request for acceptance in writing to the Designer. The letter must be received not less than ten calendar days before the anticipated date for substantial completion inspection.
- C. Upon completion of all repairs and/or renewals required by the Designer, the Designer will verify the completeness of the work and then notify the Owner in writing if the work is accepted. Upon acceptance, the Owner will assume maintenance of all lawn areas. The contractor will supply the owner with written care instructions.

#### 4.3 WARRANTY

- A. The Contractor shall warrant the areas of lawn seed mix for a period of one (1) year from the date of substantial completion. The lawn shall be free from defects in material or installation. The Contractor shall repair or replace at the sole option of and at no additional cost to the Owner the turf found to be defective or non-conforming during the Warranty Period. Replacement turf shall be warranted for an additional year and subject to the same replacement requirements.

END OF SECTION

SECTION 32 93 00  
PLANTS

PART 1- GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
1. Tree, shrub, groundcover, perennial and bulb installation. Native plants are those species that are indigenous to New England, New York, and Pennsylvania and that were found prior to European settlement. All new tree installations on Town property shall be native trees. All new, in ground, shrubs and flower installations shall be at least 70% native plants.
  2. Sampling and testing of loam borrow.
  3. Sampling and testing of existing on-site topsoil.
  4. Modifying, screening, placing, spreading, and grading of loam borrow.
  5. Modifying, screening, placing, spreading, and grading of existing, on-site topsoil.
  6. Providing all other sampling, testing, supplying, placing, spreading, and grading of planting soils as required by this Section.
  7. Fertilizing, mulching, trimming, guying and edging.
  8. Maintenance of installed plant material.
  9. Warranty.
- B. Related Work: The following Sections contain requirements that relate to this Section:
1. Section 310000 - SITE CLEARING for topsoil stripping and stockpiling.
  2. Section 312000 - EARTH MOVING for excavation, backfilling and rough grading.
  3. Section 312213 - ROUGH GRADING for establishment of rough grade
  4. Section 329200 - TURF AND GRASSES for planting in lawn areas.

1.3 REFERENCES

- A. American Joint Committee on Horticultural Nomenclature Publication: Standardized Plant Names.
- B. ANSI Z60.1 - American Standard for Nursery Stock.
- C. ASTM D2607 - Classification of Peats, Mosses, Humus and Related Products.
- D. FS 0-F-241 - Fertilizers, Mixed, Commercial.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and

Division 1 Specification Sections. Submit complete list of plant material growers 4 weeks prior to digging of plants. List is to include names of individuals to contact, phone numbers, addresses and latest possible date for completion of tagging.

- B. Submit proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons of delay.
- C. Submit schedule of arrival of "specimen plant material".
- D. Submit instructions for continuing Owner maintenance. Include pruning and trimming methods and types, application frequency and recommended coverage of fertilizer; and water requirements for year-round care of installed plants. Document is to be in bound 8½" x 11" format. Submit prior to expiration of required maintenance period(s).
- E. Submit for approval a proposed maintenance procedure and schedule of the storage of plant materials. Trees, shrubs, groundcover and perennials stored on, and off site shall be maintained by watering, fertilizing, mulching, and spraying for infestation and disease to maintain these plants in a healthy condition. Plants stored off site shall be available for inspection by the Engineer.
- F. Samples of each of the following:
  - 1. 5 lb (2 kg) of mulch for each type required for the Project, in labeled plastic bags.
  - 2. Existing On-Site Topsoil: Sample and test existing on-site topsoil. The Contractor shall sample the existing loam soils of the construction site in the following manner:
    - a. sample on outside of bag, identifying sample by soil type and acre. Provide an approved site plan showing locations of stockpiles cross referenced to soil samples and test results.
  - 3. Peat Moss: Submit a one cubic foot sample and supplier's certification of contents.
  - 4. Limestone: Submit supplier's certification that the limestone being supplied conforms to these Specifications.
  - 5. Acidulant: Submit supplier's certification that the acidulant being supplied conforms to these Specifications.
  - 6. Fertilizer:
    - a. Submit product data of planting fertilizer and certificates showing

composition and analysis. Submit fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations.

- b. Submit the purchasing receipt showing the total quantity purchased for the project prior to installation.
  - 7. Gypsum: Submit manufacturer's product data and 2 pound (1 kilogram) sample.
  - 8. All additives needed to amend a specific soil in order to meet these specifications.
  - 9. Mycorrhizal Fungal Inoculant:
    - a. Submit manufacturer's product data certifying that inoculant being supplied conforms to these Specifications.
    - b. Submit the purchasing receipt showing the total quantity purchased for the Project prior to installation.
    - c. Submit empty packets of fungal spore inoculant to the Engineer for verification of use.
  - 10. Tree Staking System: Submit manufacturer's product data of system.
- G. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers and Owners, and other information specified.

#### 1.5 QUALITY ASSURANCE

- A. Prior to being approved, the successful bidder will be required to submit to the Engineer a statement of qualifications listing the names of contact references for at least three jobs of similar scope that have been completed in the last five years. Attention is called to the fact that the installation will not be awarded to a firm that does not possess the required technical expertise and construction organization.
- B. Allow Engineer option of traveling to growers facility to select trees from available stock.
- C. Allow four weeks, after receipt of list of growers, to finish tagging trees.
- D. Trees dug prior to tagging by Engineer are subject to rejection.
- E. Engineer will confirm the trees satisfy the requirements of ANSI Z60.1 and all special conditions stated in project manual and drawings.

- F. Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150mm) above ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300-mm) above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
- G. Unacceptable trees will not be tagged and a different Grower will be selected by landscape contractor at no expense to Owner. A second tagging trip will then be scheduled.
- H. Decision by Engineer to forego tagging trip does not release landscape contractor from responsibility of obtaining plant material which meets standards and conditions stated in project manual and drawings.
- I. Minimum three years' experience installing plant material of this type required of Installer.
- J. Minimum five years' experience specializing in growing and cultivating the specified material is required by of Grower.

#### 1.6 REGULATORY REQUIREMENTS

- A. Comply with regulatory requirements for fertilizer and herbicide composition.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Plant material is to be covered with tarpaulin during transport.
- B. Deliver soil conditioners and fertilizer in unopened waterproof bags showing weight, chemical analysis, and name of manufacturer. Keep materials in dry storage away from contaminants.
- C. Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by Engineer. Do not bend or bind tie trees or shrubs in such a manner as to damage bark, break branches, or destroy natural shape. Do not drop balled and burlapped stock during delivery. Protect plants until planted to prevent damage to root balls or desiccation of leaves.
- D. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than six hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.
- E. Provide water to staged material as required to keep root balls moist.
- F. Do not remove container-grown stock from containers until planting time.



## 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not install plant life when ambient temperatures may drop below 30 degrees F or above 90 degrees F.
- B. Do not install plants when wind velocity exceeds 30 mph.
- C. Planting shall be done when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting.
- D. Conduct planting operations for Trees, shrubs and groundcover during recommended planting seasons. Preferable planting season is March 15 to May 30 and September 15 to November 15, inclusive.
- E. Conduct planting operations for perennials during recommended planting seasons. Preferable planting season is May 1 - October 1.
- F. At the landscape contractor's option and full responsibility, planting operations may be conducted under unseasonable conditions without additional compensation.

## 1.9 JOB CONDITIONS

- A. Locate above grade and underground utilities and perform Work in manner which will avoid damage. Hand excavate in areas where underground utilities may exist.
- B. Maintain grade stakes set by others until removal is mutually agreed upon by concerned parties.
- C. Notify Engineer, before proceeding, when conditions detrimental to plant growth are encountered, such as rubble fill or adverse drainage conditions.
- D. Install plants after final grades are established unless otherwise approved by Engineer.

## 1.10 SEQUENCING AND SCHEDULING

- A. Coordinate the Work of this Section with installation of underground utilities and remainder of Work associated with this Project.
- B. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations.

## 1.11 WARRANTY

- A. Provide a warranty on Work of this Section for a minimum one year including one

continuous growing season. Commence warranty on date identified in the Certificate of Substantial Completion. Inspection of the planting work to determine its completion for beginning the guarantee period will be made by the Engineer upon written notice requesting such inspection by the landscape contractor at least seven days prior to the anticipated date. Trees, shrubs, groundcover and perennials shall be alive and healthy at time of inspection before approval to start the guarantee period will be given.

- B. Any plants showing signs of stress shall be maintained until they display a healthy growing condition.
- C. Inspection of the planting to determine its acceptance will be made at the conclusion of the guarantee period by the Engineer. Plants will not be accepted unless they are alive and healthy. The landscape contractor shall replace plants which are dead, or in the opinion of the Engineer are in an unhealthy or unsightly condition or have lost their natural shape due to dead branches, excessive pruning, inadequate or improper maintenance, or other causes due to the landscape contractor's negligence with same size and species as specified. Plant in the next growing season, with a new warranty commencing on date of replacement. Replacement costs will be borne by Landscape Contractor.
- D. All bulbs shall be guaranteed to bloom vigorously the first respective blooming season after planting. Bulbs that do not bloom shall be replaced. Replacement costs shall be borne by the Landscape Contractor.

#### 1.12 MAINTENANCE SERVICE

- A. Maintenance Services: Performed by installer.
- B. Maintain plant life immediately after placement for a minimum of one growing season and until plants are well established and exhibit a vigorous growing condition.
- C. Maintenance to include:
  - 1. Cultivation and weeding plant beds and tree pits.
  - 2. Application of herbicides for weed control in accordance with manufacturer's instructions. Remedy damage resulting from use of herbicides.
  - 3. Application of pesticides in accordance with manufacturer's instructions. Remedy damage from use of pesticides.
  - 4. Watering sufficiently to saturate root system.
  - 5. Trimming and pruning, including removal of clippings and dead or broken branches.
  - 6. Disease control.
  - 7. Maintaining accessories. Adjust, repair or replace accessories when damaged.
  - 8. Restoring planting saucers.
  - 9. Resetting plant material to proper grades or vertical position.

### 1.13 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated.
- D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- E. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- I. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- J. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- K. Planting Area: Areas to be planted.
- L. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface

soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

- M. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- N. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- O. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- P. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- Q. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- R. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- S. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

## PART 2 - PRODUCTS

### 2.1 TREES, SHRUBS, GROUND COVER AND BEDDING PLANTS

- A. Plant material to be nursery grown stock conforming to ANSI Z60.1.
- B. Publication for Standardized Plant Names will govern nomenclature issues.
- C. Plans will supersede planting material schedule where a discrepancy in quantity occurs.
- D. Provide plant material, which is well branched and formed, sound, vigorous, healthy, and free from disease, sun-scald, windburn, abrasion, and harmful insects, eggs, larvae and such defects as knots sun scald, injuries, abrasions and disfigurement, and shall have healthy, normal, and unbroken root systems.
- E. Provide symmetrically developed plant material, of uniform habit with straight boles and free from objectionable disfigurements. Tree leader shoots shall not be cut or broken.

- F. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assure symmetry in planting.
- G. Provide vigorous ground covers and vines with number and length of runners and clump size specified and proper age for the grade of plants specified. Use only vines and ground cover plants well established in removable containers, integral containers, or formed homogeneous soil sections.
- H. Plants shall have been grown in the same or colder climatic zone of this project.
- I. Provide plants according to measurements indicated. Measure sizes before pruning and with branches in normal position. Plants larger in size than specified may be used as approved.
- J. Spray plants, budding into leaf or having soft growth, with an anti-desiccant at the nursery or collecting field before digging.
- K. The Contractor shall furnish all plants shown on the Contract Documents, as specified, and in quantities listed on the PLANT LIST. No substitutions will be permitted, without written approval by the Engineer. All plants shall be nursery grown unless specifically authorized to be collected as noted on the PLANT LIST.
- L. If, at any time during the performance of the Contract, any plant shows signs of graft in- compatibility, as determined by the Engineer, then the tree or shrub and all other similarly grafted plants of the same Genus/Species/Variety shall be rejected and removed from the site.

## 2.2 LOAM - GENERAL

- A. The Contractor shall provide sufficient loam borrow to complete all loaming operations required of the Contract Documents. Loam borrow shall be obtained from one of the following sources:
  - 1. On-site topsoil stripped, stockpiled, and paid for under the work of the Division 31 Section, EARTH MOVING, of this Specification and meeting the requirements of this Division 32 Section, PLANTS.
  - 2. A commercial processing facility specializing in the manufacturing of loam.
  - 3. On-site granular material stripped and stockpiled on the site may be used as the basis for an on-site, manufactured loam. Submit method and schedule of manufacturing process to the Engineer for review and approval.

4. All sources shall be acceptable provided that, after testing and the addition of necessary soil additives specified in this Division 32 Section, PLANTS, the loam borrow meets the following specifications.

### 2.3 LOAM

- A. Loam borrow for planting trees, shrubs, groundcover and vines, and perennials shall be one of the following sandy loams; "course sandy loam ", "sandy loam", and "fine sandy loam": determined by mechanical analysis (ASTM D 422) and based on the "USDA Classification System" and as defined in this Section. It shall be of uniform composition, without admixture of subsoil.

It shall be free of stones greater than one and one-quarter inches (31 mm), lumps, plants and their roots, debris and other extraneous matter as determined by the Engineer. Planting soil for trees, shrubs, groundcover and vines, and perennials shall have the following grain size distribution for material passing the #10 (2.0 mm) sieve:

<u>Millimeter</u>	Percent Passing by Weight	
	<u>Maximum</u>	<u>Minimum</u>
2	-----	100
1	100	80
0.5	87	67
0.25	78	48
0.10	68	30
0.05	55	22
0.002	7	2

1. The maximum size shall be one and one quarter inches largest dimension. The maximum retained on the #10 sieve shall be 25% by weight of the total sample.
2. The ratio of the particle size for 80% passing (D80) to the particle size for 30% passing (D30) shall be 6.0 or less. (D80/D30 < 6.0)
3. Top 18 inches (450 mm) of areas planted with tree and shrub as described in the Division 2 Section, PLANTING, of this Specification:
  - a. pH: 5.5 through 6.5 for non-acid loving plants
  - b. pH: 4.5 through 5.5 for *Ericaceae* and other acid-loving plants
  - c. Organic Content 4.0 - 6.0 percent as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours)
4. Below 18 inches (450 mm) in tree and shrub beds when details call for depths of loam borrow to exceed 18 inches (450 mm):

- a. pH: 5.5 through 6.5 for non-acid loving plants
  - b. pH: 4.5 through 5.5 for *Ericaceae* and other acid-loving plants
  - c. Organic Content 1.0 - 3.0 percent as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours. Regardless of amendment Contractor chooses to use, Contractor, not the Owner, shall be responsible for obtaining specified pH by seeding and/or planting time.
- B. Loam borrow shall be free of plants and their roots, debris and other extraneous matter. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The electrical conductivity (EC2) of a 1:2 soil-water suspension shall be equal to or less than 1.0 milliohms/cm. (Test minus sieve #4 material.) Loam borrow shall not have levels of extractable aluminum greater than 200 parts per million except for *Ericaceae* and other acid-loving plants. Cation Exchange Capacity (CEC) shall be greater than or equal to 12.
- C. On-site topsoil stripped, stockpiled, and paid for under the work of the Division 32 Section, EARTH MOVING, may be re-used if, with or without amending or blending with other material, it meets the above requirements. On-site topsoil and amendments shall be tested in accordance with requirements for loam borrow and submittals shall be made for review and acceptance as specified, performed and paid for under this Division 32 Section, PLANTS. The Contractor shall provide additional loam borrow as required to complete the required work.
- D. All loam borrow proposed for use shall be tested for conformance to the specifications.
- E. The Engineer reserves the right to reject on or after delivery to the project site any material which does not, in his opinion, meet these specifications.

#### 2.4 SOIL AMENDMENT MATERIALS

- A. Ground Cover Fertilizer: FS-0-F-241, Type 1, Class 1 with fifty percent of the elements derived from organic sources. Use fertilizer with N.P.K. ratio of 1:2:1 for Ground Cover Beds and 2:1:1 for Bedding Plant Beds.
- B. Peat Moss: Shredded, loose, sphagnum moss peat conforming to ASTM D2607; free of lumps, roots, inorganic material or acidic materials; minimum of 85 percent organic material measured by oven dry weight; 4 to 5 pH range; moisture content of 30 percent.
- C. Sphagnum Peat Moss: Sphagnum peat moss shall be imported Canadian Sphagnum peat moss, brown, low in content of woody materials, and be free of mineral matter harmful to plant life. Peat shall have an acid reaction of about 4.5 pH, and have a water absorbing capacity of 1100 to 2000 percent by weight. Peat moss shall be thoroughly pulverized before use. No native or sedge peats shall be approved.

- D. Water: Clean, fresh and free of substances or matter which could inhibit vigorous growth of plants.
- E. Herbicide: Comply with all applicable State and Federal Laws.
- F. Pesticide: Comply with all applicable State and Federal Laws.
- G. Mycorrhizal fungal inoculant: shall be live spores packaged in plastic packets. At a minimum each packet of inoculant shall contain the following:
  - 1. Live spores of VA Endomycorrhizal fungi: Vesicular-Arbuscular mycorrhizae fungi, minimum of 8 species.
  - 2. Live spores of Ectomycorrhizal fungi: including *Pisolithus tinctorius*.
  - 3. Mycorrhizal fungal inoculant shall be manufactured by Plant Health Care Incorporated, 440 William Pitt Way, Pittsburgh, PA 15238, telephone: (800) 421-9051; Horticultural Alliance, 2946 Louise Street, Sarasota, FL 34237, (800) 628-6373; BioPlex Organics, 2213 Huber Drive, Manheim, PA 17545 (800) 441-3573, or approved equal.

## 2.5 STAKING, GUYING, AND ANCHORING MATERIALS

- A. Stakes for supporting trees shall be of sound wood of uniform shape and size, reasonably free of knots, insects and fungi and capable of standing in the ground at least two years. Unless noted otherwise, stakes shall be 10 feet (3.0 meters) long of 2 inch by 4 inch (50 mm by 100 mm) nominal size. Stakes shall be pointed at drive end.
- B. Elastic Webbing, Belting or Tape:
  - 1. Guying system shall be elastic webbing, belting or tape which establishes contact with the trunk of the tree with a broad, smooth surface. Guying system shall not abrade or girdle tree. Submit the guying system to the Engineer for review and approval.

## 2.6 MULCH MATERIALS

- A. Mulching Material: Shredded, dark brown/black, native hemlock mulch free of growth or germination inhibiting ingredients.

## 2.7 MISCELLANEOUS MATERIALS



- A. Filter Fabric: Filter fabric shall be Mirafi 100X, Hanes TerraTex N04.5, Propex or approved equal. Anti-Desiccant: Emulsion type, film-forming agent, designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.

## 2.8 WATER

- A. The Contractor shall be responsible to furnish his own supply of water to the site at no extra cost. If possible, the Owner shall furnish the Contractor upon request with an adequate source and supply of water at no charge. However, if the Owner's water supply is not available or not functioning, the Contractor shall be responsible to furnish adequate supplies at his own cost. All work injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct. Water shall be free from impurities injurious to vegetation.

## 2.2 LANDSCAPE EDGINGS

- A. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Border Concepts, Inc.
    - b. Collier Metal Specialties, Inc.
    - c. Russell, J. D. Company (The).
    - d. Sure-Loc Edging Corporation.
  - 2. Edging Size: as shown on Drawings.
  - 3. Stakes: Tapered steel, a minimum of 12 inches (300 mm) long.
  - 4. Accessories: Standard tapered ends, corners, and splicers.
  - 5. Finish: as shown on Drawings.
- B. Aluminum Edging: Standard-profile extruded-aluminum edging, ASTM B 221 (ASTM B 221M), Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Curv-Rite, Inc.
    - b. Permaloc Corporation.
    - c. Russell, J. D. Company (The).
    - d. Sure-Loc Edging Corporation.

2. Edging Size: as shown on Drawings.
3. Stakes: Tapered steel, a minimum of 12 inches (300 mm) long.
4. Accessories: Standard tapered ends, corners, and splicers.
5. Finish: as shown on Drawings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
  2. Test drainage of plant beds and pits by filling with water twice in succession. Notify Engineer of conditions permitting the retention of water in planting beds for more than twenty-four (24) hours.
  3. Prior to the excavation of planting pits, or placing tree stakes, the landscape contractor shall ascertain the location of utility lines, electric cables and conduits, so that proper precautions may be taken not to disturb or damage subsurface improvements. Should obstructions be found, the landscape contractor shall promptly notify the Engineer.
  4. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
  5. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  6. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Beginning of installation means acceptance of existing conditions.

#### 3.2 PREPARATION

A. Seasons for Planting:

1. Spring: Deciduous materials - March 21 through May 1; Evergreen materials - April 15 through June 1.
2. Fall: Deciduous materials - October 1 through December 1; Evergreen materials - August 15 through October 15.

B. Plant Material Inspection:

1. At least one month prior to the expected planting date, the Contractor shall request that the Engineer provide a representative to select and tag stock to be planted under this Division 32 Section, PLANTS. The Contractor shall pay for the transportation, subsistence and overnight accommodations, if necessary, for the Engineer during the period of time required to select and tag the plant material.
2. The Contractor shall be responsible to certify the availability of quality plants in specified sizes from his/her sources of supply prior to requesting that Engineer make plant source inspections. In the event that plants at the inspection location are found to be unavailable or of insufficient size, the Contractor shall be liable to re-imburse the Owner for all costs of the Engineer's hourly services which are incurred during unproductive inspection trips.
3. Unless specifically designated otherwise, a representative of the Contractor shall accompany the Engineer on all plant material selection field trips.
4. All trees for the project shall be individually tagged for approval with Engineer's seals, and no trees shall be accepted for delivery to the site without such seals. Representative samples only of shrubs and ground cover plants may be tagged or marked for approval as an "Approved Typical Sample" and shipped to the site. Any shrub or groundcover plant that arrives at the construction site that does not meet the Approved Typical Sample will be rejected by the Engineer.
5. Plants to be inspected shall be in locations and conditions that allow direct and unobscured inspection by Engineer. Container grown or balled and burlapped shrubs shall be pulled from holding blocks by the nurseryman for scrutiny by the Engineer at no additional cost to the Owner. Harvested trees held in storage shall not have branches tied up. Harvested trees shall not have trunks obscured by burlap, cardboard trunk protection, or other devices that would otherwise obscure inspection. In the event that branches are tied up, trunks are obscured by burlap or cardboard trunk protection, or root flares hidden by burlap and twine and the Engineer cannot inspect root flares, trunks or branching habit, the Contractor shall bear all responsibility and costs associated with tree rejection at a later date during the course of the Contract.
6. Inspection and approval of plants at the source shall not impair the right of

subsequent inspection and rejection upon delivery to the site, or during the progress of the work if the Engineer finds that plants do not meet the requirements of the PLANT LIST or this Contract, have declined noticeably due to handling abuse, lack of maintenance, or other causes. Cost of replacements, as required, shall be borne by the Contractor.

### 3.3 LAYOUT

- A. Stake tree and shrub locations with 3/4" x 2" x 18" wood stakes driven into the soil at center points of plants. Paint tops of stakes representing tree locations a color different from the stakes locating shrubs. Landscape contractor may stake continuous uninterrupted straight runs of shrubs at each end. Outline ground cover beds.
- B. Mark all underground utilities.
- C. Notify Engineer, in writing, of portions of plant material which have been staked. Allow one week for Engineer to review and adjust stake locations.
- D. Plants which are planted prior to landscape contractor receiving Engineer's approval of staking and bed outlines are subject to being relocated at no cost to Owner.

### 3.4 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 6 inches (150 mm). Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply fertilizer directly to subgrade before loosening.
  - 2. Thoroughly blend planting soil off-site before spreading.
    - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
    - b. Mix lime with dry soil before mixing fertilizer.
  - 3. Spread planting soil to a depth of 12 inches (300 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
    - a. Spread approximately one-half the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: Broadcast dry product uniformly over prepared soil at Manufacturer's recommended application rate.

### 3.5 EXCAVATION FOR INDIVIDUAL TREES AND SHRUBS

- A. Planting Pits: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
  - 1. Excavate approximately three times as wide as ball diameter for balled and bur lapped stock.
  - 2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  - 4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  - 5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  - 6. Maintain supervision of excavations during working hours.
  - 7. Keep excavations covered or otherwise protected after working hours.

### 3.6 PLANTING - GENERAL

- A. Shrub masses, hedges, groundcover and perennial beds shall be entirely excavated edge to edge and backfilled with specified backfill mixture; they shall not be treated as individual planting pits.
- B. Remove all sticks, stones, roots and other objectionable materials during tilling operations larger than one inch in diameter.
- C. Damage to paving, sidewalks or other materials shall be removed and replaced at the landscape contractor's expense and to the satisfaction of the Engineer.
- D. Obstructions: Notify Engineer if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- E. Drainage: Notify the Engineer if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

- F. Setting Plants: Handle balled, and bur lapped and container-grown plants by ball or container. Set plants and hold in plumb position until sufficient soil has been firmly placed around roots or ball. Set plants in relation to surrounding grade so that they are even with depth at which they were grown in nursery, collecting field, or container.
- G. Place fertilizer prior to backfilling and in accordance with the manufacturer's recommendations. Ground cover plants may be planted after mulch is in place. Take care to avoid contaminating mulch with planting soil.
- H. Backfill excavations for balled and bur lapped stock with planting soil mixture to approximately half the depth of the ball and then tamp and water. Carefully remove, open or fold back burlap and tying materials. Completely remove plastic wrap before the placement of backfill. Finish backfilling and tamp. Form earth saucers around isolated plants of size ample enough to hold at least 2-1/2 gallons for shrubs or 5 gallons for trees. Do not use planting stock if ball is cracked or broken before or during planting operation.
- I. Bulbs shall be planted in the locations and at the spacing indicated on the Drawings. Plant bulbs at the depths and orientation recommended by the Supplier. Do not remove the leaves until after they have lost their green color. Remove leaves by cutting.

### 3.7 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set balled and bur lapped stock plumb and in center of planting pit or trench with root flare [1 inch (25 mm) above adjacent finish grades.
  - 1. Use approved planting soil for backfill.
  - 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  - 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  - 4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Set container-grown stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
1. Use approved planting soil for backfill.
  2. Carefully remove root ball from container without damaging root ball or plant.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

### 3.8 GROUND COVER AND PERENNIAL PLANTING

- A. Set out and space ground cover and perennials as indicated in even rows with triangular spacing.
- B. Use approved planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.9 FERTILIZATION, WATERING AND MULCHING

- A. Trees, Shrubs. Ground Cover and perennials: Fertilize according to manufacturer's recommendations.
- B. Watering: Provide uniform coverage which will not cause erosion or damage to the finished surface. Water sufficiently to penetrate the planting bed to a depth of 4 inches.
- C. Mulch within 24 hours after planting. Spread to uniform thickness of 3 inches.

3.10 EDGING INSTALLATION

- A. Edging: Install edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 36 inches (760 mm) apart, driven below top elevation of edging.

3.6 PLANT SUPPORT

- A. Perform above-ground staking at the time of planting, unless otherwise approved or directed by the Owner's Representative. Stakes shall be of even height, plumb and neat in appearance and they shall not injure plant balls.

3.7 PRUNING AND REPAIR

- A. Plants shall be neatly pruned and or clipped to preserve the natural character of the plants (with exception to clipped shrub hedges); in a manner appropriate to the particular requirements of each plant and to the satisfaction of the Engineer.
- B. Unless otherwise directed by Engineer, do not cut tree leaders; remove only injured or dead branches.
- C. Remove broken or badly bruised branches with a clean cut. All pruning shall be done with sharp tools in accordance with instructions of the Owner. Accidental damage to trees occurring during the course of planting operations which is not so great as to necessitate removal of a branch or replacement of a plant shall promptly be treated in accordance with recognized horticultural practices.
- D. Do not apply pruning paint to wounds.

3.8 MAINTENANCE

- A. Maintenance shall begin immediately after each plant is planted and shall continue for a minimum 60-day Monitoring Period and until Final Acceptance.
- B. Maintenance shall consist of keeping the plants in a healthy growing condition and shall include but is not limited to watering, weeding, cultivating, pruning, re-mulching, tightening and repairing of guys, straightening of trees to a plumb position, removal of



dead material, resetting plants to proper grades or upright position, and maintaining the planting saucer.

- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.
- D. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- E. During the maintenance period, any decline in the condition of 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 horticulturalists 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.

### 3.9 ACCEPTANCE

- A. Upon completion of all planting work, the Contractor shall request in writing that the Engineer formally inspect the planting work.
- B. If plant materials and workmanship are acceptable, the Engineer will issue a written Certificate of Conditional Acceptance to the Contractor.
- C. Following the issuance of the Certificate of Conditional Acceptance to the Contractor, the Contractor shall maintain the plants for a minimum 30 day Monitoring Period. At the end of the Monitoring Period, the plant material will be inspected by the Engineer to determine whether or not all planting work has been performed to the requirements of this Division 32 Section, PLANTS.
- D. Acceptance Standards at end of the Monitoring Period: If plant material is reviewed when it is in full leaf, leaves shall be plump with water with a shape indicative of the species and shall be free of insect, pest and disease damage. Twigs shall have living cambium for their full length. Twigs and branches shall have a full bud set for their full length, including terminal buds. Trunks and branches shall be free of frost cracks; sun scald; damage due to insects, pests, and disease; structural defects; and damage resulting from machinery or tools. Plant material inspected and reviewed when the plants are not in full leaf shall have twigs, branches and trunks meeting the above requirements. All plants regardless of the season of review shall have a minimum of 75 percent healthy, balanced branching structure with a healthy terminal leader(s) with viable terminal bud(s).

- E. If any number of plants do not meet these Acceptance Standards at the time of inspection, or if in the Engineer's opinion, workmanship is unacceptable, written notice will be given by the Engineer to the Contractor in the form of a punch list, which itemizes necessary planting replacements and/or other deficiencies to be remedied. The Contractor's responsibility for maintenance of all plants shall be extended until replacements are made or other deficiencies are corrected. All plants that do not meet these Acceptance Standards shall be removed from the project within seven days of receipt of the punch list. Replacements shall conform in all respects to the Specifications for new plants and shall be planted in the same manner
- F. Following the correction of all Punch List deficiencies, the Contractor shall request in writing that the Engineer formally inspect the planting work. If plant materials and workmanship are acceptable, the Engineer will issue a written Certificate of Final Acceptance to the Contractor.

### 3.10 WARRANTY

- A. The date of the Certificate of Final Acceptance shall establish the commencement of the required one-year guarantee and establishment period for planting work.
- B. At the end of the guarantee and establishment period, a final inspection will be held to determine whether any plant material replacements are required. Each plant shall be plumb, shall have a character that is natural for its species as determined by the Landscape Architect, and shall conform to the Acceptance Standards described in this Division 32 Section, PLANTS. Plants found to be unacceptable shall be removed promptly from the site and replaced according to this Division 32 Section, PLANTS. A final inspection will be made after the replacement plants have lived through one year.
- C. At the end of the one-year guarantee and establishment period, remove all tree stakes, guys, or anchors installed on trees during the course of the work of this contract.
- D. All replacements shall be plants of the same kind and size specified in the PLANT LIST. The cost shall be borne by the Contractor, except for possible replacements due to vandalism or neglect on the part of others.

### 3.11 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation and before Substantial Completion remove nursery tags, nursery stakes, tie

tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.12 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 33 41 00  
STORM UTILITY DRAINAGE  
PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Town of Lunenburg Design Details for Subdivisions and Projects.

1.02 SUMMARY

- A. This Section includes gravity-flow storm drainage outside the building including foundation drains, with the following components:
  - 1. Special fittings for expansion and deflection.
  - 2. Special fittings for material and size transition of piping.
  - 3. Drains.
  - 4. Drain Pipe With Headwalls
  - 5. Flared end sections.
- B. Related Work Specified in Other
  - 1. Division 31 Section "Earth Moving"

1.03 DEFINITIONS

- A. HDPE- High Density Polyethylene

1.04 SUBMITTALS

- A. Initial Submittal: Within 30 days of award the subcontractor must submit a complete list of all the materials including manufacturers, and model numbers where applicable, and lead times to be used to allow for timely delivery of materials.

B. Product Data: For the following:

1. Pipe and fittings
2. Drains
3. Drain Pipe
4. Headwall
5. Drainage castings

C. Field quality-control test reports.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic pipe and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.
- D. Handle catch basins according to manufacturer's written rigging instructions.

1.06 PROJECT CONDITIONS

- A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  1. Notify Architect and Owner no fewer than 7 days in advance of proposed interruption of service.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. **Reinforced Concrete Pipe:** Pipe shall comply with the requirements of ASTM C76. All pipe 18 inches and smaller shall be Class V. All other pipe shall be Class III unless indicated otherwise on the Drawings.
  1. Joints for the reinforced concrete pipe shall be the tongue and groove or bell and spigot type with rubber gasket conforming to ASTM C443.
  2. Flared end pipe sections shall be constructed in conformance with ASTM C76, Class V requirements and shall be supplied by the same manufacturer as the pipe.

2.02 CONCRETE

- A. General: Cast-in-place concrete according to Division 03, and the following:
  1. Cement: ASTM C 150, Type II.
  2. Fine Aggregate: ASTM C 33, sand.

3. Coarse Aggregate: ASTM C 33, crushed gravel.
  4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
- C. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water-cementitious materials ratio.
1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
  2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed steel.
- 2.03 PIPE OUTLETS
- A. Flared end sections: Reinforced concrete flared end sections with Headwall

### PART 3 - EXECUTION

#### 3.01 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
- B. As soon as possible after the joint is made, and cement mortar allowed to cure, place sufficient bedding material, in 6-inch layers, along the pipe to spring line, and compact to prevent pipe movement offline or grade.
- C. Do not backfill until testing has been completed.

#### 3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Trenches shall be kept free of water and as dry as possible during bedding, laying and jointing and for as long a period. Pipe shall not be installed in water or when trench conditions are unsuitable for the work.
- B. Each pipe shall be installed accurately to the line and grade shown on the Drawings.
- C. Pipe laying will not be allowed to begin at any point other than a manhole, catch basin or other appurtenance.
- D. Pipes entering or leaving manholes, catch basins or structures shall extend a minimum of 1 inch into the manhole, catch basin or structure as measured from the inside wall face.

- E. When work is not in progress, open ends of pipe and fittings shall be plugged so that trench water or other material will not enter the pipe or fitting.
- F. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings and joints.
- G. Pipe cutting:
  - 1. Where required, sections of pipe may be cut to provide shorter sections of pipe necessary for the construction. Cut pipe in accordance with the pipe manufacturer recommendations, and subject to the approval of the Architect.
  - 2. In general, to cut pipe, use a saw or milling process approved by the pipe manufacturer; do not use an impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.
- H. Before testing storm drainage lines, thoroughly clean pipe by flushing with water to remove debris.
  - 1. Each run of pipe between manholes or catch basins shall be flushed individually and the debris caught in and removed from the lower manhole or catch basin.
  - 2. Make a visual inspection of storm drainage lines, manholes, and catch basins after flushing to verify that all debris has been removed.

### 3.03 PIPE JOINT CONSTRUCTION

- A. Polyethylene (PE) Plastic Pipe and Fittings: Join pipe, tubing, and fittings with couplings for soil tight joints according to AASHTO "Standard Specifications for Highways Bridges" Division II, Section 26.4.2.4 "Joint Properties" and manufacturer's written instructions.
- B. Join dissimilar pipe materials with pressure-type couplings.

### 3.04 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

- A. Backfill to grade according to Division 31 Section "Earth Moving."

### 3.05 FIELD QUALITY CONTROL

- A. Testing and inspection are the responsibility of the Contractor. The Contractor, at his option, may perform the specified testing of the storm drainage system, or have an independent testing laboratory perform the testing.

- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Reinspect and repeat procedure until results are satisfactory.
- C. Perform additional field tests on storm drainage which are required by the Town:
  - 1. It is the Contractor's responsibility to ascertain the extent of additional testing required by the Town.
  - 2. If there is disagreement between standards as required by the Town and the Contract Documents, the stricter shall govern.
- D. Complete testing within 10 working days after installation of storm drainage:
  - 1. If a section of storm drainage line is not to be installed until later in the construction schedule, the sections of storm drainage line installed shall be tested within 10 working days after completion, with the other sections tested after their installation.
- E. Should the storm drainage pipe as installed fail to meet the requirements specified, the Contractor will perform the necessary remedial work, including retesting, at no additional cost to the Owner.

### 3.06 CLEANING

- A. Clean interior of piping and structures prior to the completion of the project. Cleaning includes new and existing piping and sumps of catch basins.
- B. Maintain drainage outfalls in the same condition as at the start of construction throughout the construction operations. Clean drainage outfalls prior to the completion of the project.

END OF SECTION



MassDOT SECTION 600: HIGHWAY GUARD, FENCES AND  
WALLS SUBSECTION 601: GUARDRAIL

PART 1- DESCRIPTION

601.20: General

This work shall consist of the construction of guardrail and guardrail end treatments in accordance with these specifications and in close conformity with the lines and grades shown on the plans or established by the Engineer.

PART 2- MATERIALS

601.40: General

Materials shall meet the requirements specified in the following Subsections of Division III, Materials:

Guardrail.....	M8.07.0
Guardrail End Treatment .....	M8.07.1
Guardrail Delineator .....	M9.30.7
Guardrail Termini Delineator .....	M9.30.10

The contractor shall provide a detailed list of all system components for maintenance purposes.

No work shall commence under these items until the Engineer has received all documentation.

PART 3- CONSTRUCTION METHODS

601.60: Posts

Posts shall be set plumb, in hand or mechanically dug holes, or driven, then backfilled with acceptable material placed in layers and thoroughly compacted.

If driven, the posts shall be provided with suitable driving caps and equipment used which will prevent battering or injury of posts. Posts damaged or distorted as a result of driving shall be removed and replaced with approved posts.

Posts to be set in areas of proposed hot mix asphalt surfacing shall be erected prior to laying the surrounding finished surface.

Posts set in areas of hot mix asphalt or cement concrete surfacing shall conform to the special post design shown on the plans.

#### 601.62: Guardrail Panel

The rail shall be erected in a smooth continuous rail conforming to the required line and grade. All rail elements and splices shall be per the plans. The rail shall make full contact at each splice.

All bolts, except where otherwise required at expansion joints shall be drawn tight. Bolts through expansion joints shall be drawn up as tightly as possible without being too tight to prevent the rail elements from sliding past one another longitudinally.

Curved guardrail shall be used when the radius is 150 ft or less.

Guardrail delineators shall be installed at intervals as indicated on the plans. Retroreflective sheeting shall conform to the following colors:

- a. White on the upstream face in the right shoulder.
- b. Yellow on the upstream face in the left shoulder.
- c. Red on the downstream (wrong-way travel direction) face within 1,000 ft upstream of a median break of a divided highway or interchange.

#### 601.63: Guardrail End Treatment

Proprietary end treatment systems shall be installed in accordance with the manufacturers' specifications and recommendations.

### PART 4- COMPENSATION

#### 601.80 : Method of Measurement

Guardrail and curved guardrail will be measured along the top edge of the rail element from the center of the first mid-span splice to the center of the last mid-span splice.

Transition to NCHRP 350 Guardrail will be measured as individual units 34 ft-4.5 in. in length, measured over two 12-ft-6-in. and one 9-ft-4.5-in. panels, as shown on the plans.

Transition to Rigid Barrier (Single Faced) will be measured as individual units 39 ft-10.75 in. in length, measured from the mid-span splice with the guardrail or end terminal to the end of the W beam terminal connector, as shown on the plans.

Transition to Rigid Barrier (Double Faced) will be measured as individual units 45 ft-7.75 in. in length, measured from the mid-span splice with the guardrail or end terminal to the end of the thrie beam terminal connector, as shown on the plans.

Transition to Bridge Rail will be measured as individual units 33 ft-9 in. in length, measured from the mid-span splice with the guardrail or end terminal to the end of the thrie beam terminal connector, as shown on the plans.

Transition to Thrie Beam, for connections between new guardrail and existing thrie beam guardrail, will be measured as individual units 6 ft-3 inches in length, measured from the W Beam post bolt

slots to the three beam post bolt slots, as shown on the plans.

Trailing Anchorage will be measured as an individual unit 9 ft-4.5 in. in length, measured from the mid-span splice with the guardrail to the centerline of the short timber breakaway post, as shown on the plans.

Flared end treatments, tangent end treatments and guardrail end treatments will be measured as individual units, measured from the Begin Length of Need to the face of the impact head, as shown on the plans.

601.81 : Basis of Payment

The construction of all guardrail items shall include the assembly and erection of all components, parts and materials complete at the intended locations.

Guardrail and curved guardrail will be paid for at the contract price per foot, complete in place, including posts, offset blocks, panels and connecting hardware.

Transition to NCHRP 350 Guardrail, Transition to Rigid Barrier (Single Faced), Transition to Rigid Barrier (Double Faced), Transition to Bridge Rail, and Transition to Thrie Beam Guardrail will be paid for at the contract unit price each, complete in place.

Trailing Anchorage will be paid for at the contract unit price each. Guardrail flared end treatments, tangent end treatments and guardrail terminal ends will be paid for at the contract unit price each, complete in place.

Guardrail delineators shall be considered incidental to the cost of the guardrail, guardrail end treatment or guardrail trailing anchorage.

The use of special post designs, where necessary or directed by the Engineer, shall be incidental to the work with no additional compensation.

Class B Rock Excavation, if necessary, will be paid under 140.81 Basis of Payment.

601.82 : Payment Items

620.12	Guardrail, TL-2 (Single Faced).....	Foot
620.13	Guardrail, TL-3 (Single Faced).....	Foot
620.14	Guardrail, Deep Post (Single Faced).....	Foot
620.32	Guardrail - Curved, TL-2 (Single Faced).....	Foot
620.33	Guardrail - Curved, TL-3 (Single Faced).....	Foot
621.12	Guardrail, TL-2 (Double Faced) .....	Foot
621.13	Guardrail, TL-3 (Double Faced) .....	Foot
621.32	Guardrail - Curved, TL-2 (Double Faced) .....	Foot
621.33	Guardrail - Curved, TL-3 (Double Faced) .....	Foot
627.1	Trailing Anchorage.....	Each
627.72	Guardrail End Treatment, TL-2 (Double Faced).....	Each
627.73	Guardrail End Treatment, TL-3 (Double Faced).....	Each
627.82	Guardrail Tangent End Treatment, TL-2 .....	Each

627.83	Guardrail Tangent End Treatment, TL-3 .....	Each
627.92	Guardrail Flared End Treatment, TL-2 .....	Each
627.93	Guardrail Flared End Treatment, TL-3 .....	Each
628.21	Transition to NCHRP 350 Guardrail .....	Each
628.22	Transition to Rigid Barrier (Single Faced).....	Each
628.23	Transition to Rigid Barrier (Double Faced) .....	Each
628.24	Transition to Bridge Rail .....	Each
628.25	Transition to Thrie Beam.....	Each

END OF SECTION

MassDOT SUBSECTION 628 IMPACT ATTENUATORS

PART 1- DESCRIPTION

628.20: General

Work under this subsection shall consist of furnishing, installing, and in the case of temporary, the removal of impact attenuators in close conformance with the specifications of the manufacturer, and in close conformance with the locations, lines, and grades shown on the plans and/or designated in the Special Provisions.

PART 2- MATERIALS

628.40 : General

Materials shall meet the requirements specified in the following Subsections of Division III, Materials and as otherwise specified herein.

Gravel Borrow .....	M1.03.0
Cement Concrete .....	M4.02.00
Impact Attenuators .....	M9.18.0
Redirective Impact Attenuators .....	M9.18.1
Non-Redirective Impact Attenuators .....	M9.18.2
Low-Maintenance Impact Attenuators.....	M9.18.3
Retroreflective Sheeting.....	M9.30.0

Impact attenuators shall be listed on the QTCE.

The Contractor shall supply an impact attenuator that meets or exceeds the Test Level (TL) designated in the description of the bid item.

The Contractor shall supply an impact attenuator for each location that can shield, at a minimum, the full width of the hazard but shall not exceed any maximum widths or lengths shown in the Plans or Special Provision.

Impact attenuators on bridge decks or spanning bridge joints shall require no anchorage to the bridge deck unless approved by the Engineer.

Transitions to rigid or semi-rigid barriers or connections to fixed objects such as bridge piers shall be supplied and installed by the Contractor and included in the unit price of the impact attenuator.

The approach end shall include a Type 3 Object Marker conforming to the requirements of the MUTCD. The sheeting material shall meet the requirements of M9.30.0: Retroreflective Sheeting.

The Contractor shall submit Shop Drawings for all materials a minimum of 60 days in advance of installation. Shop Drawings shall include a parts list, manufacturer’s instructions for installation, drawings, transition details and drawings (if needed), and all service, maintenance, and/or owner’s manuals. Any part of the system that varies from the exact make and model that was crash tested

must be clearly identified in the Shop Drawings. The Contractor shall not proceed with installation prior to receipt of Shop Drawing approval.

#### 628.41 : Permanent

Impact attenuators classified as Permanent shall be installed by the Contractor and become property of the Department upon acceptance.

Permanent impact attenuators shall be supplied with all new, unused parts.

All materials and work associated with anchoring a Permanent Impact Attenuator, including the installation of a concrete slab if required by the manufacturer, shall be included in the bid price of the item.

#### 628.42 : Temporary

Impact attenuators classified as Temporary shall be installed by the Contractor and remain property of the Contractor during deployment and after removal. The Contractor shall be responsible for maintaining the attenuator in working condition throughout its deployment and repairing and/or replacing damaged components or systems per Subsection 7.17: Traffic Accommodation.

Temporary Impact Attenuators shall not require anchoring into a concrete foundation. Asphalt anchors, if required by the manufacturer, shall be supplied and installed by the Contractor and shall be included in the bid price of the item.

The condition of Temporary Impact Attenuators shall meet the quality standards set forth in the *Quality Standards for Work Zone Traffic Control Devices* published by ATSSA. Failure to meet these minimum standards will require the Contractor to clean or replace any retroreflective sheeting at no additional cost.

### PART 3- CONSTRUCTION METHODS

#### 628.60: General

Excavation for attenuator foundations and anchorage, if required, shall be made to the required depth and to a width that will permit the installation and bracing of forms where necessary. All soft and unsuitable material shall be replaced with gravel borrow.

The impact attenuator and any anchorage or transitions, if necessary, shall be installed in accordance with the manufacturer's instructions. Any modification to the instructions or change in design due to field conditions must be approved by the Engineer.

#### 628.61: Temporary Impact Attenuators

A Temporary Impact Attenuator shall be removed or removed and reset at the conclusion of the temporary traffic control plan setup and is no longer needed. The final removal shall be considered incidental to the cost of the item.

Removing and Resetting Temporary Impact Attenuators shall consist of removing and then reinstalling a Temporary Impact Attenuator to a new location shown on the plans or as directed by the Engineer.

Once a Temporary Impact Attenuator has been removed, the pavement surface shall be restored as needed. This work shall include filling any holes and the sweeping of any debris that may have accumulated around it during deployment. This work shall be considered incidental to the cost of the item.

A damaged Temporary Impact Attenuator shall be repaired or replaced within 24 hours. The damaged location shall be protected by a Truck Mounted Attenuator, or as directed by the Engineer, until the impact attenuator has been restored to working conditions.

#### PART 4- COMPENSATION

##### 628.80 : Method of Measurement

All impact attenuators will be measured as a single unit, each in place.

Temporary Impact Attenuator Removed and Reset will be measured as a single unit, each, to completely remove and reinstall the attenuator to a new location.

##### 628.81 : Basis of Payment

All impact attenuators will be paid for at the contract unit price for each location, which includes full compensation for all labor, equipment, materials, foundation and/or anchorage, and all incidental work necessary to complete the work as specified.

The final removal of a Temporary Impact Attenuator shall be considered incidental to the cost of the item.

Temporary Impact Attenuator Removed and Reset will be paid for at the contract unit price for the entire remove and reset operation and will include full compensation for all labor, equipment, materials, anchorage, restoration, and all incidental work necessary to complete the work as specified. Adjusting a Temporary Impact Attenuator that has moved due to passing traffic or

weather events and/or the movement of a Temporary Impact Attenuator to accommodate the Contractor is not considered Removing and Resetting and will not be paid for.

Gravel Borrow required to replace unsuitable soils for any foundation and anchorage work will be paid for at the contract unit price under Item 151. Gravel Borrow.

A Truck Mounted Attenuator, if required to protect a damaged Temporary Impact Attenuator, will be paid for at the contract unit price under Item 853.403 Truck Mounted Attenuator.

628.82 : Payment Items

628.302	Permanent Impact Attenuator, Non-Redirective, TL-2.....	Each
628.303	Permanent Impact Attenuator, Non-Redirective, TL-3.....	Each
628.304	Temporary Impact Attenuator, Non-Redirective, TL-2.....	Each
628.305	Temporary Impact Attenuator, Non-Redirective, TL-3.....	Each
628.312	Permanent Impact Attenuator, Redirective, TL-2.....	Each
628.313	Permanent Impact Attenuator, Redirective, TL-3.....	Each
628.214	Temporary Impact Attenuator, Redirective, TL-2.....	Each
628.215	Temporary Impact Attenuator, Redirective, TL-3.....	Each
628.322	Permanent Impact Attenuator, Low-Maintenance, TL-2.....	Each
628.323	Permanent Impact Attenuator, Low-Maintenance, TL-3.....	Each

END OF SECTION



MassDOT SUBSECTION 230: CULVERTS, STORM DRAINS, AND SEWER PIPES  
DESCRIPTION OF WORK

PART 1- GENERAL

230.20: General

This work shall consist of the construction of culvert storm drains, sewer pipes, hereinafter referred to as "Pipe" and flared end sections for Reinforced Concrete or Metal Pipe, in accordance with these specifications and in close conformity with the lines and grades shown on the plans or established by the Engineer.

PART 2- MATERIALS

230.40: General

**M5.00.0:** Pipe, Culvert Sections and Conduit These shall consist of individual sections of the kinds and sizes shown on the plans and as directed. They shall conform to the requirements of the applicable following subsections. All pipes shall be subject to inspection at the point of manufacture as well as the site of the work. The purpose of the inspection shall be to cull and reject pipes which, independent of the physical tests, fail to conform to the specification in the particulars of dimension, workmanship, finish, blisters, cracks or fractures.

**M5.02.1:** Reinforced Concrete Pipe Reinforced concrete pipe shall conform to the requirements of AASHTO M 170 for Standard Strength Reinforced Concrete Culvert Pipe for Class III Pipe, unless otherwise designated on the plans, except that the steel area for 24-in. pipe shall be 0.10 in.<sup>2</sup> per ft and circular reinforcement only shall be used in circular pipes.

PART 3- CONSTRUCTION METHODS

230.60 : General

Excavation and backfill shall conform to the applicable portions of Subsection 140: Excavation for Structures and Subsection 150: Embankment.

230.61 : Bedding Pipes

The bedding for the pipe shall be shaped to conform reasonably close to the lower 10% of the pipe and recesses excavated for bells of bell and spigot pipes.

All pipe shall be laid to the specified line and grade, with a firm bearing throughout each length and with bell ends uphill.

### 230.62 : Pipe Joints

The joints of concrete pipe shall be formed by caulking a gasket of jute or oakum into the bell and then filling the remainder of the joint with cement mortar. The invert shall be kept smooth and free of any obstructions. In the case of concrete pipe the surfaces to be joined shall be thoroughly cleaned and wetted with water before the joint is made. Corrugated metal pipe and corrugated plastic (polyethylene) pipe shall be firmly joined with an approved coupling.

When rubber type ring gaskets are used the pipe ends shall be designed so that the gasket will be confined on all sides and will not support the weight of the pipe. Regardless of the type of joint used the interior surfaces of abutting pipes shall form a smooth grade when pipe laying is completed.

Where watertight joints are required, concrete pipe shall be joined using flexible water tight rubber gaskets conforming to ASTM C443. Any alternative joint design must be pre-approved by the Engineer.

In designated areas, as directed, certain joints may be left open to allow for entrance of underground water into the pipeline.

### 230.63 : Structural Plate Pipe and Pipe-Arch

#### A. Excavation.

(See 140.60: General)

#### B. Bedding.

The pipe or pipe-arch structure shall be placed on a prepared foundation carefully shaped to fit the lower plate or plates of the structure so that the flow line will conform to the required grade.

The arch structure shall be placed on a foundation as shown on the plans. Each side of the arch shall rest on a galvanized channel, as detailed on the plans, securely embedded in the substructure.

#### C. Erections.

The plates for the structure shall be assembled according to the manufacturer's assembly instructions. Pipe or pipe-arch structures may be assembled in their final location or adjacent to it, and then placed on the prepared foundation as a complete unit. Arches shall be erected in place upon the prepared substructure. When completed, all bolts shall be effectively tightened.

#### D. Elongation of Pipe.

All pipe shall be fabricated elliptically so as to increase the vertical diameter 5% and decrease

the horizontal diameter 5%. These dimensions shall be subject to manufacturing tolerances.

#### E. Coating.

The entire outside surface and the inside bottom half of the pipes and the entire outside and inside of the bottom and corner plates of pipe arches shall be covered with a coat of bituminous material conforming to Subsection M7.04.01.

When the structure is erected in the final location, the bottom of all plates that are to be in contact with the ground shall be coated and allowed to dry before they are placed in the structure.

For arches, the entire outside surface shall be covered with one coat of bituminous material as specified above. The metal bearing channel shall be filled with an approved asphalt filler to the level of the concrete after erection of the arch and before backfilling is started.

#### F. Backfilling

Backfilling requirements shall conform to the provisions of 120.60: General, Paragraph B, 150.60: General, and 150.64: Backfilling for Structures and Pipes.

#### G. Flared End Sections.

The unit shall be accurately aligned on a prepared bed on the existing ground, or if so directed by the Engineer, on compacted gravel fill.

#### 230.64 : Field Testing of Corrugated Plastic Pipe

Installed pipe shall be tested to ensure the maximum vertical deflection of the thermoplastic pipe does not exceed 5% of its base inside diameter. The base inside diameter is defined as the specified nominal diameter minus the AASHTO allowable inside diameter tolerance of 1.5% but not more than ½ in. A minimum of 20% of the total length of each size of Corrugated Plastic Pipe installed on the project shall be tested. Only mandrel testing shall be used for pipe sizes of 24 in. or less. For pipe sizes greater than 24 in., the Contractor shall have the option to video inspect, and (1) use a mandrel test if a deflection is noted or (2) hand measure, for pipes with a diameter greater than 36 in., to the requirements listed below. Runs of pipe to be tested shall be selected by the Engineer. The failure of any tested pipe shall subject all Corrugated Plastic Pipe of every size to 100% testing, at the discretion of the Engineer.

Deflection tests shall be performed by the Contractor under the direction of the Engineer not sooner than 30 days after completion of installation and compaction of backfill. The pipe shall be

cleaned and inspected for offsets and obstructions prior to testing.

#### Mandrel Test:

- Shall be used for all pipes up to 24 in. nominal inside diameter.
- The mandrel shall be pulled through the pipe by hand to ensure that maximum allowable deflections have not been exceeded.
- The mandrel diameter shall be verified and approved by the Engineer prior to use.
- Use of an unapproved mandrel will invalidate the test.
- If the mandrel fails to pass through the pipe, the pipe will be deemed to be over-deflected.
- The mandrel shall be a rigid device, with odd numbered-legs (9 legs minimum) having an effective length not less than its nominal diameter.
- The mandrel shall be fabricated of steel with pulling rings at each end.
- The mandrel shall be stamped or engraved on some segment other than a runner indicating the nominal size, and mandrel OD.

#### Video Inspection:

- May be used to determine if a deflection is evident in pipes with a nominal inside diameter greater than 24 in.
- Verification of the actual deflection limits must be accomplished using the mandrel test method or the hand measurement method.
- Provide and use a mobile color video camera and light source to inspect pipes.
- The video camera must be able to be moved inside the pipe barrel and be controlled remotely by the inspector.
- The video camera must have a remote monitor and a recording apparatus to view and record the condition of the installed pipes.
- A copy of the pipe inspection video recording, in an approved format, shall be provided to the Engineer.

#### Hand Measurement:

- Measure manually any deflections of pipe larger than 36 in. nominal inside diameter.
- Must be done in the presence of the Engineer.

The minimum diameters, based on approximately 95% of base inside diameter at any point along the full length, are as follows:

**Table 230.64-1: Maximum Allowable Vertical Deflection of Corrugated Plastic Pipe**

<b>Nominal Size (in.)</b>	<b>Allowable Deflection Diameter (in.)</b>
12	11.2
15	14.0
18	16.8
24	22.4
30	28.0
36	33.7
42	39.4
48	45.1
60	56.5

Any pipe deflected beyond acceptable limits shall be uncovered. If not damaged, as determined by the Engineer, the pipe may be reinstalled. Damaged pipe shall not be reinstalled and shall be removed from the work site. No other method or process to reduce or correct deflection shall be acceptable.

230.65 : Strutting of Pipe

Strutting shall be used as required to ensure the integrity of the pipe and all costs associated are incidental to the item.

**PART 4- COMPENSATION**

230.80 : Method of Measurement

Pipes shall be measured in place and the quantity to be paid for shall be the length actually constructed as directed within the limits specified below.

For measurement purposes the end of pipe in closed structures shall be considered at the inside

face of the wall and at masonry headwalls it shall be considered to be at the face of the headwall.

Pipe bends for Corrugated Metal pipe shall be in accordance with the standard drawings and the length of pipe sections containing bends shall be measured along the centerline and shall be paid for as straight sections of pipe.

Reinforced Concrete Pipe Flared Ends and Metal End Sections will be measured in place by the unit each, complete and approved.

Trench excavation in excess of 5 ft and rock excavation shall be measured as specified in 140.80: Method of Measurement for Class B Trench Excavation and Class B Rock Excavation respectively.

Structural plate pipe or pipe arches shall be measured in place and the quantity to be paid for shall be the length actually constructed as directed and to the following limits:

For structural plate pipe the length shall be the average of the top and bottom center line length; for pipe arches, the bottom center line length; and for arches, the average of the springing line lengths.

Trench Excavation in excess of 5 ft and Rock Excavation for structural plate pipe, arches and pipe arches shall be measured in accordance with the relevant provisions of 140.80: Method of Measurement for Class B Trench Excavation and Class B Rock Excavation.

Corrugated Plastic Pipe includes testing and all other incidentals necessary to complete the work. All costs incurred by the Contractor attributable to testing and corrective action, including any delays, shall be borne by the Contractor at no cost to the Department.

#### 230.81 : Basis of Payment

Pipe culverts, pipe drains and pipe sewers will be paid for at the contract unit price per lineal foot of the kind of pipe required, installed and complete in place. Corrugated plastic pipe shall include Gravel Borrow Type d backfill material.

Reinforced Concrete Pipe Flared Ends and Metal End Sections will be paid for at the contract unit price each for the size and kind of pipe end specified.

Trench excavation for pipe culverts, pipe drains, pipe sewers, structural plate pipe arches and pipe arches greater than a depth of 5 ft and rock excavation will be paid for as specified in 140.81: Basis of Payment for Class B Trench Excavation and Class B Rock Excavation. No payment for trench excavation for pipes will be made within the limits of 1 ft outside the base section of catch basins, manholes or leaching basins.

Trench excavation and backfill for trenches 5 ft or less in depth for pipe arches, pipe culverts, pipe drains, pipe sewers, and structural plate pipe arches shall be included in the various pipe items.

Backfill for that part of a trench which is more than 5 ft in depth shall be included in the item for Class B Trench Excavation. If the material for backfill is obtained from borrow it will be paid for at the contract unit price per cubic yard or ton of the kind of borrow required.

Masonry ends and foundations will be paid for at the contract unit price per cubic yard of the kind of masonry required.

Gravel Borrow will be paid in accordance with Subsection 150: Embankment.

230.82 : Payment Items

- \*230. -Inch Corrugated Metal Pipe \_\_ Gage ..... Foot
- \*230.7- -Inch Corrugated Metal Pipe End Section..... Each
- \*232. \_\_ x \_\_ Inch ACCM Pipe-Arch \_\_ Gage. .... Foot
- \*234.- -Inch Drainage Pipe-Option ..... Foot
- \*238. Ductile Iron Pipe ..... Foot
- \*239. Structural Plate Pipe ..... Foot
- \*240. Structural Plate Pipe-Arch, \_\_ Gage ..... Foot
- \*241.- -Inch Reinforced Concrete Pipe ..... Foot
- to \*245.-
- \*241.-1 -Inch Reinforced Concrete Pipe Flared End.....Each to
- \*245.-1
- \*252.- -Inch Corrugated Plastic (Polyethylene) Pipe..... Foot
- \*252.1- -Inch Corrugated Plastic Pipe Flared End..... Each
- \*255.- Polymeric Precoated Corrugated Metal Pipe..... Foot

\*Pipe or appurtenance size will be included as part of the item number in order to differentiate between the sizes.

END OF SECTION

SECTION 03416  
PRECAST CONCRETE SYSTEMS

PART I-GENERAL

I.I SUMMARY OF WORK

- A. This section of the specification covers all materials, labor, tools and equipment testing, and operations necessary to furnish and install precast concrete headwalls, wing walls, and associated work as shown on the Contract Drawings.
- B. Work includes all excavation, dewatering, subgrade preparation, precast installation, backfill compaction, and surface restoration. Refer to the General Conditions.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General Conditions.
- B. Related Sections include the following:
  - 1. Section 31 00 00 Earthwork
  - 2. Section 230-00 – Culverts, Storm Drains and Sewer pipes

1.3 SUBMITTALS

- A. Submit the following in accordance with the General Conditions.
- B. Submit product data and design mixes for each concrete mix.
- C. Submit one copy of the blow count testing results.
- D. Copies of shop and erection drawings shall be submitted for the Engineer's review. The drawings shall show all dimensions of precast sections; location openings; the locations, type, size and strength of inserts, embedded angles, steel reinforcement; and all other information necessary to ensure proper handling, fabrication, and erection of the culvert.
- E. Copies of the headwall and wingwall design calculations stamped by a Massachusetts registered professional engineer shall be submitted to the Engineer for record purposes only.



## 1.4 QUALITY ASSURANCE

- A. The Precaster shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual. The Precaster shall meet either Section 16.1 or 16.2.
- B. Certification: The Precaster shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program or the National Precast Concrete Association's Plant Certification Program prior to and during production of the products covered by this specification.
- C. Qualifications, Testing, and Inspection:
  - 1. The Precaster shall have been in the business of producing precast concrete products similar to those specified for a minimum of three years. The Precaster shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the Precaster to produce quality products consistent with industry standards.
  - 2. The Precaster shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed for each 150 cubic yards of concrete placed, but not less frequently than once per production run.
    - i. Compressive Strength: ASTM C39 and ASTM C497
    - ii. Air Content: ASTM C231 or ASTM C173
  - 3. The Precaster shall provide documentation demonstrating compliance with this section to the Engineer at regular intervals or upon request.
  - 4. The Owner may place an inspector in the plant when the products covered by this specification are being manufactured.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide, Storage, and Handling and as specified herein. Ship equipment and material complete except where partial disassembly is required by transportation regulations or for protection of components.

## 1.6 DESIGN

- A. The precast element dimensions and reinforcement details shall be as prescribed in the plans and the shop drawings provided by the manufacturer. The minimum concrete compressive strength shall be as noted on the shop drawings. The minimum steel yield strength shall be 60,000 psi, unless otherwise noted on the shop drawings.
- B. The precast elements shall be designed in accordance with the "Standard Specifications for Highway Culverts" 17<sup>th</sup> Edition, adopted by the American Association of State Highway and Transportation Officials, 1996, as amended by the 1997, 1998, 1999, 2000, and 2002 Interim Revisions. A minimum of 6-inches of cover above the crown of the culvert units is required in the installed condition (Unless noted otherwise on the shop drawings and designed accordingly).
- C. Placement of Reinforcement for Precast Elements - The cover of concrete over the longitudinal and transverse reinforcement shall be 2 inches minimum. The clear distance from the end of each precast element to the end transverse reinforcing steel shall not be less than one inch nor more than two inches. Reinforcement shall be assembled utilizing a single layer of welded wire fabric, or a single layer of deformed billet-steel bars. Welded wire fabric shall be composed of transverse and longitudinal wires meeting the spacing requirements of Part 2 - Products, and shall contain sufficient longitudinal wires extending through the element to maintain the shape and position of the reinforcement. Longitudinal reinforcement may be welded wire fabric or deformed billet-steel bars and shall meet the spacing requirements of Part 2 - Products, below. The ends of the longitudinal reinforcement shall be not more than 3 inches and not less than 1½ inches from the ends of the walls.
- D. Laps, Welds, and Spacing for Precast Elements - Splices in the reinforcement shall be made by lapping. Laps may be tack welded together for assembly purposes. For smooth welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.2 and 8.32.6. For deformed welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.1 and 8.32.5. For deformed billet-steel bars, the overlap shall meet the requirements of AASHTO 8.25. The spacing center-to-center of the wires in a wire fabric sheet shall be not less than 2 inches nor more than 8 inches.
- E. The precast footings shall be sized based on the results of the blow count testing. Refer to Section 3 for testing requirements.

## 1.7 DESIGN CERTIFICATION

- A. The headwall and its components shall be designed by a registered professional structural engineer and engineered to meet code requirements for Massachusetts and the Town of Lunenburg, Massachusetts. The headwall shall be furnished with design calculations and a letter of certification signed and sealed by a registered professional structural engineer stating the culvert system and foundations meet the design load requirements.
- B. The precast units shall be designed to meet the requirements of loading of the following:
  - 1. Standard Specifications for The Highways and Bridges, 17th- Edition (or latest edition).
  - 2. American Concrete Institute (ACI-318R-05) "Building Code Requirements for Reinforced Concrete".
  - 3. Concrete Reinforcing Institute "Manual of Standard Practice".

## 1.8 PLANT CERTIFICATION

- A. The plant shall be regularly engaged in the construction and erection of precast concrete units. The manufacturing plant shall be "National Precast Certified Plants". The manufacturer should be engaged in producing precast concrete units for a minimum of five years.

## PART 2 -PRODUCTS

### 2.1 MATERIALS

- A. Concrete - The concrete for the precast elements shall be air-entrained, when installed in areas subject to freeze-thaw conditions, composed of Portland cement, fine and coarse aggregates, admixtures, and water. Air-entrained concrete shall contain  $6 \pm 2$  percent air, and the air-entraining admixture shall conform to AASHTO M154
  - 1. Portland Cement - Shall conform to the requirements of ASTM Specifications C150- Type I, Type II, or Type m cement.
  - 2. Coarse Aggregate - Shall consist of stone having a maximum size of 1 inch. Aggregate shall meet requirements for ASTM C33.
  - 3. Water Reducing Admixture - The manufacturer may submit, for approval by the Engineer, a water-reducing admixture for the purpose of increasing workability and reducing the water requirement for the concrete.

4. Calcium Chloride - The addition to the mix of calcium chloride or admixtures containing calcium chloride will not be permitted.
- B. Steel Reinforcement and Hardware - All reinforcing steel for the precast elements shall be fabricated and placed in accordance with the detailed shop drawings submitted by the manufacturer.
1. Steel Reinforcement - Reinforcement shall consist of welded wire fabric conforming to AASHTO M55 (ASTM A 185) or AASHTO M221 (ASTM A 497) or deformed billet steel bars conforming to AASHTO M31 (ASTM A 615) Grade 60. Longitudinal distribution reinforcement may consist of welded wire fabric or deformed billet- steel bars.
  2. Hardware - Bolts and threaded rods for wing wall connections shall conform to ASTM A307. Nuts shall conform to AASHTO M292 (ASTM A194) Grade 2H. All bolts, threaded rods, and nuts used in wing wall connections shall be mechanically zinc coated in accordance with ASTM B 695 Class 50.
  3. Structural Steel for wing wall connection plates and plate washers shall conform to AASHTO M270 (ASTM A709) Grade 36 and shall be hot dip galvanized as per AASHTO M 111 (ASTM A123).
  4. Inserts for wing wall connections shall be 1" diameter Two-Bolt Preset Wing Wall Anchors as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio.
  5. Ferrule Loop Inserts shall be F-64 Ferrule Loop Inserts as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio.
  6. Hook Bolts used in attached headwall connections shall be ASTM A307.
  7. Insert for detached headwall connections shall be AISI type 304 stainless steel, F-58 Expanded Coil inserts as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio. Coil rods and nuts used in headwall connections shall be AISI type 304 stainless steel. Washers used in headwall connections shall be either AISI type 304 stainless steel plate washers or AASHTO M 270 (ASTM A709) Grade 36 plate washers hot dip galvanized as per AASHTO M 111 (ASTM A153).
  8. Reinforcing bar splices shall be made using the Dowel Bar Splicer System as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio or approved equal, and shall consist of the Dowel Bar Splicer (DB-SAE) and Dowel-Ju (DI).

## 2.2 CONCRETE MANUFACTURE REQUIREMENTS

- A. Mixture - The aggregates, cement and water shall be proportioned and mixed in a batch mixer to produce a homogeneous concrete meeting the strength requirements of this specification. The proportion of Portland cement in the mixture shall not be less than 564 pounds (6 sacks) per cubic yard of concrete.
- B. Curing - The precast concrete elements shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength in 28 days or less. Any one of the following methods of curing or combinations thereof shall be used:
  - 1. Steam Curing - The precast elements may be low-pressure steam cured by a system that will maintain a moist atmosphere.
  - 2. Water Curing - The precast elements may be water cured by any method that will keep the sections moist.
  - 3. Membrane Curing - A sealing membrane conforming to the requirements of ASTM Specification C 309 may be applied and shall be left intact until the required concrete compressive strength is attained. The concrete temperature at the time of application shall be within+ 10 degrees F of the atmospheric temperature. All surfaces shall be kept moist prior to the application of the compounds and shall be damp when the compound is applied.
- C. Forms - The forms used in manufacture shall be sufficiently rigid and accurate to maintain the wing wall and headwall dimensions within the permissible variations included in Section 2.3 of these Specifications. All casting surfaces shall be of smooth nonporous material.
- D. Handling - Handling devices or holes shall be permitted in each precast element for the purpose of handling and installation.
- E. Storage - The precast elements shall be stored in such a manner to prevent cracking or damage. The culvert units shall not be moved until the concrete compressive strength has reached a minimum of 2,500 psi, and they shall not be stored in an upright position until the concrete compressive strength has reached a minimum of 4,000 psi.

## 2.3 PERMISSIBLE VARIATIONS

- A. Wing Walls and Headwalls
  - 1. Wall Thickness - The wall thickness shall not vary from that shown in the design by more than ½ inch.

2. Length/Height of Wall sections - The length and height of the wall shall not vary from that shown in the design by more than ½ inch.
3. Position of Reinforcement - The maximum variation in the position of the reinforcement shall be + ½ inch from that shown in the approved shop drawings. In no case shall the cover over the reinforcement be less than 1½ inches.
4. Size of Reinforcement - The permissible variation in diameter of any reinforcing shall conform to the tolerances prescribed in the ASTM Specification for that type of reinforcing. Steel area greater than that required shall not be cause for rejection.

#### 2.4 FORM LINER

- A. Precast concrete headwalls and wing walls shall be provided with thermoform plastic form liner. Form liners shall be Hill Country Flagston by Dayton Superior or Engineer approved equal.

#### 2.5 WARRANTY

- A. The basic concrete structure shall endure and not deteriorate for a period of at least five (5) years.

### PART 3- EXECUTION

#### 3.1 BLOW COUNT TESTING

- A. The pre-cast manufacturer shall be responsible for conducting four (4) blow count tests prior to submitting shop drawings for the pre-cast box culvert, headwalls, wingwalls, and footings. Blow count tests shall be located along the bank of the Herring Run Culvert. Two tests shall be conducted upstream of the Herring Run Culvert (one north of the culvert, one south of the culvert). Two tests shall be conducted downstream of the Herring Run Culvert (one north of the culvert, one south of the culvert). The results of the blow count tests shall be used by the pre-cast manufacturer to size the culvert footings.

#### 3.2 FABRICATION AND ASSEMBLY

- A. The manufacturer shall check and verify all dimensions, elevations, and locations of openings, anchor bolts, inserts, and other cast-in items. Any discrepancy or lack of information shall be reported to the Engineer before fabrication.

- B. The Contractor shall be responsible for any failure to precast sections to the correct dimensions and for any omissions or inaccuracies in the manufacture. If, in the opinion of the Engineer, proper corrections cannot be made, the section shall be rejected and shall be replaced with a new section at the Contractor's expense.
- C. The precast elements, including form liner, shall be entirely assembled by the manufacturer at the plant, sealed and waterproofed.

### 3.3 INSTALLATION

- A. Erection shall be done by experienced workmen, in accordance with previously mentioned standards.
- B. No field holes or cuts shall be made in any section without prior approval of the Engineer. All holes shall be cut in accordance with manufacturer recommendations.
- C. The Manufacturer shall be responsible for delivery of the entire system and shall provide representation to off load and set the unit in place. The unit shall be set per contract document, and final touch-up completed if necessary.
- D. Contractor shall be responsible for coordinating installation with space and installation limitations at site, refer to Contract Drawings.

### 3.4 CONSTRUCTION REQUIREMENTS

- A. Placement of the Wing Walls, and Headwalls - The wing walls, and headwalls shall be placed as shown on the Contract Drawings. Special care shall be taken in setting the elements to the true line and grade. The wing walls shall be set on 6" x 6" masonite or steel shims. A minimum of 1/2-inch gap shall be provided between the footing and the bottom of the wing wall. This gap shall be filled with cement grout (Portland cement and water or cement mortar composed of one part Portland cement and three parts of sand, by volume, and water).
- B. External Protection of Joints - The butt joint made by two adjoining precast units shall be covered with a 7/8" x 1 3/8" piece of preformed bituminous joint sealant and a minimum of a nine-inch-wide joint wrap. The surface shall be free of dirt before applying the joint material. A primer compatible with the joint wrap shall be applied for a minimum width of nine inches to each side of the joint. The external wrap shall be either EZ-WRAP RUBBER by PRESS-SEAL GASKET CORPORATION, SEAL WRAP by MAR MAC MANUFACTURING CO. INC. or Engineer approved equal. The joint shall be

covered continuously from the bottom of one precast section leg, across the top of the arch and to the opposite precast section leg. Any laps that result in the joint wrap shall be a minimum of six inches long with the overlap running downhill.

- C. In addition, the joint between the end box culvert and the headwall shall also be sealed as described above. If precast wing walls are used, the joint between the box culvert and the wing wall shall be sealed with a 2' -0" wide strip of filter fabric. Also, if lift holes are formed in the arch units, they shall be primed and covered with a 9" x 9" square of joint wrap.
- D. Where precast wing walls are used, the joint between the headwall and the wing wall shall be sealed with a 2'-0" wide strip of filter fabric. Also, if lift holes are formed in the arch units, they shall be primed and covered with a 9" x 9" square of joint wrap.
- E. During the backfilling operation, care shall be taken to keep the joint wrap in its proper location over the joint.
- F. Backfill - Backfill shall be considered as all replaced excavation and new embankment adjacent to the box culvert, wing walls, and headwalls. The project construction and material specifications, which include the specifications for excavation for structures and roadway excavation and embankment construction, shall apply except as modified in this section.
- G. No backfill shall be placed against any structural elements until they have been approved by the Engineer.
- H. Mechanical tampers or approved compacting equipment shall be used to compact all backfill and embankment immediately adjacent to each side of each precast element until it is covered to a minimum depth of one foot, unless the design fill height is less than 1'- 0". Heavy compaction equipment shall not be operated in this area.
- I. In no case shall equipment operating in excess of the design load (HS20 or HS25) be permitted over the culvert unless approved by the Engineer.
- J. Any additional fill and subsequent excavation required to provide this minimum cover shall be made at no additional cost to the project.
- K. As a precaution against introducing unbalanced stresses in the culvert units when placing backfill, at no time shall the difference between the heights of fill on opposite sides of the culvert exceed 24 inches.
- L. Backfill in front of wing walls shall be carried to ground lines shown in the Contract Drawings.



### 3.5 QUALITY CONTROL/TESTING AND INSPECTION

- A. Testing Agency: The Contractor will engage a qualified independent testing and inspecting agency subject to Owner approval to sample materials, perform tests, and submit test reports during concrete placement. Tests shall be performed according to ACI 301.
- B. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- C. Type of Test Specimen - Concrete compressive strength shall be determined from compression tests made on cylinders or cores. For cylinder testing, a minimum of 4 cylinders shall be taken during each production run. For core testing, one core shall be cut from each of 3 precast elements selected at random from each production group. A production group shall be defined as 15 or fewer wing walls or headwalls in a continuous production run. For each continuous production run, each production group or fraction thereof shall be considered separately for the purpose of testing and acceptance. A production run shall be considered continuous if not interrupted for more than 3 consecutive days.
- D. Compression Testing - Cylinders shall be made and tested as prescribed by the ASTM C 39 Specification. Cores shall be obtained and tested for compressive strength in accordance with the provisions of the ASTM C 497 Specification.
- E. Acceptability of Cylinder Tests- When the average compressive strength of all cylinders tested is equal to or greater than the design compressive strength, and not more than 10% of the cylinders tested have a compressive strength less than the design concrete strength, and no cylinder tested has a compressive strength less than 80% of the design compressive strength, then the lot shall be accepted. When the compressive strength of the cylinders tested does not conform to this acceptance criteria, the acceptability of the lot may be determined as described in section 8.4, below. Failure of any of the 28-day test cylinders to meet 90 percent of the minimum compressive strength requirement can be cause for rejection.
- F. Acceptability of Core Tests - The compressive strength of the concrete in each production group as defined in 8.1 is acceptable when the average core test strength is equal to or greater than the design concrete strength. When the compressive strength of the core tested is less than the design concrete strength, the precast element from which that core was taken may be re-cored when the compressive strength of the re-core is equal to or greater than the design concrete strength, the compressive strength of the concrete in that production group is acceptable.

1. When the compressive strength of any re-core is less than the design concrete strength, the precast element from which that core was taken shall be rejected. Two precast elements from the remainder of the group shall be selected at random and one core shall be taken from each. If the compressive strength of both cores is equal to or greater than the design concrete strength, the compressive strength of the remainder of that group is acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength. The remainder of the group shall be rejected or, at the option of the manufacturer, each precast element of the remainder of the group shall be cored and accepted individually. and any of these elements that have cores with less than the design concrete strength shall be rejected.
  2. Plugging Core Holes - The core holes shall be plugged and sealed by the manufacturer in a manner such that the element will meet all of the test requirements of this specification. Precast elements so sealed shall be considered satisfactory for use.
- G. Test Equipment- Every manufacturer furnishing precast elements under this specification shall furnish all facilities and personnel necessary to carry out the tests required.

### 3.6 WORKMANSHIP AND FINISH

- A. The wing walls, and headwalls shall be substantially free of fractures. The ends of the culvert units shall be normal to the walls and centerline of the culvert section, within the limits of the variations given in the section above, except where beveled ends are specified. The faces of the wing walls and headwalls shall be parallel to each other, within the limits of the variations given in the section above. The surface of the precast elements shall be a smooth steel form or troweled surface. Trapped air pockets causing surface defects shall be considered as part of a smooth, steel-form finish.

### 3.7 REPAIRS

- A. Precast elements may be repaired, if necessary, because of imperfections in manufacture or handling damage, and they will be acceptable if, in the opinion of the purchaser, the repairs are sound, properly finished and cured and the repaired section conforms to the requirements of this Specification.

### 3.8 INSPECTION

- A. The quality of materials, the process of manufacture, and the finished precast

elements shall be subject to inspection by the purchaser.

### 3.9 REJECTION

A. The precast elements shall be subject to rejection because of any of the specification requirements. Individual precast elements may be rejected because of any of the following:

1. Fractures or cracks passing through the wall, except for a single end crack that does not exceed one half the thickness of the wall.
2. Defects that indicate proportioning, mixing, and molding not in compliance with these Specifications.
3. Honeycombed or open texture.
4. Damaged edges, where such damage would prevent making a satisfactory joint.

END OF SECTION

SECTION 03416  
PRECAST CONCRETE SYSTEMS

PART I -GENERAL

I.I SUMMARY OF WORK

A. This section of the specification covers all materials, labor, tools and equipment testing, and operations necessary to furnish and install precast concrete headwalls, wing walls, and associated work as shown on the Contract Drawings.

B. Work includes all excavation, dewatering, subgrade preparation, precast installation, backfill compaction, and surface restoration. Refer to the General Conditions.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General Conditions.

B. Related Sections include the following:

1. Section 31 00 00 Earthwork

2. Section 230-00 – Culverts, Storm Drains and Sewer pipes

1.3 SUBMITTALS

A. Submit the following in accordance with the General Conditions.

B. Submit product data and design mixes for each concrete mix.

C. Submit one copy of the blow cowit testing results.

D. Copies of shop and erection drawings shall be submitted for the Engineer's review. The drawings shall show all dimensions of precast sections; location openings; the locations, type, size and strength of inserts, embedded angles, steel reinforcement; and all other information necessary to ensure proper handling, fabrication, and erection of the culvert.

E. Copies of the headwall and wingwall design calculations stamped by a Massachusetts registered professional engineer shall be submitted to the Engineer for record purposes only.

## 1.4 QUALITY ASSURANCE

A. The Precaster shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual. The Precaster shall meet either Section 16.1 or 16.2.

B. Certification: The Precaster shall be certified by the Precast/Prestressed Concrete Institute Plant Certification Program or the National Precast Concrete Association's Plant Certification Program prior to and during production of the products covered by this specification.

C. Qualifications, Testing, and Inspection:

1. The Precaster shall have been in the business of producing precast concrete products similar to those specified for a minimum of three years. The Precaster shall maintain a permanent quality control department or retain an independent testing agency on a continuing basis. The agency shall issue a report, certified by a licensed engineer, detailing the ability of the Precaster to produce quality products consistent with industry standards.

2. The Precaster shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed for each 150 cubic yards of concrete placed, but not less frequently than once per production run.

- i. Compressive Strength: ASTM C39 and ASTM C497
- ii. Air Content: ASTM C231 or ASTM C173

3. The Precaster shall provide documentation demonstrating compliance with this section to the Engineer at regular intervals or upon request.

4. The Owner may place an inspector in the plant when the products covered by this specification are being manufactured.

## 1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide, Storage, and Handling and as specified herein. Ship equipment and material complete except where partial disassembly is required by transportation regulations or for protection of components.

## 1.6 DESIGN

A. The precast element dimensions and reinforcement details shall be as prescribed in the plans and the shop drawings provided by the manufacturer. The minimum concrete compressive strength shall be as noted on the

shop drawings. The minimum steel yield strength shall be 60,000 psi, unless otherwise noted on the shop drawings.

B. The precast elements shall be designed in accordance with the "Standard Specifications for Highway Culverts" 17th Edition, adopted by the American Association of State Highway and Transportation Officials, 1996, as amended by the 1997, 1998, 1999, 2000, and 2002 Interim Revisions. A minimum of 6-inches of cover above the crown of the culvert units is required in the installed condition (Unless noted otherwise on the shop drawings and designed accordingly).

C. Placement of Reinforcement for Precast Elements - The cover of concrete over the longitudinal and transverse reinforcement shall be 2 inches minimum. The clear distance from the end of each precast element to the end transverse reinforcing steel shall not be less than one inch nor more than two inches. Reinforcement shall be assembled utilizing a single layer of welded wire fabric, or a single layer of deformed billet-steel bars. Welded wire fabric shall be composed of transverse and longitudinal wires meeting the spacing requirements of Part 2 - Products, and shall contain sufficient longitudinal wires extending through the element to maintain the shape and position of the reinforcement. Longitudinal reinforcement may be welded wire fabric or deformed billet-steel bars and shall meet the spacing requirements of Part 2 - Products, below. The ends of the longitudinal reinforcement shall be not more than 3 inches and not less than 1½ inches from the ends of the walls.

D. Laps, Welds, and Spacing for Precast Elements - Splices in the reinforcement shall be made by lapping. Laps may be tack welded together for assembly purposes. For smooth welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.2 and 8.32.6. For deformed welded wire fabric, the overlap shall meet the requirements of AASHTO 8.30.1 and 8.32.5. For deformed billet-steel bars, the overlap shall meet the requirements of AASHTO 8.25. The spacing center-to-center of the wires in a wire fabric sheet shall be not less than 2 inches nor more than 8 inches.

E. The precast footings shall be sized based on the results of the blow count testing. Refer to Section 3 for testing requirements.

## 1.7 DESIGN CERTIFICATION

A. The headwall and its components shall be designed by a registered professional structural engineer and engineered to meet code requirements for Massachusetts and the Town of Lunenburg, Massachusetts. The headwall shall be furnished with design calculations and a letter of certification signed and sealed by a registered professional structural engineer stating the culvert system and foundations meets the design load requirements.

- B. The precast units shall be designed to meet the requirements of loading of the following:
1. Standard Specifications for The Highways and Bridges, 17th- Edition (or latest edition).
  2. American Concrete Institute (ACI-318R-05) "Building Code Requirements for Reinforced Concrete".
  3. Concrete Reinforcing Institute "Manual of Standard Practice".

## 1.8 PLANT CERTIFICATION

A. The plant shall be regularly engaged in the construction and erection of precast concrete units. The manufacturing plant shall be "National Precast Certified Plants". The manufacturer should be engaged in producing precast concrete units for a minimum of five years.

## PART 2 -PRODUCTS

### 2.1 MATERIALS

A. Concrete - The concrete for the precast elements shall be air-entrained, when installed in areas subject to freeze-thaw conditions, composed of Portland cement, fine and coarse aggregates, admixtures, and water. Air-entrained concrete shall contain  $6 \pm 2$  percent air, and the air-entraining admixture shall conform to AASHTO M154

1. Portland Cement - Shall conform to the requirements of ASTM Specifications CISO- Type I, Type II, or Type m cement.

2. Coarse Aggregate - Shall consist of stone having a maximum size of 1 inch. Aggregate shall meet requirements for ASTM C33.

3. Water Reducing Admixture - The manufacturer may submit, for approval by the Engineer, a water-reducing admixture for the purpose of increasing workability and reducing the water requirement for the concrete.

4. Calcium Chloride - The addition to the mix of calcium chloride or admixtures containing calcium chloride will not be permitted.

B. Steel Reinforcement and Hardware - All reinforcing steel for the precast elements shall be fabricated and placed in accordance with the detailed shop drawings submitted by the manufacturer.

I. Steel Reinforcement - Reinforcement shall consist of welded wire fabric conforming to AASHTO M55 (ASTM A 185) or AASHTO M221 (ASTM A 497) or deformed billet steel bars conforming to AASHTO M31 (ASTM A 615) Grade 60. Longitudinal distribution reinforcement may consist of welded wire fabric or deformed billet- steel bars.

2. Hardware - Bolts and threaded rods for wing wall connections shall conform to ASTM A307. Nuts shall conform to AASHTO M292 (ASTM A194) Grade 2H. All bolts, threaded rods, and nuts used in wing wall connections shall be mechanically zinc coated in accordance with ASTM B 695 Class 50.

3. Structural Steel for wing wall connection plates and plate washers shall conform to AASHTO M270

(ASTM A709) Grade 36 and shall be hot dip galvanized as per AASHTO M 111 (ASTM A123).

4. Inserts for wing wall connections shall be 1" diameter Two-Bolt Preset Wing Wall Anchors as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio.
5. Ferrule Loop Inserts shall be F-64 Ferrule Loop Inserts as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio.
6. Hook Bolts used in attached headwall connections shall be ASTM A307.
7. Insert for detached headwall connections shall be AISI type 304 stainless steel, F-58 Expanded Coil inserts as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio. Coil rods and nuts used in headwall connections shall be AISI type 304 stainless steel. Washers used in headwall connections shall be either AISI type 304 stainless steel plate washers or AASHTO M 270 (ASTM A709) Grade 36 plate washers hot dip galvanized as per AASHTO M 111 (ASTM A153).
8. Reinforcing bar splices shall be made using the Dowel Bar Splicer System as manufactured by Dayton/Richmond Concrete Accessories, Miamisburg, Ohio or approved equal, and shall consist of the Dowel Bar Splicer (DB-SAE) and Dowel-Ju (DI).

## 2.2 CONCRETE MANUFACTURE REQUIREMENTS

- A. Mixture - The aggregates, cement and water shall be proportioned and mixed in a batch mixer to produce a homogeneous concrete meeting the strength requirements of this specification. The proportion of Portland cement in the mixture shall not be less than 564 pounds (6 sacks) per cubic yard of concrete.
- B. Curing - The precast concrete elements shall be cured for a sufficient length of time so that the concrete will develop the specified compressive strength in 28 days or less. Any one of the following methods of curing or combinations thereof shall be used:
  1. Steam Curing - The precast elements may be low-pressure steam cured by a system that will maintain a moist atmosphere.
  2. Water Curing - The precast elements may be water cured by any method that will keep the sections moist.
  3. Membrane Curing - A sealing membrane conforming to the requirements of ASTM Specification C 309 may be applied and shall be left intact until the required concrete compressive strength is attained. The concrete temperature at the time of application shall be within+ 10 degrees F of the atmospheric temperature. All surfaces shall be kept moist prior to the application of the compounds and shall be damp when the compound is applied.
- C. Forms - The forms used in manufacture shall be sufficiently rigid and accurate to maintain the wing wall and headwall dimensions within the permissible variations included in Section 2.3 of these Specifications. All casting surfaces shall be of smooth nonporous material.



D. Handling - Handling devices or holes shall be permitted in each precast element for the purpose of handling and installation.

E. Storage - The precast elements shall be stored in such a manner to prevent cracking or damage. The culvert units shall not be moved until the concrete compressive strength has reached a minimum of 2,500 psi, and they shall not be stored in an upright position until the concrete compressive strength has reached a minimum of 4,000 psi.

### 2.3 PERMISSIBLE VARIATIONS

#### A. Wing Walls and Headwalls

1. Wall Thickness - The wall thickness shall not vary from that shown in the design by more than ½ inch.

2. Length/Height of Wall sections - The length and height of the wall shall not vary from that shown in the design by more than ½ inch.

3. Position of Reinforcement - The maximum variation in the position of the reinforcement shall be + ½ inch from that shown in the approved shop drawings. In no case shall the cover over the reinforcement be less than 1½ inches.

4. Size of Reinforcement - The permissible variation in diameter of any reinforcing shall conform to the tolerances prescribed in the ASTM Specification for that type of reinforcing. Steel area greater than that required shall not be cause for rejection.

### 2.4 FORM LINER

A. Precast concrete headwalls and wing walls shall be provided with thermoform plastic form liners. Form liners shall be Hill Country Flagstone by Dayton Superior or Engineer approved equal.

### 2.5 WARRANTY

A. The basic concrete structure shall endure and not deteriorate for a period of at least five (5) years.

## PART 3-EXECUTION

### 3.1 BLOW COUNT TESTING

A. The pre-cast manufacturer shall be responsible for conducting four (4) blow count tests prior to submitting shop drawings for the pre-cast box culvert, headwalls, wingwalls, and footings. Blow count tests shall

be located along the bank of the Herring Run Culvert. Two tests shall be conducted upstream of the Herring Run Culvert (one north of the culvert, one south of the culvert). Two tests shall be conducted downstream of the Herring Run Culvert (one north of the culvert, one south of the culvert). The results of the blow count tests shall be used by the pre-cast manufacturer to size the culvert footings.

### 3.2 FABRICATION AND ASSEMBLY

- A. The manufacturer shall check and verify all dimensions, elevations, and locations of openings, anchor bolts, inserts, and other cast-in items. Any discrepancy or lack of information shall be reported to the Engineer before fabrication.
- B. The Contractor shall be responsible for any failure to precast sections to the correct dimensions and for any omissions or inaccuracies in the manufacture. If, in the opinion of the Engineer, proper corrections cannot be made, the section shall be rejected and shall be replaced with a new section at the Contractor's expense.
- C. The precast elements, including form liner, shall be entirely assembled by the manufacturer at the plant, sealed and waterproofed.

### 3.3 INSTALLATION

- A. Erection shall be done by experienced workmen, in accordance with previously mentioned standards.
- B. No field holes or cuts shall be made in any section without prior approval of the Engineer. All holes shall be cut in accordance with manufacturer recommendations.
- C. The Manufacturer shall be responsible for delivery of the entire system and shall provide representation to offload and set the unit in place. The unit shall be set per contract document, and final touch-up completed if necessary.
- D. Contractor shall be responsible for coordinating installation with space and installation limitations at site, refer to Contract Drawings.

### 3.4 CONSTRUCTION REQUIREMENTS

- A. Placement of the Wing Walls, and Headwalls - The wing walls, and headwalls shall be placed as shown on the Contract Drawings. Special care shall be taken in setting the elements to the true line and grade. The wing walls shall be set on 6" x 6" Masonite or steel shims. A minimum of 1/2-inch gap shall be provided between the footing and the bottom of the wing wall. This gap shall be filled with cement grout (Portland cement and water or cement mortar composed of one part Portland cement and three parts of sand, by volume, and water).
- B. External Protection of Joints - The butt joint made by two adjoining precast units shall be covered with a

7/8" x 1 3/8" piece of preformed bituminous joint sealant and a minimum of a nine-inch-wide joint wrap. The surface shall be free of dirt before applying the joint material. A primer compatible with the joint wrap shall be applied for a minimum width of nine inches to each side of the joint. The external wrap shall be either EZ-WRAP RUBBER by PRESS-SEAL GASKET CORPORATION, SEAL WRAP by MAR MAC MANUFACTURING CO. INC. or Engineer approved equal. The joint shall be covered continuously from the bottom of one precast section leg, across the top of the arch and to the opposite precast section leg. Any laps that result in the joint wrap shall be a minimum of six inches long with the overlap running downhill.

C. In addition, the joint between the end box culvert and the headwall shall also be sealed as described above. If precast wing walls are used, the joint between the box culvert and the wing wall shall be sealed with a 2'-0" wide strip of filter fabric. Also, if lift holes are formed in the arch units, they shall be primed and covered with a 9" x 9" square of joint wrap.

D. Where precast wing walls are used, the joint between the headwall and the wing wall shall be sealed with a 2'-0" wide strip of filter fabric. Also, if lift holes are formed in the arch units, they shall be primed and covered with a 9" x 9" square of joint wrap.

E. During the backfilling operation, care shall be taken to keep the joint wrap in its proper location over the joint.

F. Backfill - Backfill shall be considered as all replaced excavation and new embankment adjacent to the box culvert, wing walls, and headwalls. The project construction and material specifications, which include the specifications for excavation for structures and roadway excavation and embankment construction, shall apply except as modified in this section.

G. No backfill shall be placed against any structural elements until they have been approved by the Engineer.

H. Mechanical tampers or approved compacting equipment shall be used to compact all backfill and embankment immediately adjacent to each side of each precast element until it is covered to a minimum depth of one foot, unless the design fill height is less than 1'-0". Heavy compaction equipment shall not be operated in this area.

I. In no case shall equipment operating in excess of the design load (HS20 or HS25) be permitted over the culvert unless approved by the Engineer.

J. Any additional fill and subsequent excavation required to provide this minimum cover shall be made at no additional cost to the project.

K. As a precaution against introducing unbalanced stresses in the culvert units when placing backfill, at no time shall the difference between the heights of fill on opposite sides of the culvert exceed 24 inches.

L. Backfill in front of wing walls shall be carried to ground lines shown in the Contract Drawings.

### 3.5 QUALITY CONTROL/TESTING AND INSPECTION

- A. Testing Agency: The Contractor will engage a qualified independent testing and inspecting agency subject to Owner approval to sample materials, perform tests, and submit test reports during concrete placement. Tests shall be performed according to ACI 301.
- B. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- C. Type of Test Specimen - Concrete compressive strength shall be determined from compression tests made on cylinders or cores. For cylinder testing, a minimum of 4 cylinders shall be taken during each production run. For core testing, one core shall be cut from each of 3 precast elements selected at random from each production group. A production group shall be defined as 15 or fewer wing walls or headwalls in a continuous production run. For each continuous production run, each production group or fraction thereof shall be considered separately for the purpose of testing and acceptance. A production run shall be considered continuous if not interrupted for more than 3 consecutive days.
- D. Compression Testing - Cylinders shall be made and tested as prescribed by the ASTM C 39 Specification. Cores shall be obtained and tested for compressive strength in accordance with the provisions of the ASTM C 497 Specification.
- E. Acceptability of Cylinder Tests- When the average compressive strength of all cylinders tested is equal to or greater than the design compressive strength, and not more than 10% of the cylinders tested have a compressive strength less than the design concrete strength, and no cylinder tested has a compressive strength less than 80% of the design compressive strength, then the lot shall be accepted. When the compressive strength of the cylinders tested does not conform to this acceptance criteria, the acceptability of the lot may be determined as described in section 8.4, below. Failure of any of the 28-day test cylinders to meet 90 percent of the minimum compressive strength requirement can be cause for rejection.
- F. Acceptability of Core Tests - The compressive strength of the concrete in each production group as defined in 8.1 is acceptable when the average core test strength is equal to or greater than the design concrete strength. When the compressive strength of the core tested is less than the design concrete strength, the precast element from which that core was taken may be re-cored when the compressive strength of the re-core is equal to or greater than the design concrete strength, the compressive strength of the concrete in that production group is acceptable.
1. When the compressive strength of any re-core is less than the design concrete strength, the precast element from which that core was taken shall be rejected Two precast elements from the remainder of the group shall be selected at random and one core shall be taken from each. If the compressive strength of both cores is equal to or greater than the design concrete strength, the compressive strength of the remainder of that group is acceptable. If the compressive strength of either of the two cores tested is less than the design concrete strength.

The remainder of the group shall be rejected or, at the option of the manufacturer, each precast element of the remainder of the group shall be cored and accepted individually. and any of these elements that have cores with less than the design concrete strength shall be rejected.

2. Plugging Core Holes - The core holes shall be plugged and sealed by the manufacturer in a manner such that the element will meet all of the test requirements of this specification. Precast elements so sealed shall be considered satisfactory for use.

G. Test Equipment- Every manufacturer furnishing precast elements under this specification shall furnish all facilities and personnel necessary to carry out the tests required.

### 3.6 WORKMANSHIP AND FINISH

A. The wing walls, and headwalls shall be substantially free of fractures. The ends of the culvert units shall be normal to the walls and centerline of the culvert section, within the limits of the variations given in the section above, except where beveled ends are specified. The faces of the wing walls and headwalls shall be parallel to each other, within the limits of the variations given in the section above. The surface of the precast elements shall be a smooth steel form or troweled surface. Trapped air pockets causing surface defects shall be considered as part of a smooth, steel-form finish.

### 3.7 REPAIRS

A. Precast elements may be repaired, if necessary, because of imperfections in manufacture or handling damage, and they will be acceptable if, in the opinion of the purchaser, the repairs are sound, properly finished and cured and the repaired section conforms to the requirements of this Specification.

### 3.8 INSPECTION

A. The quality of materials, the process of manufacture, and the finished precast elements shall be subject to inspection by the purchaser.

### 3.9 REJECTION

A. The precast elements shall be subject to rejection because of any of the specification requirements. Individual precast elements may be rejected because of any of the following:

1. Fractures or cracks passing through the wall, except for a single end crack that does not exceed one half the thickness of the wall.
2. Defects that indicate proportioning, mixing, and molding not in compliance with these Specifications.
3. Honeycombed or open texture.

4. Damaged edges, where such damage would prevent making a satisfactory joint.

END OF SECTION

## TEMPORARY STEEL PLATING

### PART 1-DESCRIPTION:

1. Work under this item covers the temporary bridging of the roadway or sidewalk to accommodate vehicular and pedestrian traffic during construction. Steel road plates are to be used in areas where there is trenching of the roadway or sidewalk while maintaining continued movement of traffic at the discretion of the Town of Lunenburg-Town Engineer.

### PART 2-RESTRICTIONS:

1. The use of steel road plates will not be allowed from November 1 to April 30 or holidays.
2. The placement of steel road plates will be restricted at intersections, limited access highways, bridges, schools, pedestrian ramps, crosswalks, or any other locations determined not suitable.
3. The length of time the steel road plates will be allowed in the roadway.
4. The length and width of the open trench requiring steel plates.
5. The temporary bridging plate system including the plates, blocking and anchors shall be designed by a Professional Engineer licensed in the State of Massachusetts for conditions deemed necessary by the Town of Lunenburg

The items list above including the circumstances requiring the placement of steel road plates will be approved by the Town of Lunenburg.

### PART 3-MATERIALS:

1. The steel for plate(s) shall be either ASTM A 36 Grade 36 (Yield Strength of 36,000 psi) or ASTM A 572 Grade 50 (Yield Strength of 50,000 psi).
2. All plating used shall be without deformations (warping, cracking, etc.) and shall be subject to 10' to 12' straight edge testing. Plate removal will be required if plate is permanently deformed. Steel road plate deformation may occur during loading, but if a steel plate is deformed without loading to at least 0.5 inch per 10 feet in length the plate shall be removed and replaced.
3. Attachment hardware for bolting the plate to the roadway shall be a carbon steel reusable concrete anchor system that is suitable to be removed and reused.
4. Steel grates may also be used if all the requirements of this specification and the plans can be satisfied. Use of steel grates needs to be approved.
5. Material for temporary transition/wedge pavement leading to the plate shall be 2.1 Hot-mix asphalt

(specifically HMA S0.375) conforming to the requirements of the Section 4.06. Material for final course (if required.) after removal of the temporary bridging plate shall be in accordance with Section M.04 and as shown on the plans.

#### PART 4-DESIGN:

1. The contractor shall review the location where the steel road plate(s) are to be used and shall identify irregularities of the roadway which preclude the plates from lying flush with the road surface. The Contractor shall develop a permit drawing for submission.
2. The contractor shall submit permit drawings to the Town of Lunenburg –Town Engineer for review in accordance with the requirements of the standard specifications and shown on the drawings if required by the Town.
3. The maximum width of an individual section of plate transverse to traffic shall be 6 feet.
4. Live Loads including dynamic allowance: Each transverse plate section and anchorages shall be designed for the following conditions at a minimum and shall consider the effects from the actual wheel placement:
  - A. 32-kip wheel load over a 4' transverse width of plate. 64 kips axle load over a 6' transverse width of plate.
5. Braking Forces: The plate and the anchor system shall be designed for the forces resulting from a truck braking on the plate.
6. The plate(s) must extend beyond the edge of the trench to safely and adequately support the traffic loads on it. Steel road plate(s) shall be large enough to allow minimum of 2' beyond the limits of each side of the trench.
7. Steel road plates shall be placed perpendicular or parallel to the direction of travel and shall be fabricated to accommodate any skews. In all situations, the longitudinal edges of the steel road plates shall not be in the wheel path.
8. The minimum thickness of plate shall be 1½ ". The maximum live load deflection allowed is 'L'/400. Where 'L' is the span between the anchor locations as noted on the plans. The minimum gap between the plate and the top of concrete header shall be the maximum of the computed deflection or ½".

#### PART 5-INSTALLATION:

1. When a trench walls have unstable material, approved shoring or side support treatment will be require.
2. The details of the plates shall include an original manufactured non-skid plate surface, or a plate surface alternative approved by the Town of Lunenburg. Alternative Skid resistant surface treatments such as the use of high-friction synthetic polymer resin aggregate filled coating or anti-slip tapes for transportation



may be used if approved. Plate(s) without the required skid-resistant surfacing will require removal. Surfacing requirements are not required in areas not exposed to traffic or pedestrian movements. Epoxy-coated plates are not approved for use. The contractor shall be responsible for periodically monitoring skid resistance, reporting results to the Inspector, and removing deficient plates from service. If imprinted waffle-shaped patterns or right-angle undulations to achieve skid resistance on the steel road plate is used. The maximum vertical deviation within the pattern shall be no more than 0.25 inch.

3. Traffic control devices shall be in place before and during plating period in accordance with the requirements of the “Work Zone Plan for Temporary Steel Plates Over Trench” Drawing.
4. Each steel road plate must be fully supported around the perimeter to prevent wobbling or rocking with non-asphaltic shims and installed to operate with minimum noise in accordance with requirements of the “Temporary Steel Plate Over Trench” Drawing.
5. Steel road plates shall not be overlapped or stacked on top of another plate. Steel road plate bridging shall be secured against displacement by using adjustable cleats, shims, blocking or other devices. Securing devices shall not extend above the wearing surface of the plate. The roadway surface milling and paving shall include the anchor bolt holes after the holes are filled with a pre-mix non-shrink rapid set material.
6. The gap between the edge of the plate(s) and the adjacent pavement (not being reconstructed) shall be filled with a temporary bituminous overlay wedge.
7. The plates shall be secured by an approved method to prevent any movement. If the plates are to be left in place for an extended period of time, the method of securing the plates shall be inspected every 3 days, at the Contractor’s expense to ensure that they have not become loose.
8. Plates shall be secured, transitioned, and ramped as required by the Town of Lunenburg on all sides using temporary pavement in accordance with these specifications to ensure a smooth transition from the road surface to the top of the plate surface and back to the road surface.

END OF SECTION

SECTION 99-99  
MISCELLANEOUS SPECIFICATIONS

ITEM 120.1 UNCLASSIFIED EXCAVATION

The work to be done under this item shall conform to the relevant provisions of Section 120 of the Standard Specifications and the following:

The work to be done under this item shall include the excavation of all existing surface materials as required such as hot mix asphalt berm, unsuitable materials, pavement excavation where required and called out on the plans, excavation of swales, excavation for road widening, excavation for profile adjustments, and excavation of any other materials, except for Item 121, as directed by the Engineer.

Any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope

ITEM 440.01 CALCIUM CHLORIDE FOR SUBBASE

The work to be performed under this item shall conform to the relevant Standard Specifications and the following:

The work shall consist of the application of calcium chloride to the pulverized roadway surface prior to compaction and as directed by the Town of Lunenburg Highway Department.

ITEM 983.1 RIPRAP

The work to be performed under this item shall conform to the relevant provisions of the Standard Specifications and the following:

The contractor is responsible for furnishing and installing the protective covering of angular shaped stones, having a reasonably flat face, carefully placed on the slope to insure its protection and within stormwater channels.

Riprap shall be sound, durable rock which is angular in shape. Each stone shall weigh not less than 50 pounds. The remainder of the stones shall be so graded that when placed with the larger stones the entire mass will be compact.

The stone shall meet the requirements of M2.02.0

SUBSECTION 748: MOBILIZATION DESCRIPTION 748.20:

General This item shall consist of preparatory work and operations including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, for the establishment of all contractor's field offices, buildings, and other facilities necessary for work on the project

and all other work and operations which must be performed or for costs which must be incurred prior to beginning work. The unit bid price for Item 748, Mobilization shall not exceed 3% of the contract bid total, exclusive of this item. Failure to observe this requirement may result in rejection of the bid in accordance with Subsection 2.04: Preparation of Proposals. Massachusetts Department of Transportation – Highway Division Standard Specifications for Highways and Bridges II.354 2022 Edition CONSTRUCTION METHODS 748.60: General The work required to provide the above facilities and services for Mobilization shall be done in a safe and workmanlike manner and shall conform with any pertinent local or state law, regulation or code. Good housekeeping consistent with safety shall be maintained. COMPENSATION 748.80: Method of Measurement Payment for Mobilization will be made on a lump sum basis. 748.81: Basis of Payment 1. The first payment of one third of the lump sum price for Mobilization or 1% of the total bid price, whichever is less, will be made on the first estimate. 2. The second payment of one third of the lump sum price for Mobilization or 1% of the total bid price, whichever is less, will be made following the completion of 5% of the total Contract price. 3. The third payment of one third of the lump sum price for Mobilization or 1% of the total bid price, whichever is less, will be made following the completion of 10% of the total Contract price. 4. Upon completion of all the work on the project, payment of any amount bid for Mobilization in excess of the total amount previously paid, will be paid by the Department. 748.82: Payment Items 748.

#### ITEM 852& 999.1 SAFETY CONTROLS FOR CONSTRUCTION OPERATIONS

Work under this item shall be done in accordance with the relevant provisions of the Standard Specifications and the following:

This work consists of providing lane closures, shoulder closures, and detours for Contract work on Page Street. Traffic management on this project shall comply with the enclosed temporary traffic control templates, the current Manual On Uniform Traffic Control Devices (with revisions), and direction by the engineer.

Under this item, the contractor shall provide and use the necessary Warning Devices, Signs, Cones, Police, Details, Special Apparel, detours, etc. so ensure that one-lane of traffic will be maintained open during construction. Prior to Construction the selected contractor shall meet with the Chief of Police for the Town of Lunenburg to create traffic management plan. Contractor shall submit a traffic control plan prior to construction for approval by Director of Public Works.