TECHNICAL SPECIFICATIONS
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SECTION 01 14 33
WORK WITHIN LAKE VIEW STREET AND AGATE AVENUE RIGHT OF WAY

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Within the Lake View Street and Agate Avenue right of ways:

a) Pavement removal

b) Drain installation

c) Manhole installation

d) Water line installation

e) Water cabinet, sprinkler cabinet, interior cabinet components, and concrete pad installation

f) Backfill and compaction

g) Temporary/permanent pavement repair

h) Curb, berm, and sidewalk restoration/installation

i) Straw wattle and silt fence installation, maintenance, and removal

j) Filter sack installation, maintenance, and removal

C. All work described above shall be marked out in the field for review and approval by the Owner's representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. 31 23 10 – Section 1.08 WORK IN THE PUBLIC WAYS

1.03 GENERAL PROVISIONS

A. This specification applies to work depicted on the Civil Drawings prepared by Quinn Engineering, Inc., herein referred to as the "Drawings" and specifically consisting of:

1. Sheets C-1 through C-3.

B. Attention is directed to PROJECT SPECIAL CONDITIONS which are hereby made a part of this Section of the Specifications.

C. All work conducted in association with this section shall conform to the applicable requirements of the Occupational Safety and Health Administration (OSHA).

D. In accordance with MA General Law Chapter 82 Section 40A and prior to construction, the Contractor shall contact DIGSAFE and other utility providers to determine the location of existing utilities within the project area. The Contractor is responsible for coordinating the work with the existing utilities so that disruption to the existing utilities is minimized.

E. Prior to construction, the Contractor shall notify and coordinate any planned disruptions to existing utilities that are required to perform the work with the appropriate utility provider and with the Owner's representative. Disruptions to existing utilities shall be planned so that the time of disruption is minimized.

1.04 INDUSTRY STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications, latest edition

2. AASHTO: American Association of State Highway and Transportation Officials

3. ASTM: American Society for Testing and Materials

4. Mass DOT: Massachusetts Department of Transportation, Highway Division

5. MSSHB: Massachusetts Standard Specifications for Highways and Bridges

6. City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision)

1.05 PERMITS

A. The Contractor shall secure all necessary permits from the City of Worcester of Department of Public Works and Parks and City of Worcester Water Operations prior to construction. Securing permits shall be conducted in accordance with project specifications.

B. The Contractor shall apply for and obtain all permits necessary for the work depicted on the Drawings and specified in this section.

C. Permits shall be secured and paid for in accordance with these specifications.

1.06 WARRANTY

A. The Contractor shall warrant all materials and workmanship specified herein for a period of one year from the time of acceptance by the Owner unless otherwise noted.

1.07 SUBMITTALS

A. Submit to the Owner's representative in accordance with these specifications, copies of all necessary permits required prior to the beginning work.

1.08 COORDINATION

A. The work specified in this section shall be coordinated with all work shown/described on the Drawings and in the specifications with other portions of the work for the entire project.

B. The Contractor shall give the Engineer at least 48-hour notice when requesting inspections on site.

1.09 EXISTING UTILITIES

A. Existing utility information depicted on the Drawing has been provided to Quinn Engineering, Inc. unless otherwise noted. The Contractor is responsible for coordinating the locations of all existing utilities with the utility provider and "DIGSAFE". Quinn Engineering, Inc. does not warrant that all existing utilities have been depicted on the Drawings. Quinn Engineering, Inc. does not warrant the accuracy of the existing utilities depicted on the Drawings.

B. The Contractor shall take every precaution to limit disruption to existing utilities. Any existing utilities disrupted or affected by the Contractor because of his/her work shall be repaired at least to the condition that existed prior to construction. The Contractor shall coordinate repair of any utilities with the utility providers and any costs associated with the repair shall be borne by the Contractor.

1.10 DRAWINGS

A. The Contractor is responsible for reviewing the Drawings and existing site conditions with respect to this section.

B. The information depicted on the Drawings is believed to reflect the current site conditions unless otherwise noted on the Drawings. The Contractor is responsible for reviewing the existing site conditions in the areas of the proposed work and notify the Owner's representative as soon as possible if any discrepancies exist between the two.

C. The existing conditions depicted on the Drawings have been provided to Quinn Engineering, Inc. Quinn Engineering, Inc. does not warrant that all existing conditions, structures, utilities, etc. have been depicted.

1.11 POLICE DETAILS

A. Contact the Worcester Police Department and provide the Police Department with a description of the work (plans, etc.) as necessary for the Police Department to determine if oversight and detail is required.

B. The Contractor is responsible for coordinating and paying for all police oversight and details required for work in LAKE VIEW STREET and AGATE AVENUE.

PART 2 - PRODUCTS

A. All products and execution including materials, means, method, sequencing, testing, inspection, traffic control, etc. used within the LAKE VIEW STREET and AGATE AVENUE right of ways shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

PART 3 - EXECUTION

A. All products and execution including materials, means, method, sequencing, testing, inspection, traffic control, etc. used within the LAKE VIEW STREET and AGATE AVENUE right of ways shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

END OF SECTION

SECTION 01 73 29
EXTERIOR CUTTING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Cutting and patching within the existing paved travelled ways, sidewalk areas, and curb located within the Lake View Street and Agate Avenue Right of Ways.

C. All cutting locations shall be marked out in the field for review and approval by the Owner's representative prior to execution of the cut.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Worcester Special Conditions and Specifications – GRAVEL BORROW

B. Worcester Special Conditions and Specifications (additional requirements for excavation)

C. 31 23 10 – Earthwork

D. 32 11 16 – Aggregate Base Courses

E. 32 91 13 – Loam

F. 32 92 19 - Seeding

1.03 GENERAL PROVISIONS

A. This specification applies to work depicted on the Civil Drawings prepared by Quinn Engineering, Inc., herein referred to as the "Drawings" and specifically consisting of:

1. Sheets C-1 through C-3.

B. Attention is directed to PROJECT SPECIAL CONDITIONS which are hereby made a part of this Section of the Specifications.

C. All work conducted in association with this section shall conform to the applicable requirements of the Occupational Safety and Health Administration (OSHA).

D. In accordance with MA General Law Chapter 82 Section 40A and prior to construction, the Contractor shall contact DIGSAFE and other utility providers to determine the location of existing utilities within the project area. The Contractor is responsible for coordinating the work with the existing utilities so that disruption to the existing utilities is minimized.

E. Prior to construction, the Contractor shall notify and coordinate any planned disruptions to existing utilities that are required to perform the work with the appropriate utility provider and with the Owner's representative. Disruptions to existing utilities shall be planned so that the time of disruption is minimized.

1.04 INDUSTRY STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications, latest edition.

2. AASHTO: American Association of State Highway and Transportation Officials

3. ASTM: American Society for Testing and Materials

4. Mass DOT: Massachusetts Department of Transportation, Highway Division

5. MSSHB: Massachusetts Standard Specifications for Highways and Bridges

6. City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision)

1.05 REFERENCES

A. The phrase "MA DOT Specifications" used in these specifications is used as a reference to the most current specification published by the Massachusetts Department of Transportation, Highway Division, including (but not limited to) in the following publications:

1. Standard Specifications for Highways and Bridges published by the Commonwealth of Massachusetts - Massachusetts Highway Department, Boston Massachusetts, dated 1988.

2. Supplemental Specifications to the 1988 English Standard Specifications for Highways and Bridges and the 1995 Metric Standard Specifications for Highways and Bridges April 1, 2019

3. Interim Supplemental Specifications dated September 30, 2019.

1.06 DEFINITION

A. "Cutting and Patching" is defined to include the cutting and patching of existing pavement, concrete, curb, piping, or other existing features to accommodate the new work or the installation of other items or structures or to uncover other facilities and structures for access or inspection, or to obtain samples for testing.

1.07 OPERATIONAL AND SAFETY LIMITATIONS

A. The Contractor shall not cut any operation or safety-related items in a manner resulting in a reduction of capacities to perform in the manner intended or resulting in decreased operational life, increased maintenance, or decreased safety.

1.08 PERMITS

A. The Contractor shall secure all necessary permits from the City of Worcester of Department of Public Works and Parks and City of Worcester Water Operations prior to construction. Securing permits shall be conducted in accordance with project specifications.

B. The Contractor shall apply for and obtain all permits necessary for the work depicted on the Drawings and specified in this section.

C. Permits shall be secured and paid for in accordance with these specifications.

1.09 SITE CONDITIONS

A. The Contractor is responsible for performing layout of all materials as specified on the Drawings and in relation to the existing conditions.

B. The Contractor shall provide barricades or barriers to protect the public from construction activities.

C. The work specified herein shall take place under weather conditions so as not to cause erosion or negatively impact any portion of the site.

1.10 WARRANTY

A. The Contractor shall warrant all materials and workmanship specified herein for a period of one year from the time of acceptance by the Owner.

1.11 CONFORMANCE WITH THE AMERICANS WITH DISABILITIES ACT AND THE MASSACHUSETTS ARCHITECTURAL ACCESS BOARD

A. Materials and work identified on the Drawings and specified herein shall conform to the Americans with Disabilities Act Standards for Accessible Design (28 FCR Part 36) and the Massachusetts Architectural Access Board (521 CMR).

B. The Contractor shall notify the Owner's representative of any discrepancies between the Drawings and work specified herein and the above referenced standards prior to installation.

1.12 COORDINATION

A. The work specified in this section shall be coordinated with all work shown/described on the Drawings and in the specifications with other portions of the work for the entire project.

B. The Contractor shall give the Engineer at least 48-hour notice when requesting inspections on site.

1.13 EXISTING UTILITIES

A. Existing utility information depicted on the Drawing has been provided to Quinn Engineering, Inc. unless otherwise noted. The Contractor is responsible for coordinating the locations of all existing utilities with the utility provider and "DIGSAFE". Quinn Engineering, Inc. does not warrant that all existing utilities have been depicted on the Drawings.

B. The Contractor shall take every precaution to limit disruption to existing utilities. Any existing utilities disrupted or affected by the Contractor because of his/her work shall be repaired at least to the condition that existed prior to construction. The Contractor shall coordinate repair of any utilities with the utility providers and any costs associated with the repair shall be borne by the Contractor.

1.14 DRAWINGS

A. The Contractor is responsible for reviewing the Drawings and existing site conditions with respect to this section.

B. The information depicted on the Drawings is believed to reflect the current site conditions unless otherwise noted on the Drawings. The Contractor is responsible for reviewing the existing site conditions in the areas of the proposed work and notify the Owner, Architect, and Engineer as soon as possible if any discrepancies exist between the two.

C. The existing conditions depicted on the Drawings have been provided to Quinn Engineering, Inc. unless otherwise noted. Quinn Engineering, Inc. does not warrant that all existing conditions, structures, utilities, etc. have been depicted.

PART 2 - PRODUCTS

2.01 MATERIALS USED IN CUTTING AND PATCHING

A. The Contractor shall furnish and provide all hand tools and power tools used for cutting, sawing, or grinding. Hammering and chopping of existing surfaces is not allowed.

B. Unless otherwise indicated, the Contractor shall provide materials for patching which will result in an equal-or-better product than the material being cut and patched, in terms of performance characteristics and including visual effects where applicable. The Contractor shall use material identical with the original materials where feasible.

2.02 BITUMINOUS CONCRETE PAVEMENT

A. Bituminous concrete shall be Hot Mix Asphalt and shall conform to the applicable MA DOT Specifications including portions of *SUBSECTION 460: HOT MIX ASPHALT PAVEMENT FOR LOCAL STREETS*, *SUBSECTION 472: TEMPORARY ASPHALT PATCHING*, *SUBSECTION 482: SAWCUTTING,* and *SECTION M3: ASPHALTIC MATERIALS.*

2.03 TACK COAT

A. Bituminous Concrete Tack shall be as specified in MA DOT Specification *M3.03.0 ASPHALT EMULSIONS.*

2.04 MINERAL AGGREGATE

A. Coarse mineral aggregate shall conform to MA DOT Specification *M3.11.2 AGGREGATE FOR HOT MIX ASPHALT A*.

B. Fine mineral aggregate shall conform to MA DOT Specification *M3.11.04 AGGREGATE FOR HOT MIX ASPHALT B*.

C. Gradation and quality shall conform to that specified for "SUPERPAVE Intermediate Course" and "SUPERPAVE Surface Course" pavements in MA DOT Specification *TABLE 460.10-1: HMA PAVEMENT COURSES & MIXTURE TYPES.*

2.05 BITUMINOUS CONCRETE BERM / CURB:

A. Bituminous concrete used for berm and curbs shall be Class I as specified in the MA DOT Specifications including *SUBSECTION 470: HOT MIX ASPHALT BERM,,* and *M3.11.6: HMA FOR DRIVEWAYS, SIDEWALKS, BERM, AND CURB.*

B. Bituminous concrete curb dimensions shall be as indicated on the Drawings.

2.06 GRAVEL BORROW

A. Gravel borrow used for bituminous concrete pavement base shall conform to MA DOT Specification *M1.03.0 GRAVEL BORROW TYPE C* (2 inch largest dimension). See Worcester Special Conditions and Specifications – GRAVEL BORROW for additional requirements.

2.07 PAVEMENT MARKINGS

A. Pavement markings shall conform to the Federal Highway Administration Manual of Uniform Traffic Control Devices, MA DOT Specification M7.01.24 Fast Drying Water-Borne Traffic Paint, Architectural Access Board regulations 521 CMR, ADA Standards for Accessible Design 28 CFR Part 36.

PART 3 - EXECUTION

3.01 GENERAL

A. Employ skilled workers to perform cutting and patching.

B. Cut existing items and surfaces to provide for installation of other components or performance of other construction activities and the subsequent patching required to restore surfaces to their original condition.

3.02 PROTECTION

A. The Contractor shall be responsible for conducting the work with care so as not to damage, undermine, or destroy existing structures, utilities, etc. within the vicinity of the project. The Contractor shall also be responsible for planning the work means and methods prior to beginning work to identify activities or areas that may be damaged, undermined, or destroyed by the work. Any activities or areas identified as such shall be brought to the Owner's representative attention immediately.

B. Any damage to improvements within these areas or to adjacent properties that is outside the scope of work defined on the Drawings and herein shall be restored to the original condition that existed immediately before the damage was done. Restoration operations shall be conducted to the satisfaction of the project Owner and adjacent property owner and all costs associated with restoration shall be borne by the Contractor.

3.03 EXTERIOR PATCHED FINISH SURFACES

A. All new exterior finish ground surfaces shall:

1. Be constructed flush with the adjacent finish ground surfaces.
2. Have uniform slopes and shall not contain any irregularities.
3. Slope away from the buildings (unless otherwise noted).
4. Slope towards the existing surface drains (unless otherwise noted).
5. Be stabilized. Finish all areas disturbed by new construction with top soil and grass seed (unless stabilized by other means). The contractor shall water and fertilize the grass so that a dense growth is developed.

3.04 PREPARATION

A. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

B. Take all precautions necessary to avoid cutting existing pipe, conduit or ductwork serving the building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.05 CUTTING EXISTING SURFACES/ITEMS

A. Provide temporary bracing and/or support as required to accommodate cutting and patching.

B. In areas where new work requires removal of existing finish surfaces, saw cut and remove existing finish surfaces to provide joint at the new work location where the existing finish surface may be removed.

C. Temporarily cover openings when not in use.

D. All cuts shall be neat, straight, vertical cuts with no broken edges.

E. All cuts shall be uninterrupted. In areas where trenching is required, saw cuts shall be approximately parallel to trench (max. 1:6 longitudinal variance).

F. Trench width shall be minimum 24 inches. Removal and restoration of the existing finish surfaces shall be minimized. The Contractor shall be responsible for all surface restoration required to accommodate new work.

G. PAVEMENT

1. The width of pavement removed shall not exceed two (2) feet outside the minimum trench width.
2. If a saw cut in pavement falls within (2) foot of an existing curb, gutter, or edge of pavement, the additional pavement shall be removed and reconstructed.

3. Unstable pavement shall be removed over cave-ins/breaks and the subgrade shall be treated as the main trench. The Contractor shall not be required to pay for the repair of any pavement damage existing prior to the excavation unless the Contractor's cut results in small floating sections that may be unstable. If this occurs, the Contractor shall remove the unstable portion and the area shall be treated as part of the excavation.

4. When saw cutting pavement, the maximum overrun allowed for any saw cut beyond the boundary removal limits of existing pavement shall be 2 inches.

5. After excavation, backfill and compaction provide new finish surface to match the existing adjacent surface material. The new finish surface shall have a uniform surface, without irregularities that is flush with the existing adjacent surface and provides a uniform slope.

H. BITUMINOUS CONCRETE CURB

1. The minimum width of bituminous concrete curb to be removed is 24".

2. If a saw cut falls within 1 foot of an object, corner, unsuitable material or other disruption, the additional curb shall be removed and reconstructed.

3.06 PATCHING EXISTING SURFACES/ITEMS

A. PAVEMENT

1. Gravel base shall be placed to the depth specified on the Drawings and compacted in accordance with 32 11 16 – Aggregate Base Courses.

2. After backfill and compaction, tack coat all exposed surfaces prior to placement of new bituminous concrete pavement. Tack coat application shall be done in accordance with MA DOT Specification *M3.03.0 ASPHALT EMULSIONS.*.

3. Bituminous concrete paving, including spreading, finishing, compaction, correction of irregularities, and opening to traffic, shall be in accordance with MA DOT Specification *SUBSECTION 460: HOT MIX ASPHALT PAVEMENT FOR LOCAL STREETS*, *SUBSECTION 472: TEMPORARY ASPHALT PATCHING*, *SUBSECTION 482: SAWCUTTING,* and *SECTION M3: ASPHALTIC MATERIALS*. Bituminous concrete pavement shall be placed to the depth specified on the Drawings. The depth specified on the Drawings represents the depth after compaction.

4. All exposed joints and saw cut over runs are to be sealed with tack and stone dust.

5. Replace pavement markings to match what existed prior to cutting and patching. Pavement Markings shall be applied in accordance with MA DOT SPECIFICATION *SUBSECTION 860 REFLECTORIZED PAVEMENT MARKINGS.*

B. BITUMINOUS CONCRETE CURB

1. Tack coat all exposed surfaces prior to placement of new bituminous concrete curb.

2. Bituminous concrete curb shall be of the dimensions specified on the Drawings.

3. Bituminous berm shall be installed in accordance with MA DOT Specification *SUBSECTION 470: HOT MIX ASPHALT BERM,,* and *M3.11.6: HMA FOR DRIVEWAYS, SIDEWALKS, BERM, AND CURB*.

C. All new exterior finish ground surfaces shall:

1. Be constructed flush with the adjacent finish ground surfaces.

2. Have uniform slopes and shall not contain any irregularities.

3. Slope away from the buildings (unless otherwise noted).

4. Slope towards the existing surface drains (unless otherwise noted).

5. Be stabilized. Finish all areas disturbed by new construction with top soil and grass seed (unless stabilized by other means). The contractor shall water and fertilize the grass so that a dense growth is developed.

3.07 CLEANUP

A. The Contractor shall remove all debris, excess materials, equipment related to the storm drain installation from the site.

END OF SECTION

SECTION 01 77 00
PROJECT CLOSEOUT

PART 1 - GENERAL

1.01 FINAL INSPECTION

A. Upon completion of the project and prior to issuance of final payment certificates, the Contractor shall schedule a final inspection.

B. The Owner's Representative, the Contractor, and other persons designated by the Owner shall be present.

C. Should defects or discrepancies be encountered, a listing of such items will be supplied to all parties. Following completion of this listing including repairs, etc., a second inspection will be held in accordance with paragraph "A" above.

1.02 GUARANTEE

A. Neither the final certificate of payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner shall constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship.

B. The Contractor shall remedy any defects in the Work, and pay all expenses for any damage to other Work resulting therefrom, which shall appear within a period of one (1) year from the date of final acceptance of the work unless a longer period is specified elsewhere. The Owner will give notice of observed defects with reasonable promptness. Where items of mechanical equipment carry a manufacturer's warranty of longer than one (1) year, the manufacturer's warranty shall be considered the period of guarantee for that time only.

1.03 SUBMITTALS

A. The Contractor shall submit to the Owner's Representative, before final acceptance, two (2) copies of all warranties, guaranties, and surety bonds on the Work, as required in the Contract Documents. All such documents shall show the name of the Project, location, and name of the Owner.

END OF SECTION

SECTION 02 41 13
SITE PREPARATION AND DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Protection of existing site features to remain.
2. Protection of existing trees to remain.
3. Clearing, grubbing, and removal of trees and other plant material.
4. Removal and disposal of site features within limits of work.
5. Removal and storage of items designated for re-installation
6. Removal and delivery of items designated to be brought to Owner
7. Dust control.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Project Special Conditions
B. Section 31 25 00 – Erosion and Sedimentation Control
C. Section 31 23 10 – Earthwork (for extent of excavation and backfilling operations)

1.03 SUBMITTALS

A. Product Literature: Prior to ordering the materials listed below, the Contractor shall submit product literature to the Owner's Representative for approval as follows. The Contractor shall not order materials until the Owner's Representative's approval has been obtained.

1. No product submittals are required for site preparation & demolition work.

1.04 CODES AND STANDARDS

A. The Contractor shall perform demolition and clearing work in accordance with applicable rules, regulations, codes, and ordinances of The City of Worcester, State and Federal Authorities, and in accordance with the requirements of public utility corporations having jurisdiction over the work.

1.05 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be stockpiled, relocated, reinstalled, delivered to Owner, or otherwise indicated to remain on the Owner's property, demolished materials shall become the Contractor's property and shall be removed by the Contractor from the

site and disposed of in a legal manner.

B. Historical items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to the Owner, which may be encountered during site preparation, remain the Owner's property. The Contractor shall carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner. See Project Special Conditions for additional requirements.

1.06 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ANSI: American National Standards Institute

1.07 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 DUST CONTROL

A. Acceptable materials for dust control use shall consist of the following or equivalent thereof:

1. Potable water
2. Calcium chloride
3. Hydroseeding
4. Motorized street sweeper
5. Plastic covering

B. The Contractor shall not use oil or similar penetrants.

2.02 TEMPORARY TREE PROTECTION FENCING

A. No temporary tree protection fence is included in this work.

2.03 TEMPORARY CONSTRUCTION FENCING

A. Temporary construction fencing shall be chain-link fencing, constructed in accordance with the Drawings.

PART 3 - EXECUTION

3.01 GENERAL

A. See also Project Special Conditions.

B. Before commencing Site Preparation work, the Contractor shall meet with the Owner's Representative in order to discuss the procedures to be utilized. The Contractor shall be held responsible for any damage to all vegetation designated to remain. The Owner's Representative will be the sole judge as to damage inflicted.

1. The Owner's Representative shall make the final determination of action required regarding any and all items indicated for removal, stockpiling, disposal, adjustment and protection.

C. The work shall be conducted with prime consideration given to the following:

1. Compliance with governing laws and building codes.

2. Safety, protection, and convenience of the public and workers.

3. Erosion control (in accordance with Section 31 25 00 Erosion and Sedimentation Control)

4. Minimization of dirt and dust proliferation.

5. Neat and accurate cutting and trimming of elements to be partially removed subject to the Owner's Representative's approval.

6. Avoidance of any damage to existing vegetation to remain

3.02 PROTECTION OF EXISTING CONDITIONS

A. The Contractor shall provide protections necessary to prevent damage to existing park features indicated to remain in place. In the event of damage, they shall immediately make all repairs and replacements necessary to the approval of the Owner's Representative at no additional cost to the Owner.

B. The Contractor shall protect existing features on adjoining properties.

3.03 PROTECTION OF EXISTING VEGETATION

A. The Contractor shall protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of tree roots by stockpiling construction materials or excavated materials within drip line, foot or vehicular traffic, or parking of vehicles within drip line.

1. The Contractor shall install temporary tree protection fencing at the edge of existing tree canopies (drip line) where shown on the Drawings, and in accordance with the detail for tree protection fence (if included in this work).

2. The Contractor shall provide protection for roots over 1-1/2 inch in diameter that are

cut during construction operations. They shall temporarily cover exposed roots with wet burlap to prevent roots from drying out, and cover with earth as soon as possible. The Contractor shall notify the Owner's Representative immediately upon damage incurred during the course of construction.

3. The Contractor shall repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to the Owner's Representative. The Contractor shall employ a licensed arborist to repair damage to trees and shrubs.

4. Existing trees to be saved within or outside the limit of work line which have, in the opinion of the Owner's Representative, become damaged, shall be assessed at $300 per caliper inch and deducted from the Contract amount. Existing shrubs, vines, and groundcover indicated to be saved which have, in the opinion of the Owner's representative, become damaged, shall be replaced with plants of equal size by the Contractor.

    a. All expenses of removal and replacement incurred shall be paid by the Contractor without additional cost to the Owner. The Contractor shall remove these plants according to the Specification requirements for removals, grub out and remove the stumps, and repair the ground surface.

3.04 DUST CONTROL

A. The Contractor shall apply dust control materials to minimize raising dust from construction operations, and provide positive means to prevent air-borne dust from dispersing into the atmosphere. They shall maintain dust control at all times throughout the construction period. Control measures will be required in all areas as well as for stockpiles, temporary traffic ways, and all other areas where dust may develop.

B. Dust control procedures shall be monitored by the Owner's Representative and shall be subject to on-site review by authorities having jurisdiction.

C. Site preparation and earthwork may be halted by the Owner's Representative as deemed necessary should dust control procedures prove inadequate.

D. The Contractor shall clean all soil and debris from wheels of all construction vehicles and cover earth loads prior to leaving the construction site.

E. All streets, driveways, and sidewalks shall be swept daily or as required to prevent dust being a public nuisance.

3.05 CLEARING, GRUBBING, AND REMOVAL OF PLANT MATERIAL

A. The Contractor shall accept the site as they find it and shall remove and legally dispose off-site all plants designated for removal and all debris, organic matter, and other material which is not suitable, at no additional cost to the Owner. No burning is allowed on site.

B. Clearing and Grubbing: The Contractor shall clear site of all vegetation indicated to be

removed by the Drawings as follows.

1. The Contractor shall completely remove all stumps and roots to the following minimum depths:

    a. Eighteen (18) inches below existing ground level for shrubs
    b. Three (3) feet below existing ground level for trees.

2. The Contractor shall use only hand methods for grubbing inside drip line of trees indicated to remain.

3. Unless further excavation is required, the Contractor shall fill depressions caused by clearing and grubbing operations with Ordinary Borrow material.

    a. The Contractor shall place borrow material in horizontal layers not exceeding six (6) inches loose depth, and thoroughly compact each layer to a density equal to adjacent original ground.

C. For handling and disposal of wood, the Contractor shall follow the Asian long-horned beetle infestation protocol, in accordance with the Project Special Conditions.

D. The Contractor shall remove existing turf from areas to be graded and/or paved. Removed turf shall be disposed off-site.

3.06 TREE BRANCH PRUNING

A. Any tree branches that impede installation of new construction shall be removed in accordance with ANSI A300 pruning standards, with the following exceptions:

1. By-pass and scissor action pruning tools shall be used for smaller-sized cuts. Anvil-type pruning tools shall not be used. Pruning saws shall be used for pruning limbs 2 inches or greater in diameter.

2. All pruning shall be conducted from the ground or from a safe platform. Any pruning that involves tree-climbing or off-ground chainsaw work shall be conducted by an arborist currently certified by the National Arborist Association or by workers under their direct supervision. Climbing spurs shall not be used when climbing trees, except on tree removals.

3.07 REMOVALS (GENERAL)

A. All items to be removed shall include, but are not limited to, those items as indicated on the Site Preparation & Demolition Plan.

1. The Contractor shall be responsible for storing items designated to be relocated, and shall also be responsible for preventing damage to or theft of stored items.

2. The Contractor shall be responsible for delivering all items designated to be salvaged to a designated area at the Public Works and Parks Department headquarters facility

at Greenhill Park and/or as directed by the Owner's Representative.

3. All other removed items that are not to be stored for relocation or delivered to Owner shall be the property of the Contractor and shall be disposed of by the Contractor in a legal manner off-site.

B. The Contractor shall demolish and remove all items necessary, in their entirety, to complete the work as indicated on the Drawings. The Contractor shall use methods required to complete work within limitations of governing regulations and as follows:

1. Dispose of demolished items and materials promptly off site in a legal manner.

a. The Contractor shall not allow demolished materials to accumulate on-site.

b. Burning on Owner's property is not permitted.

c. On-site storage or sale of removed items is prohibited.

2. The items to be removed shall include all associated footings, accessories, and hardware when applicable.

3.08 PATCHING AND REPAIRS

A. The Contractor shall promptly patch and repair holes and damaged surfaces caused to adjacent areas by selective demolition and site preparation operations. See the Project Special Conditions for additional requirements.

3.09 SECURING THE SITE

A. The Contractor shall secure the site during the entire construction period with temporary construction fencing and gate, as shown on the Drawings.

3.10 GENERAL CLEAN-UP

A. The Contractor shall remove from the site all trash, litter, and debris and leave the site in a neat and orderly condition on a daily basis and to the satisfaction and approval of the Owner's Representative.

END OF SECTION

SECTION 03 30 53
CAST-IN-PLACE CEMENT CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Cement concrete pads/surfacing
2. Cement concrete mow strips
3. Cement concrete footings

C. The boundaries of all concrete pads shall be marked out in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 11 68 23 – Athletic Court Equipment
B. Section 31 23 10 – Earthwork
C. Section 32 11 16 – Aggregate Base Courses
D. Section 32 31 13 – Chain Link Fences and Gates
E. Section 32 33 00 – Site Furnishings
F. Project Special Conditions (additional requirements for cement concrete)

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ACI: American Concrete Institute
2. ASTM: American Society for Testing and Materials, latest edition

1.04 TESTING, CONTROL AND INSPECTION

A. The Contractor shall retain the services of a qualified testing agency, approved by the Owner, to test aggregate and to prepare mix design for each strength and type of concrete specified; and shall submit such mix designs and test results to the Owner's Representative for approval. The costs of all such preliminary services shall be borne by the Contractor. All other testing and inspection will be selected by the Owner's Representative and shall be paid directly by the Owner.

B. A qualified testing agency for such other testing and inspection will be selected by the

Owner's Representative and shall be paid directly by the Owner.

C. The Contractor shall cooperate fully with the testing agencies' work in taking and storing samples. The Contractor shall provide storage facilities for concrete cylinders at the site. Facilities shall protect cylinders from effects of low or high temperatures.

D. The Contractor shall accept the final results of tests made by the qualified professional testing organization engaged by the Owner.

E. Testing required because of changes requested by the Contractor in materials, sources of materials, or mix proportions; and extra testing of concrete or materials because of failure to meet the Specification requirements are to be paid for by the Contractor.

F. The Contractor shall advise the Testing Agency of intent to place concrete by notification at least twenty (24) hours prior to time of placement.

G. All materials, measuring, mixing, transportation, placing, and curing shall be subject to inspection by the Owner's Representative or by the Testing Agency. However, such inspection, wherever conducted, shall not relieve the Contractor of their responsibility to furnish materials and workmanship in accordance with the Contract requirements, nor shall inspector's acceptance of material or workmanship prevent later rejection of same by the Owner's Representative, if defects are discovered. Structural tests and inspections shall conform to Chapter 17 of the Massachusetts State Building Code, latest edition.

1.05 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Concrete shall be standard weight, ready-mixed, conforming to ASTM C94 and having the following properties:

1. Portland cement shall conform to ASTM C-150 Type II.

2. Fine aggregates for concrete shall be natural sand consisting of clean, hard, durable, uncoated particles, conforming to ASTM C33. Organic content shall be determined according to ASTM C40, and supernatant liquid above test sample shall show color no darker than reference standard color solution prepared at same time. The Contractor shall not allow any frozen or partially frozen aggregate in the mix.

3. Coarse aggregate for concrete: For regular-weight concrete, the Contractor shall use crushed stone or gravel from approved source conforming to ASTM C33. For lightweight concrete (115 pcf), the Contractor shall use materials conforming to ASTM C330. Coarse aggregate shall not contain greater amounts of deleterious

materials than specified in Table II, ASTM C33. Maximum size of coarse aggregate shall be 3/4 inch.

4. Water shall be from approved source; potable; clean; and free of oils, salt, alkali, organic matter and other deleterious material.

5. All concrete shall have minimum 4,000 p.s.i. compressive strength at 28 days.

6. All concrete shall be air-entrained to provide an air content of 4.5% to 7%, as determined by ASTM C231.

7. Non-vibrated slump of concrete shall be between 2.5 and 4 inches.

B. Admixtures:

1. Water Reducing Agent ASTM C494, Type A: WRDA by W.R. Grace Co. or equal approved by the Owner's Representative. Water-reducing agent shall be by same manufacturer as air-entraining agent.

2. Air-entraining agent ASTM C260: Darex by W.R. Grace Co., or equal approved by the Owner's Representative. Air-entraining agent shall be by the same manufacturer as water-reducing agent.

C. Concrete Reinforcement:

1. Reinforcing steel shall conform to ASTM Specification A-615 grade 60, deformed bars.

2. Welded wire fabric shall conform to ASTM Specifications A-185. The Contractor shall supply these in flat sheets.

3. Bar supports, metal accessories, and other devices necessary for proper assembly of concrete reinforcing shall be of standardized factory-made wire bar supports. Wire for tying shall be 18 gauge black annealed wire conforming to ASTM Specification A-82.

D. Formwork:

1. Forms: Formwork material shall be exterior plyform Class 1, B-B or as approved by the Owner's Representative, not less than 5/8 inch thick.

2. Form Oil: Oil shall be of a non-staining type, specifically manufactured for concrete forms.

3. Form Ties: Factory-fabricated, removable or snap back, of approved design. Wire shall be at least 1-1/2 inch back from surfaces.

4. Design Criteria:

a. The Contractor shall design, construct, erect, support, brace, maintain, and remove forms to comply with ACI 318 parts 1, 2, and 3.

b. The Contractor shall comply with ACI 347 for loads, lateral pressures, allowable stresses, and wind loads.

E. Non-shrink grout shall be Embeco 885" by Master Builders, Sonogrout by Sonneborn Building Products, Five Star Grout by U.S. Grout Corporation, or approved equal.

F. Sleeves shall be standard weight steel pipe conforming to ASTM A53.

G. Concrete curing membranes shall be:

1. White polyethylene sheeting 4 mils thick, ASTM C171; or

2. Waterproof paper, Sisalkraft Type, ASTM C171-69; or

3. Liquid membrane curing compound of resin or latex bases liquid conforming to ASTM C309 Type I, Class A, except for surfaces to be covered with other surfacing materials. The compound shall be compatible with the adhesive to be used.

H. Expansion Joint Filler: Joint filler shall be non-extruding, self-expanding filler strips conforming to ASTM D1752, Type II, as manufactured by Celotex Corporation, W.R. Meadows, Inc., W.R. Grace Company, or approved equal. Additional expansion joint materials (sealant, foam backup, steel dowels, and expansions sleeves) are described in the Drawing detail for expansion joints.

I. Chemical surface sealer/hardener for concrete shall be Home Clear Seal by A.C. Horn Company, Kure-N-Seal by Sonneborn Building Products, Division of Contech, Inc. or approved equal chlorinated rubber base material at 22% solids. The material shall be applied both in accordance with the Manufacturer's recommendations for a curing compound on the wet concrete and as a hardener on fully-cured concrete just prior to the occupancy.

J. Liquid chemical hardener for concrete shall be Hornolith by A.C. Horn Company; Surfhard by Euclid Chemical Company, or approved equal zinc and/or magnesium silicofluoride with penetrating agent. The material shall be applied in accordance with the manufacturer's written recommendations and shall be compatible with curing techniques.

PART 3 – EXECUTION

3.01 STORAGE OF MATERIALS

A. All materials shall be stored to prevent damage from the weather elements and other causes.

B. Cement and aggregates shall be stored in such a manner as to prevent deterioration or intrusion of foreign mater. Any materials which have deteriorated, or which have been damaged, shall not be used for concrete.

C. The Contractor shall store reinforcement steel on wood skids to prevent it from weather, oil, earth, and damage from trucking or other construction operations. Reinforcement shall be free from loose mill scale, rust, form oil, concrete splatter, and other extraneous coatings at the time it is embedded in the concrete.

3.02 FORMING FOR CAST-IN-PLACE CONCRETE

A. Acceptable tolerance shall be as specified in ACI Standard 247, Recommended Practice for Concrete Formwork.

B. Forms shall be constructed to conform to shapes, lines, and dimensions shown, plumb and straight, and shall be maintained sufficiently rigid to prevent deformation under load. Forms shall be sufficiently tight to prevent leakage. The Contractor shall securely brace and shore forms to prevent their displacement and to safely support the construction loads.

1. The Contractor shall form and set all sleeves, box outs, and passages as required for all existing and proposed utilities and as directed by the Owner's Representative.

C. The Contractor shall treat forms with a form release agent applied according to the manufacturer's instructions, by roller, brush, or spray to produce a uniform thin film without bubbles or streaks. The Contractor shall apply the release agent in two coats for the first use of the form and in one coat for each additional use.

D. ACI-301-89, Section 13.3 - Forms, is also hereby made a part of this Specification.

3.03 MIXING PROCESS FOR CAST-IN-PLACE CONCRETE

A. Ready-mixed concrete shall be mixed and transported in accordance with Specification for Ready-Mixed Concrete ASTM C94, Alt No. 3 and ACI STANDARD 304, Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.

3.04 REINFORCING FOR CAST-IN-PLACE CONCRETE

A. ACI 301-89, Specification for Structural Concrete for Buildings, Chapter 5 - Reinforcement, is hereby made a part of this Specification.

B. For concrete reinforcement, the Contractor shall:

1. Comply with ACI 318 standards for detail and method of placing reinforcement and supports.

2. Clean reinforcement to remove loose rust and mill scale, earth, and other materials which reduce or destroy bond with concrete.

3. Place, support, and secure reinforcement against displacement.

4. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and

hangers, as required.

5. Place reinforcement to obtain proper coverage for concrete protection in accordance with A.C.I. standards.

6. Arrange, space, and securely tie bars and bar supports together with the specified tie wire.

7. Set wire ties so twisted ends are directed away from exposed concrete surfaces.

8. Install welded wire fabric in as long lengths as practicable, lapping adjoining pieces at least one full mesh.

9. Where lap splices are used, tie securely with specified wire to prevent displacement of splices during placement of concrete.

10. Accommodate placement of formed openings.

11. After reinforcement has been placed and tied together, notify the Owner's representative for inspection before pouring concrete.

3.05 JOINTS FOR CAST-IN-PLACE CONCRETE

A. ACI 301-89, Specifications for Structural Concrete for Buildings, Sections 6.1, 6.2 and 6.3 are hereby made part of this Specification.

B. Construction joints shall be formed with keyed bulkheads.

C. Control joints shall be as shown on the drawings.

D. Control joints shall be formed using Zip-Cap control joint (Model 832) and Transverse control joint (Model 852) by Greenstreak Plastic Products Company or approved equal. Installation shall be in strict accordance with the manufacturer's recommendations. Reinforcing steel shall have a gap at the joints. Saw-cut control joints may be used as an alternative to Zip Cap and Transverse joint formers.

3.06 INSTALLING EMBEDDED ITEMS

A. General: The Contractor shall set and build into formwork anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. They shall use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached.

3.07 PLACING OF CAST-IN-PLACE CONCRETE

A. The Contractor shall not place concrete until reinforcing steel, inserts, sleeves, and other work to be built into the concrete have been inspected and approved by the Owner's Representative and by all other trades concerned.

B. In hot weather, all concreting shall be done in accordance with ACI 305, Recommended Practice for Hot Weather Concreting.

1. When the temperature rises above 70 degrees F., all surfaces of concrete shall be protected against rapid drying.

2. Concrete delivered to the forms shall have a temperature of not over 90 degrees F.

3. The temperature of the forms shall not be over 90 degrees F.

C. In cold weather, all concreting shall be done in accordance with ACI 306, Recommended Practice for Cold Weather Concreting.

1. When the average daily temperature falls below 40 degrees F., all surfaces of concrete shall be maintained at a temperature of at least 50 degrees F, and not over 90 degrees F, for seven (7) days.

2. Concrete delivered to the forms shall be at least 60 degrees F., and not over 90 degrees F.

3. The temperature of the forms shall be at least 40 degrees F.

4. The Contractor shall maintain a record of temperature of the concrete at the most exposed surfaces of each placement at the beginning and at the end of each day of the curing period, which record shall be available to the Owner's Representative.

D. Conveying: Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent separation or loss of ingredients and in a manner which will assure that the required quality of the concrete is retained.

E. Depositing: Delivery and placement of concrete shall be programmed so that time lapse between batching and placement shall not exceed 1-1/2 hours. Concrete shall not be allowed a free fall of over 4 feet. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to re-handling or flowing.

F. Concrete shall be deposited continuously, in horizontal layers of such thickness (not deeper than 18 inches) that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. Placing shall be carried out at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or which has been contaminated by foreign materials shall not be deposited.

G. Concrete shall be compacted thoroughly by vibrating to produce a dense, homogeneous mass without voids or pockets. Vibrators shall be placed in concrete so as to penetrate approximately 3 inches to 4 inches into the preceding lift so as to blend the two layers. Vibrating techniques shall assure that, when the coarse aggregate reaches the form, it stops and the matrix fills the voids.

H. Patching: Areas to be patched shall not exceed 1.5 square feet for each 1000 square feet of

surface area. Patches shall match in every respect the color and texture of the surrounding surfaces. Mix formulation shall be determined by trial to obtain a color match when both the patch and surrounding concrete are cured and dry. After initial set, surfaces of patches shall be textured manually to obtain a match with the surrounding surfaces. All patching are subject to the Owner's Representative's final acceptance as to appearance and quality. At holes formed by withdrawal of ends of steel snap-ties, the Contractor shall wet and pack solidly with patching mortar. The Contractor shall also smooth out projections and fins with wet carborundum stones or power grinders. All voids, honeycombs, and air pockets shall be patched.

I. Concrete surfaces exposed to view and as directed by the Owner's Representative in the finishing walls shall receive a smooth rubbed finish. Such elements include, but are not limited to, exposed portions of foundation walls and other exposed walls. Not later than one day after form removal, the Contractor shall moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. The Contractor shall not apply cement grout other than that created by the rubbing process.

J. For concrete pads and walkways, immediately after trowel finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main direction of pedestrian traffic, or in accordance with the Drawings.

3.08 CURING AND PROTECTION

A. The Contractor shall protect newly placed concrete against low and high temperature effects and against rapid loss of moisture. They shall moist-cure all concrete for at least seven days at a temperature of at least 50 degrees F. by curing methods approved by the Owner's Representative.

B. For vertical or near-vertical surfaces, the Contractor shall moist-cure by keeping the form in contact with the concrete, or by other effective means approved by the Owner's Representative. Intermittent wetting and drying does not provide acceptable curing.

C. The Contractor may submit for the approval of the Owner's Representative alternative methods of curing non-exposed concrete surfaces. Approval of alternatives shall not relieve the Contractor of their responsibility for the proper curing of all concrete.

D. In hot weather, the Contractor shall be adequately prepared to protect the concrete from the adverse influence of heat before the placement of any concrete. They shall take special precautions to avoid cracking of the concrete from rapid drying during placement of concrete when air temperature exceeds 70 degrees F., partially when the work is exposed to direct sunlight.

1. The Contractor shall cool forms by fog with water or by protecting them from the direct rays of the sun.

2. If requested by the Contractor, deemed advisable by the testing engineer, and approved by the Owner's Representative, a retardant may be used to delay the initial set of the mix.

E. In cold weather, the Contractor shall be adequately prepared to protect the concrete from the adverse influence of cold before placement of any concrete.

1. When the average daily temperature falls below 50 degrees F, the Contractor shall take special precautions to assure adequate strength gain of the concrete.

2. When the average daily temperature falls below 40 degrees F, the Contractor shall prepare concrete with heated materials such that the concrete delivered to the forms has a temperature of at least 60 degrees F, and not over 90 degrees F. The Contractor shall pre-warm the forms to at least 40 degrees F, to prevent the rapid cooling of the concrete by their contact; and keep forms free of all ice and snow. When heated materials are being used, the Contractor shall combine the water with the aggregate in the mixer and keep the resulting temperature below 90 degrees F before cement is added to the mix. They shall protect all concrete by the use of heated enclosures which shall be sufficiently strong and windproof and within which adequate heaters are properly distributed to maintain all concrete at the required temperatures. The Contractor shall not allow heaters to locally heat or dry the concrete and shall maintain adequate fire precautions.

3.09 ACCEPTANCE

A. When the tests on control specimens of concrete fall below the required strength, the Owner's Representative shall have the right to require, at the Contractors expense, mix redesign, load tests, and/or strengthening as directed, and/or removal and replacement of those parts of the structure in which such concrete was used.

3.10 CLEANING

A. The exposed faces of the cast-in-place concrete shall be cleaned of all stains, water marks, and leaked fines.

END OF SECTION

SECTION 03 40 00
PRECAST CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Precast concrete curb edge

C. The layout of curb edging shall be marked out in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 32 11 16 – Aggregate Base Courses
B. Section 32 12 16 – Bituminous Concrete
C. Section 32 18 16.13 – Poured-in-Place Resilient Surfacing

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ASTM: American Society for Testing and Materials, latest edition

1.04 SUBMITTALS

A. The Contractor shall submit shop drawings and manufacturer's literature for precast concrete curb edge, indicating size, shape and dimensions, and finish for approval by Owner's Representative.

B. Copies of tests on representative samples of the concrete used in the manufacture of all precast units showing a minimum compressive strength of 5,000 pounds must be received by the Owner's Representative prior to shipping any units.

C. Fabrication of any material or performing of any work prior to the final approval of the shop drawings will be entirely at the risk of the Contractor.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Precast concrete curbs shall be adequately protected from damage during transit to the site.

B. Curbs shall be protected against staining, chipping, and other damage. Cracked, badly chipped, or stained units will be rejected and shall not be employed in the work.

1.06 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 PRECAST CONCRETE CURB

A. The concrete shall have a minimum compressive strength of 5,000 psi at 28 days, and shall contain 5 to 7 percent entrained air.

B. Curved areas of precast concrete curbing shall be radius pieces that conform to the radii indicated Drawings. Straight pieces of curb shall not be used for curved areas.

C. Precast concrete curbing shall be supplied by Scituate Concrete Products (phone # 800-322-4488, www.scituatecompanies.com), or approved equal.

2.02 CONCRETE REINFORCEMENT

A. Reinforcing steel shall conform to ASTM Specification A-615 grade 60, deformed bars.

2.03 DOWEL PINS

A. Dowel pins for connecting curb units together shall be rust-resistant steel, supplied by the curb manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION OF PRECAST CONCRETE ELEMENTS

A. Curbing shall be installed at the lines and grades shown on the Drawings, and in accordance with the Drawing detail for curb edging.

B. Curb sections shall be connected to each other with dowel pins.

C. All abutting sections shall be aligned to within ¼" tolerance. Any sections determined to be misaligned shall be reset by the Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 11 68 13
PLAYGROUND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Playground equipment

C. All equipment locations and applicable safety zone boundaries shall be marked in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete
B. Section 32 11 16 – Aggregate Base Courses
C. Section 32 18 16.13 – Poured-in-Place Resilient Surfacing

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ADA: Americans with Disabilities Act, including latest amendments and additions.
2. AAB: Architectural Access Board, Commonwealth of Massachusetts, Chapter 521 CMR, latest edition.
3. ASTM: American Society for Testing and Materials

1.04 REQUIRED SUBMITTALS

A. The Contractor shall provide complete product literature and applicable color samples for approval by the Owner's Representative prior to ordering the following equipment:

1. Playground equipment

B. The Contractor shall submit CAD drawings, 2D layout, and 3D renderings of the playground equipment.

C. The Contractor shall submit a written guaranty of lead time for delivery and installation.

D. The Contractor shall provide the Owner's Representative all maintenance and repair

supplies, installation manuals, tool kits, and materials that were shipped with each playground product.

1.05 QUALITY ASSURANCE

A. This work shall be assigned to experienced and qualified subcontractors employing experienced workers who will work under the full-time supervision of a qualified foreman with a minimum of five (5) years of experience on projects comparable to this project. The Contractor shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the work in this Section. The Contractor shall demonstrate that they have successfully completed work of similar size and scope.

B. The playground equipment installer shall have at least one person on site during the entire installation who is a Certified Playground Safety Inspector.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for timing the delivery of site improvement materials so as to minimize on-site storage time prior to installation. All stored materials shall be protected from weather, careless handling, and vandalism.

B. The Contractor shall store materials under waterproof covers on planking clear of ground and protect from handling damage, dirt, stain, water and wind.

C. The Contractor shall take all necessary precautions to prevent all items from chipping, cracking, or other damage during the transportation of these materials to the project, unloading and storage on the site. The Contractor shall lift items with wide-belt type slings wherever possible; they shall not use wire rope or ropes containing tar or other substances which might cause staining. If required, they shall use wood rollers and provide cushioning at end of wood slides. Damaged items will not be allowed to be installed and should any damaged items be found in constructed work, such items shall be removed immediately and replaced, and the Contractor shall assume all expenses incurred therefrom.

D. Stored materials shall be adequately protected against moisture by one (1) stacking in such a manner as to allow a complete circulation of air under each stack, and two (2) covering each stack, including top and sides, with a waterproof paper or membrane. Coverings shall remain in place at all times, when not working from the particular stack.

1.07 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. At the beginning of work, the installer shall accept substrates, subgrades, previous work, and conditions. No claim for extra

compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or re-handling items prior to final installation.

1.08 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 PLAYGROUND EQUIPMENT

A. Play equipment shall comply with the following requirements:

1. CPSC Handbook for Public Playground Safety, Publication #325
2. ASTM F1487-07, Standard Consumer Performance Specification for Playground Equipment for Public Use
3. All applicable requirements of the ADA (Americans with Disabilities Act)
4. All components shall be certified by the International Playground Equipment Manufacturer's Association
5. The play equipment manufacturer shall carry a minimum of $10 million in liability insurance, and have a minimum of 10 years' experience manufacturing commercial playground equipment.
6. Posts shall be galvanized steel with a powder-coat finish. All posts shall have galvanized steel or aluminum caps, also powder-coated. Caps shall be installed at the factory, and shall fit snugly into post ends.
7. Slides on the composite play structure shall be stainless steel.
8. Vertical panels and climbers shall be powder-coated galvanized steel.
9. Wooden components are not allowed.
10. All posts shall be in-ground mounted.

B. Playground equipment shall include the following structures:

1. Composite Play Structure: A composite structure for school-age children shall be provided that complies with the layout and includes the specific components shown and noted on the Drawings. This shall be a custom Challengers structure by Playworld, or approved equal. If the manufacturer does not provide certain components shown, substitute components may be proposed which are similar to those on the Drawings, in which case a scale drawing of the entire structure with the substituted components shall be submitted to the Owner's Representative for approval. Substituted components, structures, and their safety zones shall fit within the play surfacing boundaries indicated on the Drawings.

1. Triple-Bay Swing Set: This shall include 6 standard belt seats. The frame shall be arch-style, with two support posts at the end of each bay. The swing hinges shall be a

maximum of 8 feet above finished grade of the play surface. Swing set shall be Challengers model Arch Swing Set (#500 ARCH) by Playworld, or approved equal.

2. Single-Bay Swing Set: This swing set shall include 2 bucket seats. The frame shall be arch-style, with two support posts at the end of each bay. Bucket seats shall be fully enclosed. The swing hinges shall be a maximum of 8 feet above finished grade of the play surface. Swing set shall be Challengers model Arch Swing Set (#500 ARCH) by Playworld, or approved equal.

3. Basket Swing Set: This swing set shall include a basket/saucer-type swing that accommodates multiple children at once. Material of seat shall be a rope basket style, and there shall be two support posts at each end of the swing set. The swing hinges shall be a maximum of 8 feet above finished grade of the play surface. This swing set shall be the Unity Basket Swing (# 350-BASKET) by Playworld, or approved equal.

4. Zip-line: This shall be the Sky Rail (# ZZCH7067) by Playworld or approved equal.

5. Seesaw: This shall be the Duo Seesaw (# ZZXX0596) by Playworld or approved equal.

6. Preschool Climber: This shall be the Flower Climber (# ZZXX0479) by Playworld or approved equal.

7. Play House: This shall be the Chattery (# ZZXX0887) by Playworld or approved equal.

8. Spinner: This shall be the Loopy Whoop (# ZZUN7096) by Playworld or approved equal.

9. Hillside Slides with Roof Structures: These shall include one 3’ high single-width slide, one 3’ high double-width slide, and one 4’ high single-width slide. Each slide shall include an entry canopy, a hexagonal roof structure, and an entry support bracket at the top of the slide. The posts that support the slide entry canopy shall also support two corners of the hexagonal roof. The slides shall be Challengers 3’ Glide Slide (# CH3127), 3’ Wide Glide Slide (# CH3106), and 4’ Glide Slide (# CH3126) by Playworld, or approved equal. The roof structures shall be Challengers Carnival Roof – Small Perforated, Hexagonal shape (# CH9887) by Playworld, or approved equal.

10. Hillside Transfer Stations: These shall include one transfer station with steps to a 3’ height, and one station with steps to a 4’ height, attached to a square deck at the top of the hill with pipe rails on two sides of the deck, and a manufacturer-supplied entry support bracket at the entry point to the deck. The transfer stations shall be Challengers 3’ high transfer station with tall guardrails (# CH 2007) and Challengers 4’ high transfer station with barriers (# CH2027) by Playworld, or approved equal. The decks and posts shall be Challengers square decks with pipe barriers on opposite sides (# CH0616) by Playworld, or approved equal. Each transfer station shall include an approach step on one side of the transfer platform. The deck support posts shall not extend more than 8” above the pipe barrier top clamps.

11. 10’ Bridge Between Hills: This shall be the Challengers model Arch Bridge by Playworld (# CH6636) or approved equal. The bridge shall include manufacturer-supplied entry support brackets at each end.

12. Accessible Merry-go-round: This shall be the 2-seat We-Go-Round with perforated panels (# 248819) by Landscape Structures, or approved equal.

13. Freestanding play panels: These shall be Miracle Museum Grand Gallery (# 453-4); and Miracle Museum Washer Stand (# 714-698-1 and # 714-549-3) by Miracle, or approved equal.

C. Playground equipment colors shall be as follows:

1. Playworld products (except for Flower Climber & Chattery):

   a. Posts: Light gray
   b. Decks: Gray
   c. Railings, clamps, climbers, roofs, and other color-coated metal components: Teal
   d. Roto-molded plastic components: Lavender
   e. Play shade (Shadesure fabric): Royal blue
   f. 1-color sheet plastic: Yellow
   g. Rope: Black

2. Flower Climber & Chattery (from Playworld):

   a. These two structures shall have the same colors as pictured on the Playworld website, and approximately as follows:
   b. Flower Climber: green posts/frame and 1 orange, 1 red, and 1 yellow plastic flower
   c. Chattery: Teal roof, white frame, and plum and forest green vertical plastic elements

3. Landscape Structures products (We-go-round):

   a. Posts and frame: Peacock
   b. Perforated panels: Cool silver matte
   c. Plastic roof: Blue
   d. Benches and handhold: Yellow

4. Miracle products (Miracle Museum):

   a. Metal components: Plum

D. Playground equipment manufacturer contact information:

1. Playworld, represented by Ultiplay: phone # 508-688-7007, ultiplayus.com
2. Landscape Structures, represented by O’Brien & Sons: phone # 800-835-0056, obrienandsons.com

3. Miracle, represented by Site Specifics: phone # 508-763-0207 or 508-633-0722, sitespecifics.net

2.02 HARDWARE

A. Hardware shall be provided in sufficient quantity to complete the assembly of the play equipment. All hardware shall be stainless steel or non-ferrous.

PART 3 – EXECUTION

3.01 PLAYGROUND EQUIPMENT

A. The Contractor shall assemble and install the playground equipment in accordance with the Drawings and manufacturer's written instructions. See Project Special Conditions for additional installation requirements.

B. All equipment shall be in-ground mounted. Cement concrete footings shall be installed in accordance with Section 03 30 53 – Cast-in-Place Cement Concrete, the Project Special Conditions, and manufacturer's written instructions. Bases of footings shall be at least 48 inches below finished grade (top of safety surfacing), and diameter shall be as per manufacturer's recommendations. Top of concrete footing shall be flush with base of safety surfacing.

C. The playground equipment installer shall have at least 5 years of experience installing comparable structures, and shall have at least one person on site during the entire installation who is a Certified Playground Safety Inspector.

D. All installation shall conform to ASTM F1487.

E. The Contractor shall mark layout of play equipment and required safety zones prior to installation of adjacent walkway, curb, and fencing, for Owner's Representative to approve.

END OF SECTION

SECTION 11 68 23
ATHLETIC COURT EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Basketball goals

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete
B. Section 32 11 16 – Aggregate Base Courses
C. Section 32 18 23 – Athletic Surfaces
D. Section 32 31 13 – Chain Link Fences and Gates

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ADA: Americans with Disabilities Act, including latest amendments and additions.
2. ASTM: American Society for Testing and Materials
3. AWS: American Welding Society

1.04 REQUIRED SUBMITTALS

A. The Contractor shall prepare and submit Shop Drawings to the Owner's Representative for approval prior to ordering the listed materials.

1. The Contractor shall provide complete shop drawings and/or cut sheets for all items listed below:

a. Basketball goals

2. Shop drawings shall show required sizes, dimensions, sections, profiles of units; the arrangement of and provision for jointing, anchoring, fastening, and support; and other necessary details.

3. Shop drawings shall include large-scale details of any unique fabrication and setting requirements or any other specified areas seen as necessary or as directed by the

Owner's Representative.

4. Each shop drawing shall reference the section and paragraph of the Specifications that requires the items included.

B. The Contractor shall provide complete product literature and applicable color samples for approval by the Owner's Representative prior to ordering the following equipment and materials:

1. Basketball goals

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for timing the delivery of equipment and materials so as to minimize on-site storage time prior to installation. All stored materials shall be protected from weather, careless handling, and vandalism.

B. The Contractor shall store equipment and materials under waterproof covers on planking clear of ground and protect from handling damage, dirt, stain, water and wind.

C. The Contractor shall take all necessary precautions to prevent all items from chipping, cracking, or other damage during the transportation of these materials to the project, unloading and storage on the site. The Contractor shall lift items with wide-belt type slings wherever possible; they shall not use wire rope or ropes containing tar or other substances which might cause staining. If required, they shall use wood rollers and provide cushioning at end of wood slides. Damaged items will not be allowed to be installed and should any damaged items be found in constructed work, such items shall be removed immediately and replaced, and the Contractor shall assume all expenses incurred therefrom.

D. Stored materials shall be adequately protected against moisture by one (1) stacking in such a manner as to allow complete circulation of air under each stack, and two (2) covering each stack, including top and sides, with a waterproof paper or membrane. Coverings shall remain in place at all times, when not working from the particular stack.

1.06 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. At the beginning of work, the installer shall accept substrates, subgrades, previous work, and conditions. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or re-handling items prior to final installation.

1.07 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 BASKETBALL GOALS

A. Goals for the basketball court shall include straight standards with a square profile, (as shown on the Drawings) with outside dimensions of 6" x 6". The offset shall be 6 feet. The standards shall be steel with a black powder coating.

B. Backboards shall be rectangular, 42" high x 72" wide, 1/2" thick polycarbonate. Connections to the standards shall include safety bolts. Outline colors shall be selected by Owner's Representative.

C. Rims shall be steel with orange powder coat, with adjustable and breakaway features; and nets shall be white nylon.

D. All basketball goal products shall be obtained from one manufacturer: TrueBounce (truebounce.com, phone # 508-999-3020); or approved equal.

E. Quantity of basketball goals: 2

PART 3 – EXECUTION

3.01 BASKETBALL GOALS

A. Basketball goals shall be assembled and installed in accordance with the Drawings and manufacturer's written instructions.

B. Cement concrete footings for the basketball goals shall be installed in accordance with the Drawings and Section 03 30 53 – Cast-in-Place Cement Concrete.

END OF SECTION

SECTION 13 34 00
FABRICATED ENGINEERED STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Hexagonal metal shelter

C. The location of the shelter shall be marked in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete
B. Section 26 00 00 – Electrical

1.03 REQUIRED SUBMITTALS

A. The Contractor shall provide complete product literature and applicable color samples for the shelter, for approval by the Owner's Representative, prior to ordering the shelter.

B. The Contractor shall provide shelter footing designs prepared by the manufacturer's engineer, for approval by the Owner's Representative. See 3.01 of this Section for more information about this submittal.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for timing the delivery of shelter materials so as to minimize on-site storage time prior to installation. All stored materials shall be protected from weather, careless handling, and vandalism.

B. The Contractor shall store materials under waterproof covers on planking clear of ground and protect from handling damage, dirt, stain, water and wind.

C. The Contractor shall take all necessary precautions to prevent all items from chipping, cracking, or other damage during the transportation of these materials to the project site, unloading, and storage on the site. The Contractor shall lift items with wide-belt type slings wherever possible; they shall not use wire rope or ropes containing tar or other substances which might cause staining. If required, they shall use wood rollers and provide cushioning at end of wood slides. Damaged items will not be allowed to be installed and should any

damaged items be found in constructed work, such items shall be removed immediately and replaced, and the Contractor shall assume all expenses incurred therefrom.

D. Stored materials shall be adequately protected against moisture by one (1) stacking in such a manner as to allow a complete circulation of air under each stack, and two (2) covering each stack, including top and sides, with a waterproof paper or membrane. Coverings shall remain in place at all times, when not working from the particular stack.

1.05 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. At the beginning of work, the installer shall accept substrates, subgrades, previous work, and conditions. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or re-handling items prior to final installation.

1.06 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 HEXAGONAL METAL SHELTER

A. The shelter shall be # HXE-16 by Polygon (represented by O'Brien and Sons, Phone # 800-835-0056, www.obrienandsons.com), or approved equal. The columns shall be a plain square style (# K01), with interior anchor bolts. The columns/frame shall have a black Poly-5000 powder-coat finish. The roof shall be a green standing seam metal roof. The Contractor shall submit color samples of the various shades of green to the Owner's Representative for color selection.

C. The westernmost column shall include a factory-supplied cutout for a duplex outlet. (Also see Electrical drawings and specifications.)

PART 3 – EXECUTION

3.01 HEXAGONAL METAL SHELTER

A. The Contractor shall assemble and install the shelter in accordance with manufacturer's

written instructions. The bases of the columns shall be set at finished grade. Concrete piers beneath surface-mounted columns shall be designed by the manufacturer, in accordance with soil boring logs included with this project manual (particularly the closest boring to the shelter location, which is boring # B-2), and drawings of the piers shall be sealed by a Professional Engineer licensed in Massachusetts. These drawings shall be submitted to the Owner's Representative.

B. The electrical conduit for the duplex receptacle and the shelter light shall be located on the interior of the westernmost column which also includes the duplex cutout. (Also see Electrical drawings and specifications.) Any conduit that is exposed beneath the roof shall be primed and painted black to match the roof frame.

END OF SECTION

SECTION 26 00 00
ELECTRICAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Section 26 05 73 – Overcurrent Protective Device Coordination Study
2. Section 26 24 16 – Panelboards
3. Section 26 27 26 – Wiring Devices
4. Section 26 56 68 – Exterior Athletic Lighting
5. All other work shown on the Drawings and included in these Specifications

C. The Contractor shall furnish a complete, working finished product, which meets all applicable codes and standards, and the intent and specific requirements of the Drawings and specifications for this project. All materials and all work, which may be reasonably implied as being incidental to the work of this Section, shall be furnished at no extra cost to the Owner.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Special Conditions (in front end documents) – Security Camera System
B. Section 32 12 16 – Bituminous Concrete
C. Section 03 30 53 – Cast-in-Place Concrete

1.03 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to work of this section.

B. The Contractor must be familiar will all other Sections of this specifications and the associated Drawings, which affect the scope of work. The General Conditions, all Supplementary and Special Conditions, and all other sections of this specification shall be adhered to, as they apply to this Section. Where paragraphs of this Section conflict with similar paragraphs elsewhere, the more stringent requirements shall prevail.

1.04 REFERENCE STANDARDS AND SPECIFICATIONS

A. Perform work strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and federal government, and other authorities that have lawful jurisdiction.

B. All materials and installations shall be in accordance with the latest edition of the Massachusetts Electrical Code, and all applicable local codes and ordinances. Materials and equipment shall be listed by Underwriters Laboratories (UL).

C. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. American National Standards Institute - ANSI
2. American Society for Testing & Materials - ASTM
3. Illuminating Engineering Society - IES
4. Institute of Electrical & Electronics Engineers - IEEE
5. Insulated Cable Engineers' Association - ICEA
6. National Electrical Code - NEC
7. National Electrical Manufacturer's Association - NEMA
8. National Electrical Safety Code - NESC
9. InterNational Electrical Testing Association - NETA
10. National Fire Protection Association - NFPA
11. Occupational Safety & Health Administration - OSHA
12. Underwriter's Laboratories, Inc. - UL

The above listed codes and standards are referenced to establish minimum requirements and wherever this Section requires higher grades of materials and workmanship than required by the listed codes and standards, this Section shall apply. In the event a conflict occurs between the above listed codes and standards and this Section, the more stringent requirement shall govern.

1.05 SITE VISIT

A. Each bidder shall visit the site of the proposed work and fully acquaint himself with the conditions there relating to construction and labor, and should fully inform himself as to the facilities involved, and the difficulties and restrictions attending the performance of the Contract.

B. The Bidder shall thoroughly examine and familiarize himself with Drawings, Technical Specifications and all other Bid and Contract Documents. The Contractor, by the execution of the Contract, shall in no way be relieved of any obligation under it due to his failure to receive or examine any form or legal document or to visit the site and acquaint himself with the conditions there existing and the Owner will be justified in rejecting any claim thereof.

1.06 AS-BUILT DRAWINGS:

A. After completion of the electrical installation, the Contractor shall furnish an "as-built" drawings showing all conduits, cables, cabinets, transformers, light poles, etc. to scale with dimensions where required. Instruction sheets and parts lists covering all operating equipment will be bound into a folder and furnished to the Owner in duplicate.

1.07 INSTRUCTIONS:

A. Within 10 days, after completion and testing of the system, the Contractor shall instruct the Owner's personnel in the proper operations and maintenance of the system, in a 2 hour training session.

B. The Contractor shall furnish at least two (2) complete sets of operating and instruction manuals for the equipment provided under this Contract. These manuals shall detail the operation, testing, and maintenance of the electrical equipment and systems. Manuals shall be provided upon Engineer's request or upon project completion, whichever comes first.

1.08 GUARANTEE

A. Guarantee work of this Section in writing for one year from date of Owner's acceptance. Repair or replace defective materials, equipment, workmanship, and installation that develop within this period, promptly and to Owner's satisfaction and correct damage caused in making necessary repairs or replacements under guarantee with no extra cost to Owner. Contractor shall transfer all equipment warrantees for lighting and other systems to Owner.

1.09 SUBMITTALS

A. Within 10 days after Award of General Contract, submit shop drawings and product data on below listed items for approval. Submit copies as requested.

B. Check, stamp and mark with project name shop drawings and product data before submitting for approval. Specifically indicate on shop drawing transmittal form or by separate letter any deviations from Contract Documents because of standard shop practice or other reason. Rectify with no extra cost to Owner, deviations which escape Engineer's scrutiny and have not been indicated on shop drawings.

C. List of materials and equipment requiring shop drawings shall include:

1. Conduits and Wiring
2. Concrete Products and Light Bases
3. Pathway Lighting
4. Sports Lighting
5. Handholes

The Engineer's review shall be only for conformance with the design concept of the project and compliance with the specifications and Drawings. The responsibility of, and the necessity of, furnishing materials and workmanship required by the specifications and Drawings which may not be indicated on the shop drawings is included under the work of this Section.

1.10 INSPECTIONS AND FEES

A. Obtain all necessary permits and licenses, file necessary plans and pay all fees for permits and inspections. Permit fees are the responsibility of the Contractor as part of his bid, as is all coordination with the municipality and the local utility National Grid.

1.11 INTERPRETATION OF DRAWINGS

A. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract. Drawings are not intended to specify or show every offset, fitting or component; however, Contract Documents require components and materials whether or not indicated or specified as necessary to make installation complete and operational.

B. Contractor is responsible for all work shown on both Contract Drawings and these written specifications, including work detailed in the specifications and not shown on the drawings and including work shown on the Drawings and not described in the specifications. All ancillary equipment necessary for a complete installation shall be included, even if not shown, detailed or described. For conflicts between the Contract Drawings, written specifications and other contract information, the more stringent requirement shall apply, and the Engineer may direct the Contractor as to what is the preferred option to be provided.

C. Any work installed contrary to, or without review by, the Engineer shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

D. Circuit layouts are not intended to show the number of fittings, or other installation details. Additional circuits shall be installed wherever needed to conform to the specific requirements of the equipment or local codes.

E. As work progresses and for duration of Contract, maintain complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately, including work installed as a modification or addition to the original design.

1.12 ELECTRIC UTILITY

A. The Electric Utility for this project is National Grid (Massachusetts Electric Company). All coordination with the Electric Utility is the responsibility of the Contractor.

PART 2 – MATERIALS & PRODUCTS

2.01 GENERAL

A. Materials and products furnished shall be designed for the intended use, shall meet all requirements of the latest edition of the National Electric Code (NEC), and all local codes.

B. Materials shall be manufactured in accordance with the standards indicated in this Section, and typical industry standards and codes for the products specified. Materials and equipment shall be Underwriter's Laboratory (UL) listed.

C. The materials used shall be new, unused, and of the best quality for the intended use. All equipment shall have the manufacturer's name, address, model or type designation, serial

number and all applicable ratings clearly marked thereon in a location which can be readily observed after installation. The required information should be marked on durable nameplates that are permanently fastened to the equipment.

D. Electrical equipment shall at all times during construction be adequately protected against mechanical injury or damage by water. Electrical equipment shall not be stored outside exposed to the elements. If any equipment or apparatus is damaged, such damage shall be repaired at no additional cost, or replaced at no additional cost as directed by the Engineer.

2.02 RACEWAYS

A. Rigid Metallic Conduit: Listed to Underwriters Laboratories Safety Standard UL6 and ANSI 080.1.

B. Electrical Metallic Tubing (EMT) Listed to Underwriters Laboratories Safety Standard UL 797 Manufactured in accordance with ANSI C80.3

C. Flexible Metallic Conduit: UL I. Liquidtight flexible metal conduit shall be used in wet locations.

D. Polyvinyl Chloride (PVC) Conduit, electrical, gray, Schedule 40 or Schedule 80 as specified, meeting the requirements of UL 651 and NEMA TC-2. If concrete encasement is required, a minimum of 3,000 psi concrete shall be used. All conduits placed under roadways, and subject to vehicular traffic, shall be concrete-encased Schedule 40 (or Schedule 80 as approved).

E. Minimum size of conduit shall be 3/4". Unless indicated on Drawings, conduit sizes can be sized in accordance with National Electric Code (NEC). Conduit bends shall not have kinks or flats, and shall not be less than standard radii.

F. Rigid Galvanized Steel (RGS) conduit shall be used for all power, control signal, and instrumentation wiring, except where noted. Conduit shall be fully threaded at both ends and each length shall be furnished with one threaded coupling. All 90 degree conduit sweeps shall be RGS.

G. Conduits shall be made electrically continuous at coupling and connections to boxes and cabinets by means of joining fasteners or copper bond wires. Conduit shall be connected to grounded structural steel or the ground network. After assembly all conduit locknuts, all EMT coupling fittings, and all bond wire screws shall be set up tight before installation of wiring. Insulated metallic bushings shall be used on all conduits entering panel cabinets, pull-boxes, and wiring gutters, except on branch lighting circuits.

H. Expansion fittings shall be provided on all conduits as required by the 2020 National Electrical Code, and as required by local and state codes. This includes, but is not limited to, vertical conduit risers coming from below-grade.

2.03 WIRE AND CABLE

A. Unless otherwise noted, conductors for power, lighting, and grounding above grade shall be No. 12 through No. 8 AWG, NEC type THWN-2/THHN, meeting the requirements of UL 83. Conductors for power and lighting shall be no smaller than No. 12 AWG.

B. Conductors for power, lighting, grounding, and control below grade (and in wet locations) shall be No. 2 AWG and larger, NEC type XHHW-2, meeting the requirements of NEMA WC7 and ICEA S-66-524.

C. All conductors shall be annealed copper, 98% conductivity, Class B stranded, except conductors used for power and lighting circuits No. 10 AWG and smaller which may be solid. All conductors should be rated for 600 volts or less, with a thermal rating of 90' C.

2.04 WIRE AND CABLE CONNECTORS AND DEVICES

A. Wire and cable connectors and devices shall meet the requirements of UL 486. Connectors, including miscellaneous nuts, bolts, and washers shall be silicon bronze. Ferrous materials shall not be used.

2.05 BOXES

A. Outlet and Switch Boxes: NEMA OS 1.

B. Pull Boxes, Junction Boxes, and Equipment Enclosures: NEMA ICS 6. Pull boxes, junction boxes, and equipment enclosures shall be of NEMA Type I construction for indoor use, and NEMA Type 3R construction for outdoor or wet location use, unless otherwise noted.

C. Box sizes shall not be less than that required by the Massachusetts Electrical Code.

2.06 WARNING TAPE

A. Warning tape shall be six (6) inches wide, polyethylene not less than 3.5 mil thick with a minimum strength of 1,500 psi. Install 8 inches below final grade. Tape shall be red for electric conduit, and red or yellow for communication conduit. Tape shall have black lettering on two lines as indicated below:

B. For Electric conduit:

CAUTION CAUTION CAUTION
BURIED ELECTRIC LINE BELOW

C. For Telephone, Fire Alarm and Communication conduit:

CAUTION.CAUTION.CAUTION
BURIED COMMUNICATION LINE BELOW

2.07 HANDHOLES

A. Electric handholes shall be 24" x 36" precast concrete with cast iron covers. Electric handholes shall be unaffected by moisture, freezing temperatures, soil, and sub-soil chemicals.

B. Communications handholes shall be 24" x 36" polymer concrete. Communications handholes shall be unaffected by moisture, freezing temperatures, soil, and sub-soil chemicals.

C. Handholes shall be provided with skid-resistant surface covers, with an Electric or Communications label for power, audio, etc. Handholes and Covers shall be designed for street-rated, heavy duty applications, meeting the requirements of the either: AASHTO HS-20 or ANSI/SCTE 77-2002 Tier 15 loading, with a minimum design load of 15,000 lbs. for both the handhole box and cover. Covers shall include recessed stainless steel captive bolts of a penta-head design. The nuts for the bolts shall be self-centering and corrosion resistant. Handholes shall meet the requirements of the latest edition of the National Electric Code (2020 or later) with regards to structural integrity, installation methods, grounding of the cover and metallic parts, etc. Handholes shall be UL listed for the intended use.

D. Handholes shall be installed flush with final grade.

2.08 CAST-IN-PLACE CONCRETE FOUNDATIONS

A. The Contractor shall provide the materials, labor, and equipment necessary for the installation of cast-in-place concrete foundations, in accordance with these Specifications, Contract Drawings, City requirements, and all applicable codes & regulations.

2.09 PRE-PACKAGED SPORTS LIGHTING SYSTEM

A. The Contractor shall provide a pre-packaged sport lighting system in accordance with Section 26 56 68 (Exterior Athletic Lighting).

2.10 SECURITY CAMERA SYSTEM

A. The Contractor shall provide a security camera system in accordance with the Special Conditions – Security Camera System Requirements.

PART 3 - EXECUTION

3.01 GENERAL

A. This Section covers the requirements for installation of materials, proper workmanship, testing, cleaning, grounding, and work methods to be followed by the Contractor. This Section also includes specific instructions and to be used in conjunction with the contract Drawings.

B. Contractor is responsible for coordinating work with other trades, Owner, and Architect's schedule. Work will be coordinated such that systems can be properly located, and

conflicts and delays are avoided. Contractor shall consider commencement of work acceptance of existing conditions.

3.02 MATERIALS AND WORKMANSHIP

A. Work shall be executed in workmanlike manner and shall present neat, rectilinear and mechanical appearance when completed. Do not run raceway exposed unless shown exposed on Drawings. Material and equipment shall be new and installed according to manufacturer's recommended best practice so that complete installation shall operate safely and efficiently.

3.03 TESTING, INSPECTION AND CLEANING

A. Test wiring and connections for continuity and grounds before fixtures are connected; demonstrate insulation resistance by megger test as required at not less than 500 volts. Insulation resistance between conductors and grounds for secondary distribution systems shall meet National Electrical Code (NEC) and InterNational Electrical Testing Association (NETA) requirements.

B. Verify and correct as necessary: voltages, tap settings, trip settings and phasing on equipment from secondary distribution system to point of use. Test secondary voltages at transformers, bus in panelboards, and at other locations on distribution systems as necessary. Test secondary voltages under no-load and full-load conditions.

C. Test lighting fixtures with specified lamps in place for 100 hours. Replace lamps that fail within 90 days after acceptance by Owner at no extra cost to Owner (no exceptions).

D. Provide necessary testing equipment and testing services.

E. Failures or defects in workmanship or materials revealed by tests or inspection shall be corrected promptly and retested. Replace defective Material.

F. Clean panels and other equipment, Panelboard interiors shall be cleaned and vacuumed. Equipment with damage to painted finish shall be repaired to Engineer's or Architect's satisfaction. After completion of project, clean exterior surfaces of electrical equipment.

3.04 WIRING METHODS

A. Install wire and cables in approved raceways as specified and as approved by authorities that have jurisdiction.

B. Follow homerun circuit numbers and/or notes as shown on drawings to connect circuits to panelboards. Where homerun circuit numbers are not shown on Drawings, divide similar types of connected leads among phase buses so that currents are approximately equal in normal usage.

C. Run concealed conduit in as direct lines as possible with a minimum number of bends, longest possible radius. Run exposed conduit parallel to or at right angles to building/field lines. Bends shall be free from dents or flattening. The exact locations and

routing shall be determined by the Contractor subject to the approval of the Owner and Engineer.

D. Polarity of all electrical connections shall be observed in order to preserve phase relationship in all feeders and equipment.

E. Splices shall be made in neat, workmanlike manner using approved mechanical connectors. After splicing, insulation equal to that on the spliced wires shall be applied at each splice. Splices are permitted only in junction boxes, outlet boxes, or other permanently accessible locations. Splices installed in electric handholes shall be weather and waterproof, pre-molded polymer splices. Hand taping of splices below-grade is not acceptable.

3.05 GROUNDING

A. Bond and ground equipment and systems connected under this Section in accordance with standards of the NEC and other applicable regulations and codes.

B. Conduit system shall be electrically continuous throughout, grounded at service entrance. Equipment frames, enclosures, boxes, etc. shall be grounded by use of green-jacketed (or bare copper) ground sized as per Table 250-95 oldie NEC.

C. Copper fittings for ground connections shall conform to the requirements of ASTM B 30. All bolts, u-bolts, cap screws, nuts, and lock washers for copper fitting shall be of approved corrosion-resisting material. Compression connectors required for all below-grade grounding connections.

D. Ground Rods shall be 5/8" diameter and 8' in length, copperweld as required by applicable codes (NEC, NESC). Bonding connections to ground rods shall be permanent, welded or crimped, with copper connectors. All wire used for grounding shall be no smaller than #4 Awg copper, stranded conductor.

3.06 INSTALLATION OF ELECTRICAL EQUIPMENT

A. Contractor shall furnish and install the following major electrical components, and all necessary minor and expected accessories.

B. Provide, furnish and install all products and work outlined in Part 1 of this Specification Section.

C. Provide new conduit system for lighting and electrical work, in locations as shown on Contract Drawings. Utilize existing empty conduits (installed by others) where possible and install new conduits for a complete and functional system. Provide all new cabling for all electrical equipment listed.

D. Install all equipment in locations as shown on Contract Drawings. All deviations must be approved, in advance by Owner, Architect, and Engineer.

E. Install all equipment per manufacturer's instructions.

F. Balance the lighting, receptacle, and electrical load evenly on all circuits and on all phases of each circuit.

G. Clean-up excavated areas, and restore with new loam & seed, as directed by Owner.

H. Provide complete "As-Built" drawings to Engineer & Owner.

3.07 INSTALLATION OF SECURITY CAMERA SYSTEM

A. The security camera system shall be installed in accordance with the Special Conditions – Security Camera System Requirements, and with the Drawings and this Section.

3.08 GUARANTEE AND ACCEPTANCE

A. Any defective elements shall be replaced in part or whole by the Contractor at no cost to the Owner.

END OF SECTION

SECTION 26 05 73
OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. This Section includes requirements for computer-based fault-current, overcurrent protective device coordination and arc flash protection studies. Protective devices shall be set based on Engineer's review of submitted results of the protective device coordination study.

1. Coordination of series-rated devices is not permitted.

1.03 PERFORMANCE REQUIREMENTS

A. Fault Current Study: Prepare computer-based, fault current study to calculate the maximum available short-circuit current in amperes RMS symmetrical at circuit-breaker positions of the electrical power distribution system based on proposed feeder routing.

B. Overcurrent Protective Device Coordination: Prepare computer-based, selective coordination study such that all overcurrent protective devices proposed for inclusion in the Work shall be selected to be selectively coordinated for total selective coordination with the overcurrent protective devices installed on their supply side such that an overcurrent event (overload, short-circuit, or ground-fault) occurring at the lowest level in the system (branch circuit) cannot cause the feeder protective device supplying the branch circuit panelboard to open.

B. Total selective coordination shall be carried through each level of distribution for all branches of emergency power system. Emergency power systems shall include life safety, legally required standby systems, critical operations power systems, and fire pumps.

C. The normal power system and standby power system shall be coordinate to 0.01s.

D. Arc Flash Hazard Analysis: Prepare computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.04 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.05 SUBMITTALS

A. The release of electrical equipment submittals (panelboards, engine generators, switchgear, etc.) is dependent on the receipt of a complete and accurate overcurrent protective device coordination study. The following submittals shall be in digital form:

1. Coordination-study input data, including completed computer program input data sheets. Provide editable electronic media including all files and breaker TCC's.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report; signed, dated, and sealed by a qualified professional engineer.
4. Arc-flash study input data, including completed computer program input data sheets.
5. Arc Flash Hazard Analysis Report; signed, dated, and sealed by a qualified professional engineer.

B. Product Data: For computer software program to be used for studies.

C. Qualification Data: For Coordination Study Specialist and Arc-Flash Hazard Analysis Specialist.

D. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399. For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

E. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

1.06 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Qualifications: Comprehensive engineering analysis by qualified Professional Engineer or personnel trained and employed by the equipment manufacturer in required calculation methodology.

1. Analysis to be performed by Professional Engineer or personnel trained, employed, and supervised by a registered Professional Engineer.
2. Registered professional engineer shall be a full-time employee of the electrical equipment manufacturer or a professional engineering firm.
3. Report shall be signed and sealed by a Professional Engineer with current registration.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 1584 for performing Arc Flash Hazard Calculations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved Manufacturers

1. SKM Systems Analysis, Inc.
2. EasyPower, LLC
3. Power Analytics Corporation
4. Or approved equal

2.02 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

A. Comply with IEEE 399 for fault-current and overcurrent protective device coordination studies.

B. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard analysis.

C. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate coordination by computer-generated, time-current coordination plots.

2.03 POWER SYSTEM STUDIES

A. The Electrical Trade Contractor shall request information required to complete the power system studies from the Utility Company. This information shall be provided to the manufacturer upon request.

B. The manufacturer shall make all necessary modifications to the circuit breaker types for a fully coordinate electrical system to comply with the specifications.

C. Short Circuits Studies, Protective Device Evaluation Studies, and Protective Device Coordination Studies shall be provided by the Manufacturer. The studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture. If formal completion of the studies may cause delay in equipment manufacture, approval may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

2.04 POWER SYSTEM DATA

A. The Design System Analyst performing the short-circuit, protective device coordination study, and arc flash hazard analysis shall furnish the Contractor with a list of required data immediately after award of the contract. Contractor shall expedite collection of the data to ensure completion of the study and analysis as required.

B. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

C. Source combination shall include present and future motors and generators indicated in the documents.

D. If applicable, include fault contribution of existing motors in the study and analysis.

E. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

    a. Circuit breakers and fuses ratings and types
    b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, X/R ratios, taps measured in per cent, and phase shift.
d. Generator short-circuit current contribution data, including short-circuit reactance, rated kilovolt amperes, size, rated voltage, and X/R ratio.
e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
f. Busway ampacity, impedance, lengths, and conductor material.
g. Motor horsepower and code letter designation according to NEMA MG 1.
h. Low-voltage cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
i Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.
b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
d. Generator thermal-damage curve.
e. Ratings, types, and settings of utility company's overcurrent protective devices.
f. Special overcurrent protective device settings or types stipulated by utility company.
g. Time-current-characteristic curves of devices.
h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

2.05 SHORT-CIRCUIT STUDY REPORT CONTENT

A. Executive Summary

B. Study descriptions, purpose, basis and scope of the study.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Cable size and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings.
4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center and panelboard designations.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

   a. Voltage.
   b. Calculated symmetrical fault-current magnitude and angle.
   c. Fault-point X/R ratio.
   d. No AC Decrement (NACD) ratio.
   e. Equivalent impedance.
   f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
   g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

F. Incident Energy and Flash Protection Boundary:

1. Calculations:

   a. Arcing fault magnitude.
   b. Protective device clearing time.
   c. Duration of arc.
   d. Arc-flash boundary.
   e. Working distance.
   f. Incident energy.
   g. Hazard risk category.
   h. Recommendations for arc-flash energy reduction.

2. Circuit breakers rated 1200A and higher shall be provided with an Arc flash Reduction Maintenance System for accelerated instantaneous trip to reduce arc flash. The setting shall be determined by the arc flash study and set in the field by the manufacturer's representative.

   a. The pickup setting is chosen using the following steps:

      1) Calculate the arcing fault current that could flow through the circuit breaker associated with the Arc flash Reduction Maintenance System. Formulas from IEEE STD 1584TM-2002 are used to calculate the arcing current.
      2) Determine the total transient load current that can flow to loads fed by the circuit breaker equipped with the Arc flash Reduction Maintenance System. These can include motor inrush and transformer inrush.
      3) Choose a pickup setting for the Arc flash Reduction Maintenance System that is:

         a) Below 75% of calculated arcing current.
         b) Above the total transient load current.

G. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.

H. Equipment specific Arc Flash Warning Labels.

I. Recommendations for system improvements, where needed.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.

1. Proceed with coordination study and arc-flash study only after relevant equipment submittals have been assembled, but prior to their submission to the Architect.
2. Coordination study shall accompany submission of relevant equipment submittals.

3.02 FAULT-CURRENT STUDY

A. A short-circuit current ratings indicated in the Contract Documents are based on Fault-Current study prepared by the Engineer during design and are based on available information and anticipated feeder lengths. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system based on proposed feeder routing. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Electric Utility's supply termination point.
2. Switchgear and switchboard bus.
3. Motor-control center.
4. Distribution panelboard.
5. Branch circuit panelboard.
6. Standby Generators and Transfer Switches.
7. Enclosed Fused Switch.
8. Enclosed Circuit Breaker.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculate short-circuit currents according to IEEE 551.

E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.

1. Transformers, as appropriate for transformers included in the Work:

a. ANSI C57.12.10.
b. ANSI C57.12.22.
c. ANSI C57.12.40.
d. IEEE C57.12.00.
e. IEEE C57.96.

2. Medium-Voltage Circuit Breakers: IEEE C37.010.
3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
4. Low-Voltage Fuses: IEEE C37.46.

F. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

G. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
4. Notify Engineer, in writing, of any existing circuit protective devices improperly rated for the calculated available fault current.

3.03 COORDINATION STUDY

A. Coordination (Selective): Localization of an overcurrent condition to restrict outages to the circuit or equipment affected, accomplished by the selection and installation of overcurrent protective devices and their ratings or settings for the full range of available overcurrents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associated with those overcurrents.

1. Emergency system (Life Safety) overcurrent devices shall be fully selectively coordinated with all supply side overcurrent protective devices (emergency and normal).

B. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

C. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

D. The studies shall include all portions of the electrical distribution system from the normal power source and emergency/standby power sources down to and including the 120/208V distribution system. Normal/emergency/standby system connections and those which result in maximum fault conditions shall be adequately covered in the study.

E. All emergency system overcurrent devices shall be selectively coordinated with the overcurrent devices installed on their supply side per Section 700.27 of the National Electrical Code. The generator circuit breakers shall be of the same manufacturer as the switchboard. Provide a letter from the manufacturer stating that the overcurrent devices have been selectively coordinated.

F. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum ground-fault currents.

G. Comply with IEEE 241 and IEEE 242 recommendations for fault currents and time intervals.

H. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

   a. Inrush current when first energized.
   b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
   c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine

temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

J. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

   a. Device tag.
   b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
   c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
   d. Fuse-current rating and type.
   e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

   a. Device tag.
   b. Voltage and current ratio for curves.
   c. Three-phase and single-phase damage points for each transformer.
   d. No damage, melting, and clearing curves for fuses.
   e. Cable damage curves.
   f. Transformer inrush points.
   g. Maximum fault-current cutoff point.
   h. Motor starting characteristics, damage points and overload relay.
   i. Thermal damage curve for motors larger than 100 HP.
   j. Generator short-circuit decrement curve and damage point, and thermal damage curve.

K. Completed data sheets for setting of overcurrent protective devices.

L. Complete Schedule of breaker settings to summarize information contained on data sheets. Sample schedule has been included at the end of this section for preferred format.

3.04 ARC FLASH HAZARD ANALYSIS

A. Comply with IEEE 1584 for arc flash hazard analysis.

B. Comply with NFPA 70E and its Annex D for hazard analysis study.

C. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system where work could be performed on energized parts including, but not limited to, the following:

1. Disconnect switches.
2. Electrical substations.
3. Electrical switchgear and switchboards.
4. Emergency system boxes and enclosures.
5. Enclosed circuit breakers.
6. Meter Sockets and assemblies.
7. Motor starter.
8. Motor-control centers.
9. Panelboards.
10. Power transfer equipment. (ATS)
11. Transformers.
12. Uninterruptible power supply equipment.

D. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent protection relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

E. Calculate the arc-flash protection boundary and the corresponding incident energy calculations for multiple system scenarios to be compared and the greatest incident energy to be uniquely reported for each equipment location. Calculations to be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions.

1. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off).
2. The maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators to be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible.

G. For each equipment location with a separately enclosed main device, calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

1. When performing incident energy calculations on the line side of a main breaker, the line side and load side contributions must be included in the fault calculation.

H. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device to compute the incident energy for the corresponding location.

I. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash even, a maximum clearing time based on the specific location shall be utilized.

J. Complete Arc Flash report to be used for the preparation of Arc Flash Warning labels for electrical equipment. Refer to Division 26 Section “Identification for Electrical Systems” for requirements of Arc Flash Study and labels.

3.05 CORRECT DEFICIENCIES, RE-CALCULATE AND REPORT

A. After Engineer’s initial review, correct unsatisfactory conditions and recalculate to demonstrate compliance; resubmit overcurrent protective devices as required to bring system into compliance.

B. Revise and Resubmit report multiple times as necessary to demonstrate compliance with requirements.

3.06 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels as specified in Division 26 Section “Identification for Electrical Systems”. Install labels under the direct supervision and control of the Arc-Flash Hazard Study Specialist.

3.07 ARC-FLASH WARNING LABELS

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Produce a 3.5-by-5-inch (76-by-127-mm) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Flash Hazard Boundary.
2. Short Circuit Current Available and date the calculation was performed.
3. Shock Hazard when Cover is Removed.
4. Limited Approach Boundary.
5. Restricted Approach Boundary.
6. Prohibited Approach Boundary.
7. PPE Requirements, including the following:
    a. Hazard Risk Category
    b. Required Minimum Arc Rating of PPE in cal/cm^2
    c. Clothing Description
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.04 SUBMITTALS

A. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Retain first subparagraph below if series rating of overcurrent protective devices is used.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Field quality-control reports.

D. Panelboard schedules for installation in panelboards.

E. Operation and maintenance data.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NEMA PB 1.

C. Comply with NFPA 70.

1.06 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

C. Transient voltage suppression devices: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.
3. Or approved equal.

2.02 BASIS OF DESIGN

A. The system specified is based upon products by Eaton Electrical Inc.; and represents the perforance standard upon which any equivalent solution shall be based.

2.03 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Di vision 26 Section "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface-mounted cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.

a. Main and Neutral Lugs: Mechanical type.

b. Ground Lugs and Bus Configured Terminators: Mechanical type.

c. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

d. Sub feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

1. Series rating shall not be acceptable.

2.04 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

C. Mains: Main circuit breakers in the distribution panelboards shall be Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

D. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

E. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

2.05 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Main circuit breakers in the lighting and appliance branch-circuit panelboards shall be Standard Micrologic (LSI Trip Units) with solid-state trip unit and flux transfer shunt trip. Breakers shall have trip rating plugs with ratings as indicated on the drawings Rating plugs shall be interlocked so they are NOT interchangeable between frames and interlocked such that a breaker cannot be latched with the rating plug removed.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Provide UL listed non-linear rated panels with 200% neutral bus bars and lugs for all 120/208 volt panelboards where fed from K rated transformers. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of the branch circuit devices. Bussing shall be braced throughout to conform to industry standard practice governing short circuit stresses in panelboards. Phase bussing shall be full height without reduction.

E. When called for, supply Surge Protective Device (SPD) units in accordance with SPD specification section here within.

F. Contactors can be incorporated to switch the entire panelboard or only a portion of the circuits. Coordinate with Drawings and schedules to indicate contactor connections, type, quantity of circuits controlled, current ratings, external control circuits, and number of poles. Consult manufacturers for their respective limitations on and availability of short-circuit ratings and electrically held contactors, which may not be available from all manufacturers.

G. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

H. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

I. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.06 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads,

and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
4. Instantaneous trip.
5. Long- and short-time pickup levels.
6. Long- and short-time time adjustments.
7. Ground-fault pickup level, time delay, and I2t response.
8. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
9. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
10. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
11. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
12. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.

    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

    e. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."

    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

    g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Portable Test Set: For testing functions of solid-state trip devices without removing from panel board. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

2.08 FUSIBLE BRANCH CIRCUIT PANELBOARDS (FBCP)

A. Summary
   1. Furnish and install fusible branch circuit panelboards for the life safety branch of the emer gency electrical system.

B. System Description

1. The panelboards shall be UL and cULus Listed.
2. Selective Coordination: Panelboards overcurrent protective devices shall be selectively co ordinated with all supply side (fed from both the normal and emergency source) Eaton's Bussmann series Low-Peak™ LPJ_SP, TCF_, LPN-RK_SP/LPS-RK_SP or KRP-C_SP fus es sized at a minimum amp ratio of 2:1.

C. Basis of Design

1. Fusible Panelboards shall be Eaton's Bussmann series Quik-Spec™ Coordination Panel boards type QSCP.

D. Panelboard Ratings

1. Panelboards shall be UL Listed with a labeled short-circuit current rating equal to or greater than that indicated on the associated schedules or drawings.
2. Panelboards shall be rated 600Vac/125Vdc but marked for actual system voltage.
3. Provide Main lug only, main fused switch or main non-fused switch as indicated in the associated schedules or drawings.
4. Provide branch circuits as indicated in the associated schedules or drawings.
5. Branch circuits must be interchangeable with fusible switches from 15A to 100A without additional required space.
6. Panelboard branch circuits shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component (1 pole, 2 pole or 3 pole) that prevents removal of the fuse while energized, provides open fuse indication, and fuse ampere rating rejection feature at 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A, and 100A. Provide open fuse indication on the branch circuit fuses where indicated in the associated schedules or drawings.
7. Provide Time-Delay Indicating Fast-Acting Class CF fuses for branch circuits.
8. Bus bars shall be tin-plated copper.
9. Neutral and equipment ground bar (isolated or non-isolated) shall be provided where indicated in the associated schedules or drawings.
10. Panelboard trim shall be door-in-door type.
11. Panelboard enclosure shall be of type indicated in the associated schedules or drawings.
12. Boxes shall be a nominal 20 inches wide and 5-¾ inches deep
13. Panelboard shall be equipped with a spare branch circuit fuse holder and spare fuses (10% of fuse for each ampacity installed in branch circuits).
14. Panelboard shall be equipped with an integral Surge Protective Device, compliant with UL 1449 4th Edition. SPD shall include remote signaling contact.

E. Construction

1. Panelboard circuits 100A and less shall incorporate overcurrent protection and branch-circuit rated disconnecting means into a single integrated component.
2. Interiors shall be factory assembled.
3. Panelboard shall be equipped with a six-space spare fuse compartment for storing replacement branch circuit fuses. Spare fuse compartment shall be located behind locking panel door.

4. Bus bars shall be tin-plated copper with sufficient cross-sectional area to meet UL 67 temperature rise requirements.
5. 200A/400A rated neutrals shall be standard, 400A or 800A rated neutral shall be provided where indicated in the associated schedules or drawings.
6. Bonded neutral shall be provided where specified in associated drawings.
7. Isolated or non-isolated equipment ground bar shall be provided as indicated in the associated schedules or drawings.
8. Where a service-entrance rated panelboard is indicated in associated schedules or drawings, a bonded neutral and non-isolated equipment ground bar shall be provided by the manufacturer.
9. Main lug conductor terminations:
10. MLO terminations shall be rated for 60/75°C, Cu-Al
11. Main disconnect terminations shall be rated for 75°C, Cu Only
12. NEMA 1 panelboards shall be field convertible for top or bottom incoming feed. NEMA 3R panelboards are bottom feed only.

F. Main Disconnect

1. Permanently installed lockout means shall be provided on the main disconnect for lockout tagout procedures.
2. Main disconnect shall be quick-make, quick-break type.

G. Branch Fused Disconnects

1. Device shall have visible circuit ON/OFF indication with colored and international symbol markings.
2. Device shall provide open fuse indication via permanently installed indicating light.
3. Device shall be UL and cUL Listed 600Vac/200kA or 125Vdc/100kA voltage/short-circuit current rating, load-break disconnect with amp ratings and number of poles as indicated on the panelboard schedule.
4. Fuse and disconnect assembly shall be a finger-safe component with trim installed.
5. Fuse and disconnect shall be mechanically interlocked so as not to allow fuse removal while fuse terminals are energized.
6. No special tools shall be required for fuse removal.
7. Devices shall have bolt-on style bus connectors.
8. Device housing shall be clearly marked with device amperage.
9. Permanently installed lockout means shall be provided on the device for lockout tagout procedures. Permanently installed means for locking device in the ON position shall also be available.
10. Device shall provide fuse amp rating rejection at the following ampacities to ensure continued circuit protection at the specified circuit rating: 15A, 20A, 30A, 40A, 50A, 60A, 70A, 90A & 100A.

H. Main & Branch Overcurrent Protection

1. All overcurrent protective devices shall have a minimum UL Listed interrupting rating of 300kA and CSA Certified interrupting rating of 200kA.
2. Branch circuit overcurrent protection shall be 600Vac UL Listed minimum 300kA IR and CSA Certified minimum 200kA IR finger-safe fuse with Class CF (equivalent to Class J) performance characteristics.
3. Main overcurrent protective devices shall be 600Vac UL Listed minimum 300kA IR and

CSA Certified minimum 200kA IR Class J fuses or Class CF (equivalent to Class J) performance fuses.

4. Where panelboard main fuses are installed, fuses in panelboard branch circuits shall selectively coordinate with main fuses for all overcurrents up to 200kA.

I. Enclosure

1. NEMA 1 enclosures shall be surface or flush mount as indicated in associated schedules or drawings. NEMA 3R enclosures shall be surface mount only.
2. Boxes shall be a nominal 20 inches wide and 5-¾ inches deep (NEMA 1) or 6.3" (NEMA 3R) with wire bending space per the National Electrical Code®.
3. Panelboard trim shall be supplied with lockable door covering all disconnect handles.
4. Panelboard trim shall be dead-front construction covering all energized parts.
5. Enclosures shall be NEMA Type 1 or Type 3R as indicated in associated schedules or drawings.
6. Door-in-door type trim shall be provided for NEMA 1 enclosures where it is specified in the associated schedules or drawings.
7. Front trim shall be lockable. All lock assemblies shall be keyed alike with like NEMA rated enclosures.

J. Integral Surge Protection

1. Panelboard should include an integral UL 1449 4th Edition Recognized Type 2 Component Assembly.
2. SPD status monitoring shall be provided by local visual indication and, if needed, by remote contact signaling using an optional Form C contact relay.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Referenced NECA and NEMA standards in first paragraph below include similar requirements. See "Testing and Inspecting" Article in the Evaluations. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

E. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

I. Comply with NECA 1.

3.02 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.03 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 COMMISSIONING

A. Comply with requirements specified in Division 1.

B. Engage a factory-authorized service representative to supervise and assist with startup service. Complete installation and startup checks according to the approved manufacturer's written instructions.

3.05 TRAINING AND SERVICE

A. Comply with Section 26 00 00.

B. Conduct two 4-hour training sessions. Train the Owner’s maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 GENERAL PROVISIONS

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

1.02 SUMMARY

A. This Section includes the following:

1. Receptacle Outlets.
2. Switches.
3. Wall Plates.
4. Contactors.
5. NEMA 3R Enclosures
6. Handholes.
7. Conductors and Cables.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.05 WARRANTY

A. Comply with Section 260001.

B. The Electrical Trade Contractor shall warranty that all materials furnished shall be free from defects of material for a period of one year from the date of Substantial Completion.

PART 2 - PRODUCTS

2.01 WIRING DEVICES

A. Manufacturers

1. Legrand; Wiring Devices & Accessories (Legrand).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Or approved equal.

2.02 BASIS OF DESIGN

A. Basis of design based upon products by Legrand.

2.03 RECEPTACLE OUTLETS

A. General: All receptacle outlets shall be tamper-resistant.

B. Weather-Resistant Convenience Receptacles, 125V, 20A: Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL498 and Federal Specification W-C-596. Prewired pigtail connectors that accommodate Fed Spec receptacles are approved. Must be crimped and welded terminal right-angle application connector.

1. Pass & Seymour: WR5362.

2. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable while-in-use cover.

   a. Hubbell: MX3200 single gang

   b. Hubbell: MX6200 dual gang

2.04 SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Pass & Seymour; CSB20AC1 (single pole), PT20AC1 (single pole – use with PTS6STR3 prewired pigtail connector), CSB20AC2 (two pole), CSB20AC3 (three way), PT20AC3 (three way – use with PTS6STR4 prewired pigtail connector), CSB20AC4 (four way).

C. Finishes

1. Color by Architect.

2.05 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as shown on the drawings.

B. Verify that outlet boxes are installed in proper locations and at the proper heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean dirt, debris, plaster, and other foreign material from outlet boxes.

3.03 INSTALLATION

A. Perform work in a neat and workmanship manner in accordance with NECA 1 and where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

C. Coordination with Other Trades:

1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pigtail or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pig-tailing existing conductors is permitted provided the outlet box is large enough.

E. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

3.04 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.05 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

END OF SECTION

SECTION 26 56 68
EXTERIOR ATHLETIC LIGHTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. New Lighting System with LED Light Source

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 26 00 00 – Electrical
B. Section 32 12 16 – Bituminous Concrete
C. Section 03 30 53 – Cast-in-Place Concrete

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. American Society of Civil Engineers – ASCE
2. American Association of State Highway and Transportation Officials - AASHTO
3. American Society for Testing & Materials – ASTM
4. International Building Code – IBC
5. Illuminating Engineering Society of North America - IESNA
6. Institute of Electrical & Electronics Engineers - IEEE
7. International Organization for Standardization – ISO
8. National Fire Protection Association - NFPA
9. Underwriter's Laboratories, Inc. - UL

1.04 SUMMARY

A. Work covered by this section of the specifications shall conform to the contract documents, engineering plans, as well as state and local codes.

B. The purpose of these specifications is to define the lighting system performance and design standards for the Mulcahy Field lighting project using an LED lighting source. The manufacturer / contractor shall supply lighting equipment to meet or exceed the standards set forth in these specifications.

C. Lighting shall be for the following venues:

1. Basketball
2. Security

D. The primary goals of this sports lighting project are:

1. Guaranteed Light Levels: Selection of appropriate light levels impact the safety of the players and the enjoyment of spectators. Therefore light levels are guaranteed to not drop below specified target values for a period of 25 years.
2. Environmental Light Control: It is the primary goal of this project to minimize spill light to adjoining properties and glare to the players, spectators and neighbors.
3. Control and Monitoring: To allow for optimized use of labor resources and avoid unneeded operation of the facility, customer requires a remote on/off control system for the lighting system. Fields shall be proactively monitored to detect luminaire outages over a 25-year life cycle. All communication and monitoring costs for 25-year period shall be included in the bid.

E. All manufacturers, regardless of approval, must demonstrate that they meet all performance and quality specifications as outlined herein. Systems that do not meet all the performance and quality specifications specified herein shall not be accepted.

1.05 SUBMITTALS

A. Complete bill of material and current brochures/cut sheets for all products being provided. Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number.

B. Drawing(s) showing field layouts with pole locations.

C. Lighting design drawing(s) showing:
4. Field Name, date, file number, prepared by
5. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified
6. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics
7. Height of light test meter above field surface.
8. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
9. Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals and 3-feet above grade along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
10. Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5

years experience. Ball Tracking luminaries are excluded from this qualification.

D. Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.

E. Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar, and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a structural engineer in the state of Massachusetts, if required by owner.

F. Test borings were conducted for general assessment and are published in volume 4 appendices, Appendix A, Geotechnical report. Test boring locations are shown on the published existing conditions drawings, grading is shown on the civil drawings. This Trade contractor/vendor to review the published information for the design criteria and the pole design (the front poles are in fill) rock should be anticipated based on the borings/test pits and excavations and be included in the design. Should ledge as defined under sections 31 20 00 be encountered, contractual adjustments for excavations only. Should the contractor deem test borings are required based on the above information, the cost to be included in the bid price.

G. Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system.

H. Provide written warranty information including all terms and conditions.

I. Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Massachusetts. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.

J. Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.

K. Manufacturer shall list all items that do not comply with the specifications.

1.06 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed and field measurements taken on the grid spacing with the minimum number of grid points specified below. Appropriate light loss factors shall be applied and submitted for the basis of design. Average illumination level shall be measured in accordance with the IESNA LM-5-04 (IESNA Guide for Photometric Measurements of Area and Sports Lighting Installations). Illumination levels shall not to drop below desired target values in accordance to IES RP-6-15, Page 2, Maintained Average Illuminance and shall be guaranteed for the full warranty period.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Basketball	28FC	2:1	50	10’ x 10’
Walkway	5FC	15:1	495	5’ x 5’

NOTE: Each pole shall have (1) OSQ luminaire mounted at 15’ on a separate security zone

B. Color: The lighting system shall have a minimum color temperature of 5700K and a CRI of 75.

C. Mounting Heights: To ensure proper aiming angles for reduced glare and to provide better playability, minimum mounting heights shall be as described below. Higher mounting heights may be required based on photometric report and ability to ensure the top of the field angle is a minimum of 10 degrees below horizontal.

# of Poles	Pole Designation	Pole Height
2	P1 & P2	40’

1.07 ENVIRONMENTAL LIGHT CONTROL

A. Light Control Luminaires: All luminaires shall utilize spill light and glare control devices including, but not limited to, internal shields, louvers and external shields. No symmetrical beam patterns are accepted.

PART 2 - PRODUCTS

2.01 SPORTS LIGHTING SYSTEM CONSTRUCTION

A. Manufacturing Requirements: All components shall be designed and manufactured as a system. All luminaires, wire harnesses, drivers and other enclosures shall be factory assembled, aimed, wired and tested.

B. Durability: All exposed components shall be constructed of corrosion resistant material and/or coated to help prevent corrosion. All exposed carbon steel shall be hot dip galvanized per ASTM A123. All exposed aluminum shall be powder coated with high performance polyester or anodized. All exterior reflective inserts shall be anodized, coated, and protected from direct environmental exposure to prevent reflective degradation or corrosion. All exposed hardware and fasteners shall be stainless steel of 18-8 grade or better, passivated and coated with aluminum-based thermosetting epoxy resin for protection against corrosion and stress corrosion cracking. Structural fasteners may be carbon steel and galvanized meeting ASTM A153 and ISO/EN 1461 (for hot dipped galvanizing), or ASTM B695 (for mechanical galvanizing). All wiring shall be enclosed within the cross-arms, pole, or electrical components enclosure.

C. System Description: Lighting system shall consist of the following:

1. Galvanized steel poles and cross-arm assembly
2. Non-approved pole technology:

a. Square static cast concrete poles will not be accepted.

b. Direct bury steel poles which utilize the extended portion of the steel shaft for their foundation will not be accepted due to potential for internal and external corrosive reaction to the soils and long term performance concerns.

3. Lighting systems shall use concrete foundations. See 2.04 for details.

   a. For a foundation using a pre-stressed concrete base embedded in concrete backfill the concrete shall be air-entrained and have a minimum compressive design strength at 28 days of 3,000 PSI. 3,000 PSI concrete specified for early pole erection, actual required minimum allowable concrete strength is 1,000 PSI. All piers and concrete backfill shall bear on and against firm undisturbed soil.

   b. For anchor bolt foundations or foundations using a pre-stressed concrete base in a suspended pier or reinforced pier design, pole erection may occur after 7 days, or after a concrete sample from the same batch achieves a certain strength.

4. Manufacturer shall supply all drivers and supporting electrical equipment.

   a. Remote drivers and supporting electrical equipment shall be mounted approximately 10 feet above grade in aluminum enclosures. The enclosures shall be touch-safe and include drivers and fusing with indicator lights on fuses to notify when a fuse is to be replaced for each luminaire. Disconnect per circuit for each pole structure shall be located in the enclosure. Integral drivers are not allowed.

   b. Manufacturer shall provide surge protection at the pole equal to or greater than 40 kA for each line to ground (Common Mode) as recommended by IEEE C62.41.2_2002.

5. Wire harness shall be complete with an abrasion protection sleeve, strain relief and plug-in connections for fast, trouble-free installation.

6. All luminaires, visors, and cross-arm assemblies shall withstand 150 mph winds and maintain luminaire aiming alignment.

7. Control cabinet shall provide remote on-off control, monitoring, and entertainment features of the lighting system. See 2.03 for further details.

8. Contactor cabinet shall provide on-off control.

9. Manufacturer shall provide lightning grounding as defined by NFPA 780 and be UL Listed per UL 96 and UL 96A.

   a. Integrated grounding shall be via concrete encased electrode grounding system.

   b. If grounding is not integrated into the structure, the manufacturer shall supply grounding electrodes, copper down conductors, and exothermic weld kits. Electrodes and conductors shall be sized as required by NFPA 780. The grounding electrode shall be minimum size of 5/8 inch diameter and 8 feet long, with a minimum of 10 feet embedment. Grounding electrode shall be connected to the structure by a grounding electrode conductor with a minimum size of 2 AWG for poles with 75 feet mounting height or less, and 2/0 AWG for poles with more than 75 feet mounting height.

D. System Description: Security lighting system shall consist of the following:

1. Approved technology: Musco's CREE product. No other distributors will be considered
2. LED-high bay light capable of a direct mount. High bay fixture shall have CRI of 70 and a color temperature of 5700k

E. Safety: All system components shall be UL listed for the appropriate application

2.02 ELECTRICAL

A. Electric Power Requirements for the Sports Lighting Equipment:

1. Electric power: 120/240 Volt, 1 Phase
2. Maximum total voltage drop: Voltage drop to the disconnect switch located on the poles shall not exceed three (3) percent of the rated voltage.

B. Energy Consumption: The kW consumption for the field lighting system shall be 41kW or less.

2.03 CONTROL

A. Instant On/Off Capabilities: System shall provide for instant on/off of luminaires.

B. Lighting contactor cabinet(s) constructed of NEMA Type 4 aluminum, designed for easy installation with contactors, labeled to match field diagrams and electrical design. Manual off-on-auto selector switches shall be provided.

C. Remote Lighting Control System: System shall allow owner and users with a security code to schedule on/off system operation via a web site, phone, fax or email up to ten years in advance. Manufacturer shall provide and maintain a two-way TCP/IP communication link. Trained staff shall be available 24/7 to provide scheduling support and assist with reporting needs.

D. The Owner may assign various security levels to schedulers by function and/or fields. This function shall be flexible to allow a range of privileges such as full scheduling capabilities for all fields to only having permission to execute "early off" commands by phone. Scheduling tool shall be capable of setting curfew limits.

E. Controller shall accept and store 7-day schedules, be protected against memory loss during power outages, and shall reboot once power is regained and execute any commands that would have occurred during outage.

F. Remote Monitoring System: System shall monitor lighting performance and notify manufacturer if individual luminaire outage is detected so that appropriate maintenance can be scheduled. The controller shall determine switch position (manual or auto) and contactor status (open or closed).

G. Management Tools: Manufacturer shall provide a web-based database and dashboard tool of actual field usage and provide reports by facility and user group. Dashboard shall also show current status of luminaire outages, control operation and service. Mobile application shall be provided suitable for IOS, Android, and Blackberry devices.

Hours of Usage: Manufacturer shall provide a means of tracking actual hours of usage for

the field lighting system that is readily accessible to the owner.

1. Cumulative hours: shall be tracked to show the total hours used by the facility
2. Report hours saved by using early off and push buttons by users.

H. Communication Costs: Manufacturer shall include communication costs for operating the control and monitoring system for a period of 25 years.

I. Communication with luminaire drivers: Control system shall interface with drivers in electrical components enclosures by means of powerline communication.

2.04 STRUCTURAL PARAMETERS

A. Wind Loads: Wind loads shall be based on the 2015 International Building Code. Wind loads to be calculated using ASCE 7-10, an ultimate design wind speed of 130 mph and exposure category C.

B. Pole Structural Design: The stress analysis and safety factor of the poles shall conform to 2013 AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaires, and Traffic Signals (LTS-6).

C. Foundation Design: The foundation design shall be based on soil parameters as outlined in the geotechnical report. If no geotechnical report is available, the foundation design shall be based on soils that meet or exceed those of a Class 5 material as defined by 2015 IBC Table 1806.2.

D. Foundation Drawings: Project specific foundation drawings stamped by an engineer licensed in Massachusetts are required. The foundation drawings shall list the moment, shear (horizontal) force, and axial (vertical) force at ground level for each pole. These drawings shall be submitted at time of bid to allow for accurate pricing.

PART 3 - EXECUTION

3.01 SOIL QUALITY CONTROL

A. It shall be the Contractor's responsibility to notify the Owner if soil conditions exist other than those on which the foundation design is based, or if the soil cannot be readily excavated. Contractor may issue a change order request / estimate for the Owner's approval / payment for additional costs associated with:

1. Providing engineered foundation embedment design by a registered engineer in the State of Massachusetts for soils other than specified soil conditions;
2. Additional materials required to achieve alternate foundation;
3. Excavation and removal of materials other than normal soils, such as rock, caliche, etc.

3.02 DELIVERY TIMING

A. Delivery Timing Equipment On-Site: The equipment shall be on-site 6-8 weeks from receipt of approved submittals and receipt of complete order information.

3.03 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with IESNA LM-5-04.

B. Field Light Level Accountability

1. Light levels shall be guaranteed not to fall below the target maintained light levels for the entire warranty period of 25 years. These levels shall be specifically stated as "guaranteed" on the illumination summary provided by the manufacturer.

2. The contractor/manufacturer shall be responsible for conducting initial light level testing and an additional inspection of the system, in the presence of the owner, one year from the date of commissioning of the lighting.

3. The contractor/manufacturer will be held responsible for any and all changes needed to bring these fields back to compliance for light levels and uniformities. Contractor/Manufacturer will be held responsible for any damage to the fields during these repairs.

C. Correcting Non-Conformance: If, in the opinion of the Owner's Representative, the actual performance levels including footcandles and uniformity ratios are not in conformance with the requirements of the performance specifications and submitted information, the Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.04 WARRANTY AND GUARANTEE

A. 25-Year Warranty: Each manufacturer shall supply a signed warranty covering the entire system for 25 years from the date of shipment. Warranty shall guarantee specified light levels. Manufacturer shall maintain specifically-funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover weather conditions events such as lightning or hail damage, improper installation, vandalism or abuse, unauthorized repairs or alterations, or product made by other manufacturers.

B. Maintenance: Manufacturer shall monitor the performance of the lighting system, including on/off status, hours of usage and luminaire outage for 25 years from the date of equipment shipment. Parts and labor shall be covered such that individual luminaire outages will be repaired when the usage of any field is materially impacted. Manufacturer is responsible for removal and replacement of failed luminaires, including all parts, labor, shipping, and equipment rental associated with maintenance. Owner agrees to check fuses in the event of a luminaire outage.

3.05 TRAINING AND SERVICE

A. Comply with Section 26 00 01.

B. Conduct four 4-hour training sessions. Train the Owner's maintenance personnel on procedures and schedules related to start up and shutdown, troubleshooting, servicing, and preventive maintenance.

C. Required submittal information for all manufacturers:

All items listed below are mandatory, shall comply with the specification. Complete the Yes/No column to indicate compliance (Y) or noncompliance (N) for each item. Submit checklist below with submittal.

Yes / No	Tab	Item	Description
	A	Letter/ Checklist	Listing of all information being submitted must be included on the table of contents. List the name of the manufacturer's local representative and his/her phone number. Signed submittal checklist to be included.
	B	Equipment Layout	Drawing(s) showing field layouts with pole locations
	C	On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, as well as pole locations referenced to the center of the field (x & y), Illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), coefficient of utilization (CU) uniformity gradient; number of luminaries, total kilowatts, average tilt factor; light loss factor.
	D	Off Field Lighting Design	Lighting design drawing showing initial spill light levels along the boundary line (defined on bid drawings) in footcandles. Lighting design showing glare along the boundary line in candela. Light levels shall be taken at 30-foot intervals along the boundary line. Readings shall be taken with the meter orientation at both horizontal and aimed towards the most intense bank of lights.
	E	Photometric Report	Provide first page of photometric report for all luminaire types being proposed showing candela tabulations as defined by IESNA Publication LM-35-02. Photometric data shall be certified by laboratory with current National Voluntary Laboratory Accreditation Program or an independent testing facility with over 5 years experience.
	F	Performance Guarantee	Provide performance guarantee including a written commitment to undertake all corrections required to meet the performance requirements noted in these specifications at no expense to the owner. Light levels must be guaranteed to not fall below target levels for warranty period.
	G	Structural Calculations	Pole structural calculations and foundation design showing foundation shape, depth backfill requirements, rebar and anchor bolts (if required). Pole base reaction forces shall be shown on the foundation drawing along with soil bearing pressures. Design must be stamped by a

			structural engineer in the state of Massachusetts, if required by owner. (May be supplied upon award).
	H	Control & Monitoring System	Manufacturer of the control and monitoring system shall provide written definition and schematics for automated control system. They will also provide ten (10) references of customers currently using proposed system in the state of Massachusetts.
	J	Warranty	Provide written warranty information including all terms and conditions. Provide ten (10) references of customers currently under specified warranty in the state of Massachusetts.
	K	Project References	Manufacturer to provide a list of ten (10) projects where the technology and specific fixture proposed for this project has been installed in the state of Massachusetts. Reference list will include project name, project city, installation date, and if requested, contact name and contact phone number.
	L	Product Information	Complete bill of material and current brochures/cut sheets for all product being provided.
	M	Delivery	Manufacturer shall supply an expected delivery timeframe from receipt of approved submittals and complete order information.
	N	Non-Compliance	Manufacturer shall list all items that do not comply with the specifications. If in full compliance, tab may be omitted.

END OF SECTION

SECTION 31 23 10
EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Excavation of all existing material for site improvements to the depth required in the plans and specifications to meet the required lines and grades.

2. Providing, placing, and compacting ordinary borrow for site improvements specified herein and/or indicated within the Drawings.

3. Providing, placing, and compacting all other specified borrow materials at locations specified herein and/or indicated within the Drawings.

4. Compaction of all disturbed and undisturbed surfaces which are to receive new foundations, footings, slabs, and other load-bearing elements, to ensure against any weak areas in the substrate.

5. Performing all operations and providing such equipment as necessary to maintain excavated areas free from water from any source whatsoever and to avoid the disturbance of the subgrade.

6. Installation of sheeting, shoring, and bracing; and protection of adjacent properties, streets utilities and structures as may be required due to the earthwork performed.

7. Rough and fine grading.

8. Dust control.

9. Removal and disposal of excavated fill and other waste materials

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 02 41 13 – Site Preparation and Demolition
B. Section 31 25 00 – Erosion and Sedimentation Controls
C. Section 32 91 13 – Loam
D. Project Special Conditions

1.03 DEFINITIONS

A. Excavation consists of the removal of material encountered to sub-grade elevations and the reuse or disposal of materials excavated.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Owner's Representative. Unauthorized excavation, as well as remedial work directed by the Owner's Representative, shall be at Contractor's expense.

1. The Contractor shall backfill and compact unauthorized excavations with structural fill as specified for authorized excavations, unless otherwise directed by the Owner's Representative.

C. Additional Excavation consists of the removal of material as directed by the Owner's Representative beyond the required subgrade that is determined as unsuitable. The Contractor shall continue excavation until suitable bearing materials are encountered. If unsuitable materials are removed that aren't indicated on the Drawings, the Contract Sum shall be adjusted by an appropriate Contract Modification. The following constitute unsuitable materials:

1. All peat, organic soil, or soil containing sod, roots, or any other material subject to decomposition or decay.

2. All soft, spongy or compressible soil, including, but not limited to, silt and loose fine sand.

3. All buried building material, which may include but is not limited to the following:

a. Concrete rubble
b. Re-bars
c. Asphalt
d. Electrical materials and debris
e. Wood
f. Brick, block, tile (ceramic/quarry)
g. Pipe
h. Ashes
i. Metal pieces/parts
j. Insulation

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular sub-base.

E. Structure: Foundations, footings, slabs, or other man-made stationary features occurring above or below ground surface.

F. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.

1.04 SUBMITTALS

A. Test Reports: The Contractor shall submit the following test reports directly to the Owner's Representative from the testing services.

1. Test reports on borrow material, in accordance with 1.05 below

2. Test reports on sub-base material, in accordance with 1.05 below

3. Chemical testing for imported borrow materials, in accordance with 1.05 below

B. Proposed Disposal Facilities: The Contractor shall provide a submittal with proposed disposal facilities for contaminated soil for approval by the Owner's Representative.

1.05 QUALITY ASSURANCE

A. Codes and Standards: The Contractor shall perform earthwork complying with all local and state regulations, laws, and ordinances and with requirements of authorities having jurisdiction.

B. Testing and Inspection Services: The Contractor shall coordinate and submit all tests as specified herein.

1. Owner's Responsibility: The Owner has employed a qualified environmental professional to perform the following services:

a. Conduct a subsurface investigation to pre-characterize soil from the site for disposal. Copies of each of the two summary reports prepared by BETA Group, Inc. (dated 12-23-25 and 12-9-24) are included in the bid/specifications package.
b. Prepare waste profiles and shipping documentation for each respective licensed off-site licensed disposal facility proposed by the Contractor for disposal of contaminated soil.
c. Oversee the excavation and handling of soil in accordance with the contract documents.

2. Contractor's Responsibility: The Contractor shall employ a qualified environmental professional and a qualified geotechnical testing agency, both approved by the Owner, to verify that soils comply with specified geotechnical requirements and to perform required testing of imported soils for contamination as follows.

a. Geotechnical field work and testing (described in further detail under "Field Quality Control" in Part 3 of this Specification Section):

1) Field in-place density tests
2) Optimum moisture-maximum density curve for each type of soil encountered
3) Bearing tests
4) Test reports on borrow material
5) Test reports on sub-base material

6) Re-testing of all tests which are found in non-compliance to the Specifications.

b. Testing imported soil for contamination:

1) Chemical testing for imported borrow and sub-base materials completed at a frequency of one sample per 2,000 cubic yards. Analytical parameters shall include Massachusetts Contingency Plan (MCP) 14 metals, Per- and polyfluoroalkyl substances (PFAS) using Environmental Protection Agency (EPA) method 1633, EPA method 8270, EPA method 8260, EPA method 8081, EPA Method 8151, EPA Method 8082, pH, flashpoint, reactive cyanide and sulfide.

1.06 PROJECT CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions both surface and sub-surface before submitting their bid, and shall be fully 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 additional compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed. The Owner shall not be responsible for interpretations or conclusions drawn from data or interpretations by the Contractor.

1. Additional test borings (other than those required herein) and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Existing Utilities

1. All locations of existing utilities shown on the plan have been developed from existing utility records and/or above ground inspection of the site. Completeness or accuracy of locations or depth of underground utility or structures cannot be guaranteed. The Contractor shall verify the location and depth of all underground utilities or structures prior to the start of work.

2. The Contractor shall locate all existing underground utilities in areas of excavation work. They shall disconnect, seal and/or protect, as required, all existing utilities, including but not limited, to water, gas, sewerage, storm, electrical, and telephone in accordance with the regulations concerned. If utilities are indicated to remain in place, the Contractor shall provide adequate means of support and protection during earthwork operations.

a. The Contractor shall be responsible for all on-site coordination with utility companies and public agencies and for obtaining all required permits and paying all required fees. In accordance with M.G.L., Chapter 82, Section 40, including amendments; the Contractor shall notify all utility companies and government agencies in writing prior to such excavation, (exclusive of Saturday, Sundays and Holidays). The Contractor shall also call "Dig Safe" at 1(888) 344-7233 no less than 72 hours prior to such excavation.

b. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, the Contractor shall consult utility owner immediately for directions. The Contractor shall cooperate with Owner and utility companies in keeping respective services and facilities in operation. The Contractor shall repair damaged utilities to satisfaction of utility owner.

c. The Contractor shall not interrupt existing utilities servicing facilities occupied by Owner or others, during occupied hours, except when permitted in writing by the Owner's Representative and then only after acceptable temporary utility services have been provided.

d. The Contractor shall provide a minimum of forty-eight (48) hours' notice to the Owner's Representative, and receive a written notice to proceed, before interrupting any utility.

e. The Contractor shall place markers to indicate location of disconnected services. The Contractor shall also identify service lines and capping locations on Project Record Documents.

C. Use of Explosives: Use of explosives is not permitted.

D. Protection of Persons and Property:

1. The Contractor shall barricade open excavations occurring as part of this work and post with warning lights. They shall operate the warning lights as recommended by authorities having jurisdiction.

2. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

3. The Contractor shall perform excavation by hand within drip line of large trees to remain. They shall protect root systems from damage or dry-out to the greatest extent possible. They shall maintain moist conditions for root system and cover exposed roots with moistened burlap.

E. Adjoining Properties: No construction work, temporary or permanent, shall take place on adjoining properties. The Contractor shall be fully responsible for monitoring and maintaining that no construction activities trespass onto adjoining properties for the duration of the Contract.

1.07 BENCH MARKS, LINES, AND GRADES

A. The Contractor shall engage a professional land surveyor, registered in the Commonwealth of Massachusetts, and submit the name, address and registration number of such persons to the Owner's Representative for approval to perform the following work:

1. Furnish all stakes, pins, and grade markings, and lay out all lines and grade work, required to implement the work in accordance with Drawings.

2. Establish permanent bench marks, maintain all established bounds and bench marks, and replace as directed any which are destroyed or disturbed.

3. Establish all lines and vertical and horizontal alignment grades for the work and verify all locations, property lines, work lines, and other dimensioned points indicated on the Drawings for the existing site.

4. Submit to the Owner's Representative a written confirmation of locations of all lines, and any discrepancies between conditions and locations as they actually exist and those indicated on the Drawings. Such confirmation shall bear the surveyor's registration stamp.

B. The Contractor shall inform the Owner's Representative when the general layout is completed and shall not begin excavation until the various alignments are approved. Any discrepancies encountered in field conditions shall be reported to the Owner's representative immediately.

1.08 WORK IN THE PUBLIC WAYS

A. The Contractor shall notify the appropriate municipal officials at least seven (7) calendar days in advance of commencing any work in the public ways. The Contractor shall pay for and obtain all required permission and permits to perform this work. The Contractor shall perform all work in the public ways in a manner required by the municipal authorities.

B. Should there be any conflict between requirements specified in the Contract Documents and those of the municipal authorities, the municipal requirements shall govern.

C. The Contractor shall not close or obstruct any streets or sidewalks unless and until they have been discontinued by the appropriate municipal authority or unless and until the Contractor has first secured all necessary or other permits therefor. No materials whatsoever shall be placed or stored in the streets. The Contractor shall conduct all operations to interfere as little as possible with the use ordinarily made of roads, driveways, sidewalks, or other facilities near enough to the work to be affected thereby.

D. The Contractor's attention is directed to the fact that the work on this project is to be performed in areas which are utilized by pedestrians as well as by vehicles. The Contractor shall be responsible for the installation of adequate precautions and other safety measures and controls deemed necessary by the authorities having jurisdiction, for the general public, and for their own personnel.

1. The Contractor shall without additional compensation be required to provide safe and convenient access during the execution of the work. Necessary areas for fire apparatus and other emergency vehicles shall be maintained at all times.

1.09 CODES AND STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Standard Specifications and Details: City of Worcester, Public Works and Parks Department

2. Standard Specifications: Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, supplemental specifications latest edition.

3. AASHTO: American Association of State Highway and Transportation Officials, latest edition.

4. ASTM: American Society of Testing and Materials, latest edition.

5. ADA: Americans with Disabilities Act, latest edition.

6. ABB: Architectural Barriers Board, Commonwealth of Massachusetts Regulation Chapter 521 CMR, latest edition.

1.10 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Compacted Gravel Borrow: See Project Special Conditions.

B. Ordinary Borrow shall be well graded, natural inorganic soil, approved by the Owner's Representative and meeting the following requirements:

1. It shall be free of organic or other weak or compressible materials, of frozen materials, and of stones larger than six (6) inches maximum dimension.

2. It shall be of such nature and character that it can be compacted to the specified densities.

3. It shall be free from highly plastic clays, from all materials subject to decay, decomposition, or dissolution and from cinders or other material which will corrode piping or other metal.

4. It shall have maximum dry density of not less than one hundred (100) pounds per cubic foot.

5. Material from excavation on the site may be used as ordinary fill if it meets the above requirements and is approved by the Owner's Representative.

C. Loam for turf and planting areas: See Section 32 91 13 – Loam

D. Excavated Materials: For areas that will not be paved, excavated soil that exceeds a contamination level of RSC-1 (in accordance with report(s) by BETA Group, Inc. included in the bid/specifications package) may be used as fill, provided it is covered with at least three feet of clean fill material. For areas to receive pavement, soil that exceeds RCS-1 may be used for fill up to the subgrade.

PART 3 - EXECUTION

3.01 PREPARATION

A. The Contractor shall protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. The Contractor shall protect sub-grades and foundation soils against freezing temperatures or frost. They shall provide protective insulating materials as necessary.

C. The Contractor shall provide erosion control measures in accordance with Section 31 25 00 to prevent erosion or displacement of soils and discharge of soil-bearing water runoff, and they shall prevent airborne dust from falling on adjacent properties and walkways.

3.02 DUST CONTROL

A. The Contractor shall refer to Section 02 41 13 Site Preparation for dust control requirements.

3.03 DEWATERING

A. The Contractor shall refer to Section 31 23 19 for dewatering and drainage control requirements.

3.04 EROSION CONTROL

A. The Contractor shall install and maintain erosion control measures as indicated in Section 31 25 00 Erosion and Sedimentation Control, and shall do the following:

1. Schedule the delivery and placement of fill materials, obtained from off-site sources, in a manner which will minimize the length of time such fill materials would be stored on site and subject to erosion.

2. Limit new embankment slopes to three (3) horizontal to one (1) vertical, maximum unless indicated as steeper on plans.

3.05 FROST PROTECTION

A. The Contractor shall not excavate to full indicated depth when freezing temperatures may be expected, unless footings or slabs can be poured immediately after the excavation has been completed. The Contractor shall protect the excavation from frost if placing of the concrete is delayed. Should protection fail, they shall remove frozen materials and replace with concrete or gravel fill, as directed, at no cost to the Owner. Once footings or slabs are placed, they shall protect them from frost.

B. The Contractor shall keep the operations under this Contract clear and free of accumulations of snow as required to carry out the work.

3.06 SHEETING, SHORING AND BRACING, AND PROTECTION

A. The Contractor shall furnish, put in place, and maintain such sheeting and bracing as may be required to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation below that necessary for proper construction, or otherwise injure or delay the work or endanger adjacent structure or personnel. If the Owner's Representative is of the opinion that at any point sufficient or proper support has not been provided, they may order additional supports put in at the expense of the Contractor.

1. Prior to installation of sheeting, the Contractor and the Owner's Representative shall notify and consult with adjacent residents who may be affected by vibrations caused by equipment installing the sheeting.

B. Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids outside of the sheeting, but if voids are formed, they shall be immediately filled with sand and compacted.

C. The Contractor shall leave in place to be embedded in the backfill all sheeting and bracing which the Owner's Representative may direct them to leave in place at any time during the progress of the work, for the purpose for preventing injury to structure, personnel, utilities, or property at no additional cost. Timber or steel sheeting and bracing to be left in place shall be cut off at least two feet below finish grade. This shall not constitute a waiver of the Contractor's responsibility to use their own judgment in where sheeting shall be left in place.

D. All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheeting shall be immediately backfilled with approved material and compacted by ramming with tools especially adapted to that purpose, by watering, or otherwise as may be directed.

E. The Contractor shall comply with local safety regulations or in the absence thereof, with the provisions of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc.

1. The Contractor shall submit sheeting and shoring design for review to the Owner's Representative. The sheeting and shoring design shall be prepared by a professional engineer licensed in the Commonwealth of Massachusetts and in the employ of the Contractor.

3.07 EXCAVATION: GENERAL

A. Classified Excavation: Excavation is classified and includes excavation to required sub-grade elevations indicated, regardless of character of materials and obstructions encountered. Excavation will be classified as earth excavation or rock excavation as follows:

1. Earth Excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

a. Intermittent drilling or ripping to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

b. All excavation shall be done with a backhoe whose bucket is equipped with a wedge plate across the teeth to provide a smooth bottom profile or equivalent equipment approved by the Owner's Representative.

2. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered that cannot be dislodged and excavated with modern, track-mounted, heavy-duty excavating equipment without drilling, blasting, or ripping. Rock excavation equipment is defined as Caterpillar Model No. 973 or equivalent track-mounted loader, rated at not less than 210 HP flywheel power and developing minimum of 45,000-pound breakout force (measured in accordance with SAE J732).

3. Rock excavation for trenches includes removal and disposal of materials and obstructions encountered that cannot be excavated with a track-mounted power excavator, equivalent to Caterpillar Model No. 215C LC, and rated at not less than 115 HP flywheel power and 32,000-pound drawbar pull and equipped with a short stick and a 42-inch wide, short tip radius rock bucket rated at 0.81 cubic yard (heaped) capacity. Trenches in excess of 10 feet in width and pits in excess of 30 feet in either length or width are classified as open excavation.

B. Material, encountered in the excavation, to qualify as rock, must be two (2) cubic yards or more in undisturbed size in open excavation and in trenches. To be considered for classification as rock, material shall be any one of the following:

1. Rock, stone, or shale (in original ledge) and all other material, including buried building foundations, which cannot be broken and removed by power excavation equipment and requires the use of drills.

2. Boulders.

C. When, during the progress of excavation, rock is encountered, the Contractor shall uncover and expose the material, and notify the Owner's Representative before proceeding further. They shall not proceed with the excavation of material claimed as rock until the material has been classified by the Owner's Representative. Failure on the part of the Contractor to uncover such material or notify the Owner's Representative, and take cross-sections, will forfeit the Contractor's right-of-claim to any additional compensation or extension of time.

1. The Contractor shall employ qualified personnel, acceptable to the Owner's Representative, to take cross-sections of rock three (3) feet on center before removal of same; and to provide computations of cross-sections.

D. See Project Special Conditions for additional excavation requirements (under "Demolition, Site Excavation and Preparation").

3.08 STABILITY OF EXCAVATIONS

A. Excavation of slopes shall be constructed to comply with all OSHA regulations and with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations. The Contractor shall notify the Massachusetts Department of Labor and Industries of the start of excavation work.

3.09 EXCAVATION FOR STRUCTURES

A. The Contractor shall excavate to designated elevations and dimensions as indicated within the Drawings within a tolerance of plus or minus 0.10 foot. They shall extend excavations a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: The Contractor shall not disturb bottom of excavation. They shall excavate by hand to final grade just before placing concrete reinforcement. They shall trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Mechanical or Electrical Appurtenances: The Contractor shall excavate to elevations and dimensions indicated on the Drawings within a tolerance of plus or minus 0.10 foot. They shall not disturb bottom of excavations intended for bearing surface.

3.10 EXCAVATION FOR WALKS AND PAVEMENTS

A. The Contractor shall excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades, as indicated within the Drawings.

B. For all areas to be paved, any unsuitable materials (as defined in this Section) shall be removed to a minimum depth of 6" below the subgrade elevation. Excavated soil shall be replaced with Ordinary Borrow to sub-grade level prior to compaction and proof-rolling.

3.11 EXCAVATION FOR UTILITY TRENCHES

A. The Contractor shall excavate trenches to indicated slopes, lines, depths, and below invert elevations as indicated in the Drawings.

B. The Contractor shall excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. They shall excavate trench walls vertically from trench bottom to twelve (12) inches higher than top of pipe or conduit, unless otherwise indicated.

C. Trench Bottoms: The Contractor shall excavate and shape trench bottoms to receive bedding for pipes and conduit. They shall shape bedding to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. They shall remove stones and sharp objects to avoid point loading.

1. Where rock is encountered, the Contractor shall excavate six (6") inches below required elevations and backfill with compacted gravel fill to required elevations.

3.12 APPROVAL OF SUBGRADE

A. The Contractor shall maintain foundation excavations at least twelve (12) inches above design bearing level until final excavation immediately before footing construction, or placing fill. If footings will not be constructed within the same day as final excavation to subgrade level, a three (3) inch thick lean concrete mud slab shall be cast over the exposed bearing surface immediately after approval of the subgrade bearing surface by the geotechnical engineer.

B. The Contractor shall notify the Owner's Representative when excavations have reached required subgrade for inspection of conditions and approval to proceed with construction.

C. If the Owner's Representative determines that unforeseen unsuitable material is present, they may direct the Contractor to continue excavation until suitable bearing materials are encountered.

D. The Contractor shall re-construct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner's Representative, at no cost to the Owner.

E. The Contractor shall not place fill material until the subgrade is approved by the Owner's Representative.

3.13 UNAUTHORIZED EXCAVATION

A. The Contractor shall fill unauthorized excavation with structural fill material as directed by the Owner's Representative. Flowable fill may be used to bring elevations to proper position when acceptable to the Owner's Representative.

B. Where indicated widths of utility trenches are exceeded, the Contractor shall provide stronger pipe, or special installation procedures, as required by Owner's Representative at no additional cost to the Owner.

3.14 STORAGE OF SOIL MATERIALS

A. The Contractor shall stockpile excavated materials approved as backfill materials, including acceptable borrow materials. They shall stockpile soil materials without intermixing. They shall place, grade, and shape stockpiles to drain surface water, and shall install temporary siltation controls on the low sides of the piles.

1. The Contractor shall stockpile soil materials away from edge of excavations. They shall not store the materials within drip line of remaining trees.

2. Intermixed stockpiles as determined and directed by the Owner's Representative shall be re-tested by the Contractor for compliance to specified requirements or removed from site immediately, at no additional cost to the Owner.

B. The Contractor shall place all stockpiles of contaminated soil on 6-mil. polyethylene sheeting, and also cover these stockpiles with the same sheeting, to prevent erosion and mixing with non-contaminated materials at the site.

3.15 SUBGRADE AND BACKFILL COMPACTION REQUIREMENTS

A. Percentage of Maximum Dry Density Requirements: The Contractor shall compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557 and in place density in accordance with ASTM D 1556. All fill and backfill material shall be compacted in layers not to exceed 6 inches.

1. Under structures, pavements, and utilities, the Contractor shall compact the sub-grade and each layer of backfill or fill material at 95 percent maximum dry density. Where compaction with large equipment is not possible due to the narrow widths of excavations, a plate compactor or walk-behind drum roller shall be used to achieve the required level of compaction of the sub-grade.

2. Under planting areas or unpaved areas, the Contractor shall compact the sub-grade and each layer of backfill or fill material at 90 percent maximum dry density.

3.16 PROOF COMPACTION

A. The Contractor shall proof-compact the bottom of excavations or existing subgrade, for all areas to be paved. Proof compaction shall consist of making ten (10) passes with a ten ton vibratory roller or by a minimum of three (3) coverages from the rear wheel assembly of a fully loaded ten-wheel dump truck or by a minimum of three (3) coverages from the treads of a tractor dozer weighing at least 30,000 pounds and observing the subgrade for any soft or weaving areas. All proof-compaction work shall be supervised by either the Owner's Representative, or a geotechnical engineer hired by the Owner.

3.17 PLACEMENT OF FILLS

A. General: The Contractor shall backfill excavations as promptly as work permits, but not before completing the following:

1. Acceptance by the Owner's Representative of construction below finish grade including, where applicable, damp-proofing, waterproofing, and perimeter insulation.

2. Coordinating drainage systems installation.

3. Surveying locations of underground utilities for record documents.

4. Testing, inspecting, and approval of underground utilities.

5. Concrete formwork removal.

6. Removal of trash and debris from excavation.

7. Removal of temporary shoring and bracing, and sheeting.

8. Removal of vegetation, topsoil, wet and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.

B. When sub-grade or existing ground surface to receive fill has a density less than that required for fill, the Contractor shall break up ground surface to depth required, pulverize, moisture-condition or aerate soil and re-compact to required density.

C. The Contractor shall notify the Owner's Representative when areas to receive fill are ready for inspection. All sub-grades to receive fill shall be compacted as noted previously in this Section of the Specifications.

D. The Contractor shall place approved fill materials in layers not exceeding six (6) inches compacted thickness and compact as specified below for various fill conditions.

E. Placing Compacted Gravel Fill: The Contractor shall place Gravel Fill and compact to specified densities as indicated within the Drawings, and for all exterior site construction requiring filling and backfilling operations as a result of excavation operations and/or filling to required subgrades from existing grades.

F. Placing Crushed Stone: The Contractor shall place Crushed Stone and compact to specified densities as indicated within the Drawings and/or specified herein.

G. Placing Ordinary Borrow:

1. Ordinary Borrow may be utilized, if approved by the Owner's Representative, as fill and backfill material beneath pavements, structures, and beneath loam in lawn and planting areas.

2. The Contractor shall place Ordinary Borrow and compact to specified densities as indicated within the Drawings and specified herein.

H. The Contractor may use excavated material that doesn't qualify as Ordinary Borrow as subgrade fill in areas that will not be paved or include structures, provided that this material can be compacted as required above, in lifts not exceeding 6 inches, and does not contain

any of the unsuitable materials listed in 1.03C of this Section. All remaining excavated material shall be removed and legally disposed off-site. For areas that will not be paved, excavated soil that exceeds a contamination level of RSC-1 (in accordance with the report from BETA Group, Inc. included in the bid/specifications package) may be used as fill, provided it is covered with at least three feet of clean fill material. For areas to receive pavement, soil that exceeds RCS-1 may be used for fill up to the subgrade.

3.18 UTILITY TRENCH BACKFILL

A. The Contractor shall place bedding course on bearing surfaces and to fill unauthorized excavations. They shall shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits to spring line.

B. The Contractor shall place concrete in backfill trenches that carry below or pass under footings and that are excavated within eighteen (18) inches of footings. They shall place concrete to level of bottom of footings.

C. The Contractor shall provide 4-inch-thick concrete base slab support for piping or conduit less than 2'-6" below surface of roadways. After installation and testing, they shall completely encase piping or conduit in a minimum of four (4) inches of concrete before backfilling or placing roadway sub-base.

D. The Contractor shall place and compact backfill material to a minimum height of twelve (12) inches over the utility pipe or conduit and as indicated within the Drawings.

1. The Contractor shall carefully compact material and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

E. The Contractor shall coordinate backfilling with utilities testing.

F. The Contractor shall fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.

G. The Contractor shall place and compact backfill material to final sub-grade of areas to be paved, or finished grade in areas to be seeded or sodded. Trenches shall be backfilled and compacted so that settling of soil does not occur.

H. The Contractor shall install warning tape directly above utilities, in accordance with the Drawings.

3.19 ROUGH GRADING

A. General: The Contractor shall uniformly grade areas to a smooth surface, free from irregular surface changes. They shall comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. The Contractor shall provide a smooth transition between existing adjacent grades and new grades.

2. The Contractor shall cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.

B. Sub-grades: The Contractor shall finish sub-grades to required elevations within the following tolerances:

1. Lawn or Unpaved Areas: Plus or minus 0.05 foot.

2. Walks: Plus or minus 0.05 foot.

3. Pavements: Plus or minus 0.05 foot.

3.20 FIELD QUALITY CONTROL

A. Geotechnical Testing Agency Services: The Contractor shall allow testing agency to inspect and test each sub-grade and each fill or backfill layer. The Contractor shall not proceed until test results for previously completed work verify compliance with requirements.

1. The Contractor shall perform field in-place density tests according to ASTM D 1556 (sand cone method).

a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 2922, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, the Contractor shall check the calibration curves furnished with the moisture gauges according to ASTM D 3017.

b. When field in-place density tests are performed using nuclear methods, the Contractor shall make calibration checks of both density and moisture gauges at beginning of work, on each different type of material encountered, and at intervals as directed by the Owner's Representative.

2. Footing Sub-grade: At footing sub-grades, the Contractor shall perform at least one (1) test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing sub-grades may be based on a visual comparison of each sub-grade with related tested strata when acceptable to the Owner's Representative.

3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, the Contractor shall perform at least one (1) field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three (3) tests.

4. Foundation Wall Backfill: In each compacted backfill layer, the Contractor shall perform at least one (1) field in-place density test for each 100 feet or less of wall length, but no fewer than two (2) tests along a wall face.

5. Trench Backfill: In each compacted initial and final backfill layer, the Contractor shall perform at least one (1) field in-place density test for each 100 feet or less of trench, but no fewer than two (2) tests.

B. When testing agency reports that sub-grades, fills, or backfills are below specified density, the Contractor shall scarify and moisten or aerate, or remove and replace soil to the depth required, re-compact and re-test until required density is obtained, at no additional cost to the Owner.

3.21 FINISHED GRADING

A. For fine grading and loaming, see Section 32 91 13 – Loam.

3.22 PROTECTION

A. Protecting Graded Areas: The Contractor shall protect newly graded areas from traffic, freezing, and erosion. They shall keep these areas free of trash and debris.

B. The Contractor shall repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or loosely compacted due to subsequent construction operations or weather conditions.

1. The Contractor shall scarify or remove and replace material to depth directed by the Owner's Representative; and shall re-shape and re-compact at optimum moisture content to the required density.

C. Settling: Where settling occurs during the Project correction period, the Contractor shall remove finished surfacing, backfill with additional approved material, compact, and reconstruct surfacing.

1. The Contractor shall restore appearance and quality of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

D. All additional repairing, removing, and restoring work shall be completed at no additional cost to the Owner.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: The Contractor shall remove and legally dispose of surplus or excavated materials not required to complete construction, including unsatisfactory soil, trash, and debris, and legally dispose of it off the park property.

B. Excess soil in the west portion of the site, including and west of borings B-1, B-10, B-7, and B-8, as shown on the map in BETA Group's 12-23-25 report, shall be disposed at an appropriately licensed in-state disposal/recycling facility (or facilities) that meets COMM-97 thresholds, approved by the Owner's Representative. Note that the map in BETA's report includes the original master plan for the property which differs somewhat from the Construction Drawings, but distances to the borings can be determined by using the graphic scale on the map.

C. Excess soil in the east portion of the site, east of borings B-1, B-10, B-7, and B-8, as shown on the map in BETA Group's 12-23-25 report, shall be disposed at an appropriately licensed out-of-state soil management facility (or facilities) that accepts soil with the chemical characteristics described in BETA's report, including total arsenic concentrations exceeding 40 milligrams per kilogram as non-hazardous waste, approved by the Owner's Representative. Note that the map in BETA's report includes the original master plan for the property which differs somewhat from the Construction Drawings, but distances to the borings can be determined by using the graphic scale on the map.

D. The Contractor shall ensure a safe working environment for their personnel during the disturbance and handling of contaminated soil. This shall include the implementation of health and safety provisions in accordance with 29 CFR 1910.120 and 29 CFR 1926.65. This shall include but not be limited to hazard identification, use of engineering controls such as wet methods to prevent creation of dust and personal protective equipment (PPE) by affected personnel.

E. The Contractor shall decontaminate construction equipment that contacts contaminated soil using dry methods. Residuals from decontamination shall be collected by the Contractor and disposed at the Contractor's sole expense at a disposal facility acceptable to the Owner's Representative.

F. The Contractor shall submit a list of proposed licensed disposal facilities for contaminated soils, prior to disposal, to the Owner's Representative for approval.

G. The Contractor shall confirm the net mass in tons of contaminated soil shipped off-site using a permanent State-certified scale acceptable to the Owner's Representative. The conversion factor from tons to cubic yards (to determine compensation amounts for the Contractor) shall be 1.5 tons = 1 cubic yard.

H. Copies of weight tickets shall be submitted to the Owner's Representative for proof of soil quantities delivered to disposal facilities.

I. See Project Special Conditions for additional disposal requirements (under "Demolition, Site Excavation and Preparation").

END OF SECTION

SECTION 31 23 19
DEWATERING AND DRAINAGE CONTROL

PART 1—GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. This Section specifies designing, furnishing, installing, maintaining, operating and removing temporary dewatering systems and the requirements for control of surface water within the site.

C. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this Section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Control of surface water runoff to prevent flooding of excavations, trenches and adjacent properties, and the loosening and saturation of soils.
2. Removal and disposal of subsurface water from excavations and trenches as required to lower and control water levels during construction.
3. Provision of equipment and facilities to remove sediment and control the rates and volumes of disposal of surface and subsurface waters removed from the work areas.

1.02 RELATED SECTIONS

A. Sections which directly relate to the work of this Section include:

1. Section 02 41 13—Site Preparation and Demolition
2. Section 31 23 19—Earthwork
3. Section 31 25 00—Erosion and Sedimentation Controls

1.03 DEWATERING SYSTEM REQUIREMENTS

A. The Contractor shall design the dewatering systems to:

1. Effectively reduce the hydrostatic pressure and lower the groundwater levels to a minimum of 2 feet below the bottom of excavations;
2. Develop a substantially dry and stable subgrade for the proposed work;
3. Prevent damage to adjacent properties, buildings, structures, utilities and other facilities;
4. Ensure that, after 12 hours of initial pumping, no soil particles will be present in the discharge.

B. The Contractor shall locate dewatering facilities where they will not interfere with utilities and construction work to be done by others.

C. The Contractor shall modify dewatering equipment and procedures when operations threaten to cause damage to new or existing facilities.

D. The Contractor shall be solely responsible for the proper design and execution methods for controlling surface and groundwater. Design review and/or field monitoring activities by the Owner's Representative shall not relieve the Contractor of their responsibilities for the work specified herein.

1.04 SUBMITTALS

A. Prior to installation of the dewatering system and at least two weeks prior to performing any excavation in areas that require dewatering, the Contractor shall submit working drawings and design data for review by the Owner's Representative with the following information:

1. The proposed type of dewatering system;
2. Arrangement, location and depths of system components;
3. Complete description of equipment and instrumentation to be used including installation, operation and maintenance procedures;
4. Types and sizes of filters;
5. Design calculations demonstrating adequacy of the proposed system and equipment; and provisions and methods of sediment removal and disposal of water.

B. It is anticipated that the initial dewatering plan will have to be modified to suit the variable soil/water conditions encountered during construction. The Contractor shall modify the dewatering plan as often as necessary to meet the Specifications.

1.05 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2—PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. The Contractor shall furnish pumps, pipe, appliances, and equipment of capacity capable to keep the excavations free from water as necessary to complete the work as specified herein.

B. The Contractor shall provide all necessary materials for environmental protection including construction fencing and erosion control barriers.

PART 3—EXECUTION

3.01 SURFACE WATER CONTROL

A. The Contractor shall intercept and divert surface water runoff away from excavations through the use of dikes, curb walls, ditches, pipes, sumps or other approved means.

B. The Contractor shall provide and maintain ditches of adequate size to collect and prevent surface and subsurface water seepage from entering the excavations. They shall divert the water to settling basins or other approved equipment required to reduce the amount of fine particles before discharge into drainage pipes and natural watercourses. If a drainage system or watercourse becomes blocked due to dewatering operation, the Contractor, at no additional cost to the Owner, shall clean it.

3.02 DEWATERING EXCAVATIONS

A. The Contractor shall accomplish dewatering in accordance with the means and methods submitted as required and approved by the Owner's Representative. The Contractor shall keep the Owner's Representative advised of any changes required to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit the information required to show the installed system.

B. The Contractor shall perform dewatering operations to lower the groundwater level in excavations as required to provide a stable, dry subgrade for the prosecution of the proposed work.

C. The Contractor shall maintain dewatering operations in a manner that prevents buildup of excessive hydrostatic pressure and damage to structures, and the subgrade.

D. The Contractor shall not allow water to accumulate in excavations. They shall provide and maintain at all times ample means and devices to remove promptly, and to dispose of properly, all water entering excavations and to keep them dry until the proposed work is completed.

E. If the Contractor's method of dewatering does not properly dewater the excavation as specified, then the Contractor shall install groundwater observation wells, as directed by the Owner's Representative, and implement a revised dewatering plan that lowers the groundwater a minimum of 6 inches below the bottom of final excavation elevation, at no additional cost to the Owner.

F. No pipe shall be laid in water. No masonry shall be laid in water, and no water shall be allowed to rise over concrete and brick masonry within 24 hours after being placed. Water shall not be allowed to rise over any concrete and masonry for four days. The Contractor shall constantly guard against the possibility of flotation of pipe or structures after installation. Backfill or other means shall be placed promptly to prevent this occurrence.

G. Dewatering units used in the work shall be surrounded by suitable filter sand such that no fines shall be removed by pumping. Pumping shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.

H. Dewatering flows shall be disposed of in an approved area. Sanitary sewer systems shall not be used to dispose of dewatering flows.

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Installation, maintenance and removal of erosion and sediment controls.

C. All work described above shall be marked out in the field for review and approval by the Owner's representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. 02 41 13 – Site Preparation and Demolition

B. 31 23 10 - Earthwork

1.03 GENERAL PROVISIONS

A. This specification applies to work depicted on the Civil Drawings prepared by Quinn Engineering, Inc., herein referred to as the "Drawings" and specifically consisting of:

1. Sheets C-1 through C-3.

B. Attention is directed to PROJECT SPECIAL CONDITIONS which are hereby made a part of this Section of the Specifications.

C. All work conducted in association with this section shall conform to the applicable requirements of the Occupational Safety and Health Administration (OSHA).

D. In accordance with MA General Law Chapter 82 Section 40A and prior to construction, the Contractor shall contact DIGSAFE and other utility providers to determine the location of existing utilities within the project area. The Contractor is responsible for coordinating the work with the existing utilities so that disruption to the existing utilities is minimized.

E. Prior to construction, the Contractor shall notify and coordinate any planned disruptions to existing utilities that are required to perform the work with the appropriate utility provider and with the Owner's representative. Disruptions to existing utilities shall be planned so that the time of disruption is minimized.

1.04 INDUSTRY STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications, latest edition.
2. AASHTO: American Association of State Highway and Transportation Officials
3. ASTM: American Society for Testing and Materials
4. Mass DOT: Massachusetts Department of Transportation, Highway Division
5. MSSHB: Massachusetts Standard Specifications for Highways and Bridges
6. City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision)

1.05 SUBMITIALS

A. Submit for approval prior to ordering and shipment technical information regarding

1. Silt fence / stakes
2. Straw wattles
3. Catch basin inserts

1.06 SITE CONDITIONS

A. The Contractor is responsible for verifying the layout of all materials prior to installation in relation to the locations specified on the Drawings and in relation to the existing conditions.

B. The Contractor shall provide barricades or barriers to protect the public from construction activities.

C. The work specified herein shall take place under weather conditions so as not to cause erosion or negatively impact any portion of the site.

1.07 QUALITY ASSURANCE

A. The Contractor is responsible for the timely and proper installation and maintenance of all sediment and erosion control devices necessary to prevent the movement of sediment from the construction site to off-site areas or into, adjacent drainage systems, or into unwanted areas of the site. The Contractor shall be responsible for implementing additional measures to those shown on the Drawings as necessary to prevent the movement of sediment into the above-mentioned areas. All erosion control measures, including any additional measures necessary, shall be installed, maintained, removed, and cleaned at the expense of the Contractor.

B. All materials for each product shall be produced and obtained from a single manufacturer.

C. Installation shall be performed by qualified personnel.

D. Coordinate the work shown on the Drawings and specified herein with all other trades to provide a complete installation.

E. The Contractor shall provide all necessary miscellaneous items and appurtenances not identified on the Drawings or specified herein to provide a complete installation.

1.08 DELIVERY, STORAGE, AND HANDLING

A. All commercially obtained material shall be delivered in the original unopened packaging with labels intact.

B. All commercially obtained materials shall be stored in a location that is protected from weather and temperatures not less than 40 degrees Fahrenheit.

1.09 COORDINATION

A. The work specified in this section shall be coordinated with all work shown/described on the Drawings and in the specifications with other portions of the work for the entire project.

B. The Contractor shall give the Engineer at least 48-hour notice when requesting inspections on site.

1.10 EXISTING UTILITIES

A. Existing utility information depicted on the Drawing has been provided to Quinn Engineering, Inc. unless otherwise noted. The Contractor is responsible for coordinating the locations of all existing utilities with the utility provider and "DIGSAFE". Quinn Engineering, Inc. does not warrant that all existing utilities have been depicted on the Drawings.

B. The Contractor shall take every precaution to limit disruption to existing utilities. Any existing utilities disrupted or affected by the Contractor because of his/her work shall be repaired at least to the condition that existed prior to construction. The Contractor shall coordinate repair of any utilities with the utility providers and any costs associated with the repair shall be borne by the Contractor.

1.11 DRAWINGS

A. The Contractor is responsible for reviewing the Drawings and existing site conditions with respect to this section.

B. The information depicted on the Drawings is believed to reflect the current site conditions unless otherwise noted on the Drawings. The Contractor is responsible for reviewing the existing site conditions in the areas of the proposed work and notify the Owner's representative as soon as possible if any discrepancies exist between the two.

C. The existing conditions depicted on the Drawings have been provided to Quinn Engineering, Inc. Quinn Engineering, Inc. does not warrant that all existing conditions, structures, utilities, etc. have been depicted.

1.12 COORDINATION WITH THE WORCESTER CONSERVATION COMMISSION

A. An Order of Conditions from the Worcester Conservation Commission is required for this work.

B. The Contractor is responsible for conducting the work in accordance with the Order of Conditions issued by the Worcester Conservation Commission.

C. The Order of Conditions is to be considered part of this specification and the contract documents.

PART 2 - PRODUCTS

2.01 SILT FENCE

A. Silt Fence shall be as manufactured by TENCATE Mirafi of 365 South Holland Drive Pendergrass, GA 30567 or approved equal.

2.02 WOODEN STAKES & STAPLES

A. Wooden stakes shall be hardwood with dimensions approximately 1”x1”x36”.

B. Staples shall be metal and suitable for exterior applications. Staples shall be capable of fastening the silt fence to the wooden stakes.

2.03 CATCH BASIN FILTER INSERT

A. Catch basin filter inserts shall be “Silt Sack” as manufactured by ACF Environmental Inc. 2831 Cardwell Road, Richmond, VA 23234 (800)-448-3636 , www.acfenvironmental.com or approved equal.

B. Catch basin filter insert must be manufactured to fit the opening of the catch basin, area drain or drop inlet. Catch basin filter insert will have the following features:

1. Two dump straps attached at the bottom to facilitate the emptying of catch basin filter insert;

2. Lifting loops as an integral part of the system to be used to lift catch basin filter insert from the basin;

3. A restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls, this cord also serves as a visual means of indicating when the sack should be emptied. Once the cord is covered with sediment, catch basin filter insert should be emptied, cleaned, and placed back into the basin.

2.04 STRAW WATTLE

A. Straw wattles shall be installed at the locations depicted on the Drawings.

B. Secure straw wattles in place using hardwood stakes at intervals of ±5 feet o.c. Stakes shall be set securely into the ground to prevent the wattles from being dislodged.

2.05 WATER

A. Dust control shall be done using sprayed water.

PART 3 - EXECUTION

3.01 SILT FENCE BARRIER

A. Staked silt fence shall be provided and installed by the Contractor to control the movement of sediment produced by construction activities on site.

B. Silt fence shall be trenched into the ground as indicated on drawings.

C. Install silt fence according to the details shown on the Drawings and per the manufacturer's instructions.

D. Backfill trench with excavated material and compact.

E. Once installed, remove accumulated sediment once it builds up to 1/4 of the height of the fence.

F. Replace damaged silt fence, or patch with a 2-ft minimum overlap.

G. Make other repairs as necessary to ensure that the fence is filtering all runoff directed to the fence.

3.02 CATCH BASIN FILTER INSERT

A. Catch basin filter insert installation shall be provided and installed by the Contractor to control to movement of sediment produced by construction activities into the onsite drain system and/or drain system located downstream of the work area.

B. Obtain permission from the municipality if catch basin filter inserts are to be installed within public right of ways.

C. Installation and maintenance shall conform to the manufacturer’s specifications.

3.03 STRAW WATTLE

A. Staked straw wattles shall be provided and installed by the Contractor to control the movement of sediment produced by construction activities on site.

B. Secure straw wattles in place using hardwood stakes at intervals of ±5 feet o.c. Stakes shall be set securely into the ground to prevent the wattles from being dislodged.

C. Install straw wattles according to the details shown on the Drawings and per the manufacturer's instructions.

D. Once installed, remove accumulated sediment once it builds up to the height of the wattle.

E. Replace damaged straw wattle, or patch with a 2-ft minimum overlap.

F. Make other repairs as necessary to ensure that the wattle is filtering all runoff directed to the fence

3.04 DUST CONTROL

A. The frequency of dust control operations shall be determined by the Contractor.

B. Water shall be applied under the control of the Contractor and shall be applied in the amounts and at locations designated by the Contractor.

C. All equipment used for the application of water shall be equipped with a positive means of shut-off.

D. At least one mobile unit with a minimum capacity of 1,000 gallons shall be available for applying water on the project, unless otherwise permitted by the Contractor, or all the water is applied by means of pipe lines.

E. Water shall be applied by means of pressure-type distributors or pipe lines equipped with a spray system or hoses with nozzles that will insure a uniform application of water.

F. See Section 02 41 13 (Site Preparation and Demolition) for additional dust control requirements.

3.05 REMOVAL AND FINAL CLEANUP

A. Upon complete stabilization of the site, all erosion and sediment control devices and any accumulated sediment shall be removed from the site. All devices and sediment shall be disposed of in a manner according to good practice. Any areas disturbed by removal of the devices or sediment removal shall be graded and stabilized as required on the Drawings.

END OF SECTION

SECTION 32 11 16
AGGREGATE BASE COURSES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. This Section specifies requirements for the preparation and placement of granular pavement base materials. The base courses shall consist of approved granular materials placed on the subgrade and in close conformity with the lines and grades on the plans or as established by the Owner's representative.

C. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Fine grading and compaction of pavement subgrade.
2. Furnishing, placing, and compacting of base materials.

1.02 RELATED SECTIONS

A. Other specification sections that directly relate to the work of this Section include:

1. Section 03 30 53 – Cast-in-Place Cement Concrete
2. Section 31 23 10 – Earthwork
3. Section 32 12 16 – Bituminous Concrete
4. Section 32 18 16.13 – Poured-in-Place Resilient Surfacing
5. Project Special Conditions (additional requirements for gravel)

1.03 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 AGGREGATE MATERIALS

A. Gravel borrow: Gravel for pavement base courses, mow strip bases, and footing bases shall meet the following gradation requirements. See Project Special Conditions for gradation requirements for gravel borrow specified for other construction.

Sieve Size	Percent Passing
3”	100
1/2”	50-85
#4	40-75
#10	30-60
#40	10-35
#100	0-8
#200	0-8

The Contractor shall comply with additional requirements for all gravel borrow in the Project Special Conditions.

B. Dynamic Base Blend for resilient surfacing sub-base course shall be obtained from Lane Trap Rock, Oxford MA quarry, phone # (508) 987-3959, www.jslane.com; or approved equal. Dynamic Base Blend consists of 3/4”, 1/2”, and 3/8” crushed stone; and manufactured sand.

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION

A. All subsurface utility construction shall be completed before fine grading is begun.

B. The pavement and mow strip subgrades shall be fine graded to the locations, elevations and cross slopes shown on the Drawings.

C. Subgrades in in-situ soils in excavation areas and in embankment areas shall be compacted in conformance with Section 31 23 10 - Earthwork.

3.02 BASE AND SUB-BASE MATERIAL PLACEMENT

A. Base course material shall not be placed until the Owner’s Representative has approved the fine grading, compaction, and condition of the subgrade.

B. Base course material shall be placed and spread on the approved subgrade in layers not exceeding six (6) inches in thickness by approved self-spreading equipment. Any displacement of the compacted subgrade material by the equipment shall be restored to the required grade and re-compacted before placement of the base course material.

C. Aggregate base material for pavements, resilient surface system, and footings/foundations shall be compacted to 95 percent maximum dry density of the material as determined by the Standard AASHO Test Designation T99 compaction test Method C at optimum moisture content.

D. The surface of the base course material shall be fine graded to the locations, elevations, and cross slopes shown on the Drawings during final layer compaction operations.

3.03 PROOF COMPACTION

A. The Contractor shall proof-compact the aggregate base courses for all areas to be paved (asphalt and concrete) and all areas to receive resilient surfacing. Proof compaction shall consist of making ten (10) passes with a ten ton vibratory roller for walkway areas; and by a minimum of three (3) coverages from the rear wheel assembly of a fully loaded ten-wheel dump truck for all other paved areas including athletic courts. All proof-compaction work shall be supervised by either the Owner's Representative or a geotechnical engineer hired by the Owner.

END OF SECTION

SECTION 32 12 16
BITUMINOUS CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this Section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Bituminous concrete walkways (in right-of-way)
2. Bituminous concrete athletic court pavement
3. Bituminous berm

C. The boundaries of all paved areas shall be marked out in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 31 23 10 – Earthwork (for preparation of the subgrade)
B. Section 32 11 16 – Aggregate Base Courses
C. Section 32 18 23 – Athletic Surfacing
D. Project Special Conditions (additional requirements for sports court paving)

1.03 SUBMITTALS

A. The Contractor shall submit the following in accordance with conditions of Contract and the Special Conditions:

1. Material certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

1.04 SITE CONDITIONS

A. Weather Limitations: The Contractor shall apply hot-mixed asphalt surface course when atmospheric temperature is above 40 degrees F and when base is dry. Base course may be placed when air temperature is above 30 degrees F and rising.

B. Grade Control: The Contractor shall establish and maintain required lines and elevations.

1.05 INDUSTRY STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications, latest edition.
2. AASHTO: American Association of State Highway and Transportation Officials
3. ASTM: American Society for Testing and Materials.
4. Mass DOT: Massachusetts Department of Transportation, Highway Division
5. MSSHB: Massachusetts Standard Specifications for Highways and Bridges

1.06 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 BITUMINOUS MATERIAL FOR PAVEMENT, GENERAL

A. Bituminous materials shall conform to Section M3 *Bituminous Materials* of the Standard Specifications for Highways and Bridges, Massachusetts Department of Transportation, hereinafter referred to as Mass. Specifications.

1. TYPE I-1 Binder
2. TYPE I-1 Top Course

2.02 BITUMINOUS MATERIAL FOR BERMS

A. Bituminous material for berms shall be the same composition as TYPE I-1 Top Course, as described in 2.01A above.

2.03 BITUMINOUS MATERIAL FOR ATHLETIC COURTS

A. Athletic court bituminous pavement material shall meet the requirements of this Section. Additional requirements for court pavement materials are also included in the Project Special Conditions.

PART 3 – EXECUTION

3.01 GENERAL

A. General: The Contractor shall comply with provisions of Section 460 Class I Bituminous Concrete Paving Type I-1, of the Standard Specifications for Highways and Bridges, Massachusetts Department of Transportation, as amended to date. The Contractor shall also comply with the Project Special Conditions for this project, for additional requirements for sports court pavement.

3.02 SURFACE PREPARATION

A. The Contractor shall proof-roll prepared base surface to check for unstable areas and areas requiring additional compaction.

B. The Contractor shall not begin paving work until deficient base areas have been corrected and are ready to receive paving.

3.03 PLACING MIX

A. The Contractor shall place mix in accordance with provisions of the Standard Specifications for Highways and Bridges, Massachusetts Department of Transportation, as amended to date.

3.04 PLACING BITUMINOUS BERMS

B. Bituminous concrete curb shall be set in accordance with MSSHB Section 501 Curb, Curb Inlets, Curb Corners, and Edging.

C. Bituminous concrete curb shall be installed to provide the reveal indicated on the Drawings.

3.05 ROLLING, REPAIR, AND VISUAL INSPECTION OF SURFACE COURSE

A. The Contractor shall perform rolling and repair work in accordance with provisions of the Standard Specifications for Highways and Bridges, Massachusetts Department of Transportation, as amended to date.

B. Before completing operations, the Contractor shall notify the Owner's Representative to inspect the top course. Inspection shall be for visual appearance of even regular finish texture with no projections, ridges, or honeycombed areas. Contractor shall correct unacceptable areas.

END OF SECTION

SECTION 32 17 23.13
PAINTED PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Hopscotch markings on concrete pavement

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete

1.03 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. At the beginning of work, the installer shall accept substrates, subgrades, previous work, and conditions. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or re-handling items prior to final installation.

1.04 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 PAINT

A. Paint shall be a low-luster acrylic exterior latex paint product. The paint shall not contain any organic coloring matter and shall not discolor in sunlight. Paint colors shall be as indicated on the Drawings.

2.02 PRIMER

A. Primer shall be an acrylic concrete primer product.

PART 3 – EXECUTION

3.01 PRIMING AND PAINTING

A. The pavement shall be dry and free of soil and foreign contaminants when primer and paint are applied. All surface preparation, including surface cleaning, shall be done by the Contractor in accordance with the manufacturer's recommendations, subject to the approval of the Owner's Representative.

B. The Contractor shall provide sufficient control points to serve as guides for application of markings. Paint shall be to widths, lengths, and placements as indicated on the Drawings. The markings shall be straight or of uniform curvature and shall conform uniformly with tangents, radii, and transitions. The finished lines and edges shall be free from waviness. In judging waviness, the lateral deviation of the finished line shall not exceed one half (½) inch from the proposed location alignment at any point. Any greater deviation may be sufficient cause for requiring the Contractor to remove and correct such markings at no cost to the Owner.

C. The pavement shall be dry and free of glaze, oil, grease, or other foreign contaminants. The primer and paint shall be applied only on clean, dry pavements, and at pavement surface temperatures above 50 degrees F and below 160 degrees F.

D. The areas to be painted shall first be primed, and the primer shall not extend beyond the boundaries of where the paint will be applied.

E. A minimum of two coats of paint shall be applied.

F. The Contractor shall protect the markings until dry by placing guarding or warning devices as necessary. In the event that wet paint from markings is tracked elsewhere on the concrete, the Contractor shall re-apply lines from which paint was tracked, and remove tracked paint.

G. Pavement markings installed by the Contractor which deteriorate, or which fail to adhere to the pavement, shall be replaced by the Contractor. Pavement markings to be replaced shall be as determined by the Owner's Representative.

END OF SECTION

SECTION 32 18 16.13
POURED-IN-PLACE RESILIENT SURFACING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Poured-in-place resilient surfacing for playground area

C. The boundaries of all resilient surfaces shall be marked out in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete
B. Section 03 40 00 – Precast Concrete
C. Section 11 68 13 – Playground Equipment
D. Section 31 23 10 – Earthwork
E. Section 32 11 16 – Aggregate Base Courses

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ASTM: American Society for Testing and Materials, latest edition:

a. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension.
b. ASTM D624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
c. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine.
d. ASTM D2859 Standard Test Method for Flammability of Finished Textile Floor Covering Materials.
e. ASTM E303 Standard Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester.
f. ASTM F1292 Standard Specification for Impact Attenuation of Surface Systems under and Around Playground Equipment.
g. ASTM F1951 Standard Specification for Determination of Accessibility of Surface Systems under and Around Playground Equipment.

1.04 SYSTEM DESCRIPTION

A. Performance Requirements: The Contractor shall provide a 2-layer rubber-polyurethane playground surfacing system which has been designed, manufactured and installed to meet the following criteria:

1. Shock Attenuation (ASTM F1292):
   a. Gmax: less than or equal to 150.
   b. Head Injury Criteria: less than or equal to 850.
2. Flammability (ASTM D2859): Pass
3. Tear Resistance (ASTM D624): 140%.
4. Water Permeability: 0.4 gal/yd2/second.
5. Accessibility: Comply with requirements of ASTM F1951.

1.05 REQUIRED SUBMITTALS

A. Color samples for initial selection
B. Manufacturer's standard verification square sample for field testing of 18" x 18"
C. Manufacturer's product data and installation instructions
D. Certificates of qualifications of the playground surfacing installer (See Quality Assurance under this Section.)
E. Following completion of the resilient surface installation, the Contractor shall submit repair materials, warranty, testing documents, and maintenance/repair instructions specified herein to the Owner's Representative.

1.06 QUALITY ASSURANCE

A. Qualifications: Installer shall be approved and trained by the manufacturer of the playground surfacing system, having experience with other projects of the scope and scale of the work described in this section. For installation of the poured-in-place safety surface, the contractor shall have a minimum of five (5) years of experience. Contractor shall provide the following information to the Owner's Representative:

1. Evidence that installer has successfully completed at least twenty-five (25) similar surfaces installed during the past five (5) years with names of clients and phone numbers.
2. Certification by manufacturer that installer is an approved applicator of the playground surfacing system.
3. Certification of installer by International Play Equipment Manufacturers Association (IPEMA).

B. Testing: After seventy-two (72) hours but within thirty (30) days following installation of the finished resilient surface, the Contractor shall be required to perform, with the Owner's Representative present, field testing by a third party (qualifications to be reviewed/approved by Owner), demonstrating that the surface is in compliance with ASTM F1292 for impact attenuation, ASTM F1951 for wheelchair accessibility, and Project Documents.
C. No request for payment for materials and labor for safety surfacing shall be reviewed or

approved by the Owner without written submittal of the testing report results, verifying proof of 100 percent compliance with this article.

1.07 DELIVERY, STORAGE & HANDLING

A. Materials shall be delivered in manufacturer's original, unopened, undamaged containers with identification labels intact.
B. Materials shall be protected from exposure to harmful environmental conditions and at a minimum temperature of 40 degrees F (4 degrees C) and a maximum temperature of 90 degrees F (32 degrees C).

1.08 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Surfacing system shall be installed when minimum ambient temperature is 40 degrees F (1 degree C) and maximum ambient temperature is 90 degrees F (32 degrees C). The Contractor shall not install system during steady or heavy rain.

1.09 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: The Contractor shall submit, for the Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.

C. Warranty Period: Surfacing shall maintain impact performance criteria as per the latest edition of ASTM F1292 and be guaranteed against defects in workmanship and materials for a period of no less than seven (7) years from the date of acceptance of the work.

1.10 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 SOURCE LIMITATIONS

A. The Contractor shall obtain primary poured-in-place playground surface system materials from a single playground surface system manufacturer. The Contractor shall obtain secondary materials, including geosynthetics and repair materials of type and from source recommended by manufacturer of primary surface system materials.

2.02 POURED-IN-PLACE (PIP) RESILIENT SURFACE SYSTEM

A. Poured-in-place playground surfacing system shall include the following:

1. Dynamic Stone Base Blend and geotextile fabric: See Section 32 11 16 – Aggregate

Base Courses.

2. Poured-In-Place Primer:

   a. Material: Polyurethane.

3. Poured-in-Place Basemat:

   a. Material: Blend of 100% recycled SBR (styrene butadiene rubber) and polyurethane.
   b. Thickness shall meet ASTM F1292 requirements for Impact Attenuation of Surface Systems within use areas of Playground Equipment and Swings for designed maximum critical fall height.
   c. Formulation Components: Blend of strand and granular material.

4. Poured-In-Place Top Surface:

   a. Material: Blend of recycled EPDM (ethylene propylene diene monomer) and Aliphatic polyurethane
   b. Thickness: Nominal 1/2" minimum
   c. Colors:
      1) Surface color 1 (See layout plans): 50% Black and 50 % of Sky Blue (Surface America color) or similar if using another manufacturer
      2) Surface color 2 (on hills and "islands" – see layout plans): 50% Black and 50% Bright Green (Surface America color) or similar if using another manufacturer
   d. Dry Static Coefficient of Friction (ASTM D2047): 1.0
   e. Wet Static Coefficient of Friction (ASTM D2047): 0.9
   f. Dry Skid Resistance (ASTM E303): 89
   g. Wet Skid Resistance (ASTM E303): 57

2.03 PRODUCT SUBSTITUTIONS

A. Substitutions: Approved Equal

2.04 MIXES

A. Required mix proportions by weight:

1. Basemat: 14% polyurethane, 86% rubber.

2. Top Surface: 18% polyurethane, 82% rubber

PART 3 – EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. The Contractor shall comply with the instructions and recommendation of the playground

surfacing manufacturer.

3.02 EXAMINATION

A. Site Verification of Conditions: The Contractor shall verify that substrate conditions are suitable for installation of the playground surfacing system.

B. The Contractor shall not proceed with installation of the system until unsuitable conditions are corrected, in accordance with Section 31 23 10 – Earthwork.

3.03 PREPARATION

A. The Contractor shall prepare the area to receive resilient surfacing as follows:

1. Stake locations of surfacing perimeter, playground equipment, walkways, and other objects that will be adjacent to and within surfacing. Also mark safety zone limits.
2. Install play equipment and other items within and adjacent to areas to receive resilient surfacing. See relevant specification sections for these items.
3. Prepare subgrade in accordance with Section 31 23 10 – Earthwork.

3.04 INSTALLATION OF SUB-BASE COURSE & EDGING

A. The Contractor shall install edging & sub-base course as follows:

1. Place and compact Dynamic Stone Blend sub-base layer on prepared subgrade in accordance with Section 32 11 16 – Aggregate Base Courses.
2. Install curb edging adjacent to resilient surface areas where indicated on the Drawings, and in accordance with the Drawing details and Section 03 40 00. Curb edge installation may take place prior to placement of stone base in the playground area.

B. Sub-base Layer, General: The Contractor shall prepare, fill, patch, clean, remove high spots and ridges, and remove incompatible coatings from substrate to receive surfacing products according to playground surface system manufacturer's written instructions. The Contractor shall verify that substrate is sound without high spots, ridges, holes, and depressions.

3.05 INSTALLATION OF POURED-IN-PLACE RUBBER SURFACING

A. Examination:

1. The Contractor shall examine substrates, areas, and conditions, with installer present, for compliance with requirements for subgrade and substrate conditions, for compliance with playground surface system manufacturer's requirements, and for other conditions affecting performance.

2. Aggregate Substrate: The Contractor shall verify that substrate is satisfactory for resilient playground surface system, as follows:

a. Verify that surfaces are uniformly sloped to drain in accordance with the Drawings.
b. Verify that substrate is dry, free from dirt, grease, oil, and other contaminants and foreign objects incompatible with resilient surface system.
c. Verify that substrate is compacted in accordance with Section 32 11 16 – Aggregate Base Courses
d. Determine adhesion and dryness characteristics by performing procedures recommended in writing by resilient surface system manufacturer.

3. The Contractor shall proceed with installation only after unsatisfactory conditions have been corrected.

B. The Contractor shall comply with playground surface system manufacturer's written installation instructions. They shall install playground surface system over area and in thickness indicated on the Drawings, and as required to comply with specified requirements for impact-attenuation performance and, where indicated, for accessibility.

C. The Contractor shall install the poured-in-place resilient surface system as follows:

1. Basemat Installation:

a. Using screeds and hand trowels, install the basemat at a consistent density of approximately 29 pounds, 1 ounce per cubic foot to the specified thickness or as determined by Article 1.04 and verification sample or whichever is more stringent.
b. Allow basemat to cure for sufficient time so that indentations are not left in the basemat from applicator foot traffic or equipment.
c. Do not allow foot traffic or use of the basemat surface until it is sufficiently cured.

2. Primer Application: Using a brush or short nap roller, apply primer to the basemat top surface, perimeter and any adjacent vertical and horizontal barriers such as playground equipment support legs, curbs or slabs that will contact the surfacing system at the rate of 300 cubic feet per gallon.

3. Top Surface Installation: Using a hand trowel, install top surface at a consistent density of approximately 58 pounds, 9 ounces per cubic foot to a nominal thickness of 1/2 inch or as determined by Section 1.04 and verification sample or whichever is more stringent.

a. Single application of each color/blend, no cold seams.
b. Where color pattern is indicated, place adjacent colored material as soon as previously-placed colored material is sufficiently cured using primer or adhesive as required by manufacturer's written instructions. Seams between colors shall be formed in an overlapping manner as indicated in the Drawing details.
c. Allow top surface to cure for a minimum of 48 hours.
d. At the end of the minimum curing period, verify that the top surface is sufficiently dry and firm to allow foot traffic and use without damage to the surface.
e. Do not allow foot traffic and protect the safety surfacing until it is sufficiently

cured.

3.06 CLEANING AND PROTECTION

A. The Contractor shall clean and protect the poured-in-place resilient surfacing as follows:

1. Prevent traffic over system for at least 48 hours after installation. Protect resilient surface system from damage and wear during the remainder of the construction period.
2. Clean surface system after time period recommended in writing by resilient surface system manufacturer but not more than four days before dates scheduled for inspections intended to establish date of Substantial Completion. Use cleaning materials and procedures recommended in writing by playground surface system manufacturer.
3. During installation of adhesively applied products, immediately remove visible adhesive from surrounding surfaces. Use cleaner recommended by playground surface system manufacturer.

END OF SECTION

SECTION 32 18 23
ATHLETIC SURFACING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this Section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Court surface coatings – patching, resurfacer coats, color coats, and line painting

C. The boundaries of all athletic surfaces shall be marked out in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 02 41 13 – Site Preparation
B. Section 31 23 10 – Earthwork
C. Section 32 12 16 – Bituminous Concrete
D. Project Special Conditions (additional requirements for sports court surfacing)

1.03 SUBMITTALS

A. Athletic Court Surface Coating System: At least two (2) weeks before surface coating work is scheduled to begin, the Contractor shall submit samples of the athletic court color surfacing system to the Owner's Representative for review and approval. Samples shall display colors, grit size, thickness, and chemical properties associated with each layer including painted lines. Information regarding pertinent ingredient properties and their quantities shall also be submitted at that time.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for timing the delivery of surfacing materials so as to minimize on-site storage time prior to installation. All stored materials shall be protected from weather, careless handling, and vandalism.

B. The Contractor, sub-contractors, and suppliers are all individually required to furnish their own equipment necessary to get workers, material, and equipment from the point of delivery at the project site to the point of use or installation within the project site. All crane and rigging services required are the responsibility of each individual contractor or trade.

C. The Contractor shall deliver materials in original sealed containers marked with name of

manufacturer and identification of contents. The Contractor shall store materials under waterproof covers on planking clear of ground and protect from handling damage, dirt, stain, water and wind.

1.05 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all 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.

1.06 STANDARDS

A. Except as modified by governing code and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ASTM: American Society for Testing and Materials, latest edition.

1.07 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 ATHLETIC COURT SURFACE COATINGS

A. 100 percent premium blend acrylic color finish system to include the following and to be obtained from one supplier:

1. Patching material (acrylic)
2. Resurfacer
3. Color coating
4. Line paint

B. Acceptable manufacturers and products:

1. Nova Sports U.S.A. (phone # 508-473-6540, www.novasports.com) – Novaplay
2. California Sports Surfaces (phone # 978-623-9980) www.californiasportssurfaces.com) – Plexipave
3. SportMaster Sport Surfaces (phone # 800-395-7325, www.sportmaster.net) – Color Plus system

C. Court coatings shall consist of three premium colors, plus white line paint where indicated on the Drawings. Colors will be determined by Owner.

PART 3 – EXECUTION

3.01 APPLICATION OF ATHLETIC COURT SURFACING

A. General: Follow manufacturer's instructions regarding installation of base coats, finish coats, and the final curing duration.

B. Flooding and Patching: After surface course of bituminous concrete is placed and rolled, and the surface is thoroughly cleaned, the surface of the entire court shall be flooded with water. Low areas with standing water of 1/16 inch or greater shall be marked with chalk. The Contractor shall contact the Owner's Representative to inspect the court during the flooding process. Low areas shall then be coated with tack and patching mixture shall then be applied to these areas. See Project Special Conditions for additional requirements.

C. Resurfacer Coats: After bituminous concrete has cured for at least 14 days, two resurfacer coats shall be applied over the bituminous concrete surface. One coat shall be applied lengthwise on the court and the second coat shall be applied crosswise. See Project Special Conditions for additional requirements.

D. Color Coats: After resurfacer coating, two coats of color shall be applied to the court surface. See Project Special Conditions for additional requirements.

E. Line Striping:

1. Sweep and clean surface to eliminate loose material and dust.
2. Paint lines as noted and specified. Use mechanical aids so that lines are true and straight. Hand-brushed painting is not permitted. Apply two coats at manufacturer's recommendations.
3. Do not apply paint until layout and placement have been verified by Owner's Representative.

F. Inspections: The Contractor shall contact the Owner's Representative for an inspection after each layer of surfacing is placed on each court.

END OF SECTION

SECTION 32 31 13
CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Chain link fencing and gates

C. All fencing lines and gate locations shall be marked in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete
B. Section 32 12 16 – Bituminous Concrete
C. Section 32 18 23 – Athletic Surfacing
D. Project Special Conditions (additional requirements for chain link fencing)

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. ASTM: American Society for Testing and Materials

1.04 REQUIRED SUBMITTALS

A. The Contractor shall provide complete product literature and color samples for approval by the Owner's Representative prior to ordering the materials listed below:

1. Chain-link fabric, posts, rails, and fittings

B. The Contractor shall submit to the Owner's Representative a notarized certificate of compliance from the galvanizer with all galvanizing requirements including ASTM number and weight of coatings in ounces per square foot. Certificate of compliance shall also contain the following:

1. Sole Source Responsibility: A statement that galvanizer accepts sole responsibility for coatings under this Section. Galvanizer who does not accept this responsibility is not acceptable and will be rejected.

2. Evidence that Galvanizer meets requirements of ANSI Q90.

3. Certification of Compliance with Current Environmental Regulations: Galvanizer shall certify that coatings proposed for use comply with applicable environmental regulations. Contractor and galvanizer shall be responsible for penalties assessed by governmental or environmental authorities for coatings that do not comply with current environmental regulations. All coatings shall be lead-free.

C. A notarized mill certification from fence manufacturer that all materials used have been tested and fully comply with the requirements specified herein.

1.05 QUALITY ASSURANCE

A. Chain link fence work shall be assigned to experienced and qualified subcontractors employing experienced workers who shall work under the full-time supervision of a qualified foreman with a minimum of five (5) years of experience on projects comparable to this project. The Contractor shall use an adequate number of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for the proper performance of the work in this Section. The Contractor shall demonstrate that they have successfully completed work of similar size and scope.

1.06 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCE

A. Fence Fabric (General): All fence mesh shall have knuckled selvage on both the top and bottom edge. All fabric shall be installed on inside of line posts.

B. Galvanized Steel Fabric: Fabric shall be number 9 gauge commercial quality steel wire having a minimum tensile strength of 80,000 psi after zinc coating, except for fabric on lower part of backstop which shall be 6 gauge (see Drawings). Fabric shall be hot dip galvanized after fabrication. The weight of the zinc coating shall not be less than 1.2 oz. per sq. ft. of actual surface covered and equal to ASTM Specification BG-58 and National Chain Link Fence manufacturer's Institute Specifications. Wire shall be woven in a 2” inch mesh.

C. PVC Coating: All parts of the chain fencing shall be PVC-coated, as specified under 2.03 of this Section. The color shall be black.

D. Posts: All corner, end, intermediate, and gate posts shall be high carbon steel pipe hot dip galvanized. Post size and weight shall be as follows:

1. End, corner, and pull posts (up to 12’ height) 2.875" o.d. @ 4.64 pounds per lin. foot

2.	End, corner, and pull posts for athletic courts	4” o.d. @ 6.56 pounds per lin. foot
3.	Line posts (up to 12’ height)	2.375" o.d. @ 3.12 pounds per lin. foot
4.	Line posts for athletic courts	2.875” o.d. @ 4.64 pounds per lin. foot
5.	Gate posts, up to 6’ height	2.875” o.d. @ 4.64 pound per lin. foot
6.	Gate posts, over 6’ to 13’ ht.	4” o.d. @ 6.56 pounds per lin. foot

E. Line and Terminal Post Caps: These shall be heavy galvanized pressed steel, sized to fit tightly over posts to prevent entry of moisture.

F. Fence Rails: All rails shall be hot dipped galvanized steel pipe 1.66 inch o.d. at 1.82 pounds per lineal foot minimum.

G. Stretcher Bars: These shall not be less than 3/16" thickness x 3/4" width, and length shall be within 1" of full height of fabric.

H. Post Brace Assembly: Same material and size as top rail for brace, and 3/8-inch diameter galvanized steel truss rods with adjustable tightener.

I. Fabric Fasteners: Band-its or approved equal. Ties shall be 0.020" thickness, 200/300 series stainless steel, ½" wide bands, with a minimum breaking strength of 850 lbs. 1/2" band capacity ear-lokt design buckles shall be manufactured with 0.050" thick material, 201/301 series stainless steel.

J. Miscellaneous Fittings: All fittings shall be hot-dip galvanized pressed steel.

K. For additional requirements, see Project Special Conditions.

2.02 CHAIN LINK GATES

A. Single and Double Swinging Gate and Hardware: Swing gates and hardware shall be manufactured to meet the requirements of ASTM F900.

B. Hinges: Industrial butt hinges, size and material as required for the gate size, non-lift-off type

C. Latch (for both single and double gates): Pressed steel, industrial series gate latch, straight fork type. For double gates, provide latch catch designed to permit operation from either side of gate, with padlock eye as integral part of latch catch.

D. Gate Cross-Bracing: 3/8-inch diameter galvanized steel truss rods and adjustable tightener

E. Gate posts: See chain link fence requirements in 2.01 of this Section.

F. Gate frames shall comply with ASTM F 900-94.

G. PVC Coating: All parts of the chain link gates shall be PVC-coated, as specified under 2.03 of this Section. The color shall be black.

H. For additional requirements, see Project Special Conditions.

2.03 POLYVINYL CHLORIDE (PVC) COATINGS

A. PVC coating shall be applied in accordance with ASTM F668 Class 2a.

B. The chain link fencing and gate framework shall be subjected to a complete thermal stratification coating process (multi-stage, high-temperature, multi-layer) including, as a minimum, a six-stage pretreatment/wash (with zinc phosphate), an electrostatic spray application of an epoxy base, and a separate electrostatic spray application of a polyester finish. The material used for the base coat shall be a zinc-rich (gray color) thermosetting epoxy; and the minimum thickness of the base coat shall be two (2) mils. The material used for the finish coat shall be a thermosetting "no-mar" TGIC polyester powder; and the minimum thickness of the finish coat shall be two (2) mils. The stratification-coated pipe shall demonstrate the ability to endure a salt-spray resistance test in accordance with ASTM B117 without loss of adhesion for a minimum exposure time of 3,500 hours. Additionally, the coated pipe shall demonstrate the ability to withstand exposure in a weather-ometer apparatus for 1,000 hours without failure in accordance with ASTM D1499 and to show satisfactory adhesion when subjected to the crosshatch test, Method B, in ASTM D3359. The polyester finish coat shall not crack, blister or split under normal use.

C. Painted framework and accessories are not acceptable, and welded joints shall be top-coated to match frame color.

D. Color of the PVC-coated framework and accessories shall be black and in accordance with ASTM F934.

2.04 OTHER MATERIALS

A. Concrete for footings and mow strips (where applicable) shall comply with Section 03 30 53 – Cast-in-Place Cement Concrete.

PART 3 – EXECUTION

3.01 CHAIN LINK FENCE AND GATE INSTALLATION

A. The Contractor shall locate and install all posts in concrete footings, plumb and true to line and grade and to the height as indicated in the Drawings.

B. Cement concrete footings and mow strips (where applicable) shall be installed in accordance with the Drawings and Section 03 30 53 – Cast-in-Place Cement Concrete.

C. Post spacing shall not exceed ten (10) feet on center.

D. All end and corner posts shall be braced to the nearest line post with center brace rails.

Outside sleeve type top rail couplings shall be placed a maximum of twelve (12) inches from posts.

E. Chain link fence shall have continuous top and bottom rails.

F. All fences shall have a top and bottom rail. Six foot high fences shall have one central brace rail, and eight and ten foot fences shall have two intermediate brace rails, with all rails equally-spaced.

G. Outside sleeve type couplings at least 6" long shall be provided approximately every 20' in a given "run" of fencing; one coupling in every five shall contain a heavy spring to compensate for expansion and contraction.

H. The top rail shall pass through the loops of line post caps and form a continuous brace from end to end of each stretch of fence. The top rail shall be securely fastened to terminal posts by pressed steel connections.

I. Bottom rail shall be joined to line posts with boulevard clamps.

J. Stretcher bars shall be arranged for attaching the fabric to all terminal posts by threading through fabric. One stretcher bar shall be provided for each gate and terminal post and two for each corner and pull post.

K. Fabric shall be stretched uniformly taut and as tight as possible, true to line and grade and complete in all details. The Contractor shall install tension bars at corners. Bands and clips to tie fabric to rails and posts shall be spaced as indicated in the Drawings or these Specifications.

L. All chain link fence fabric shall be fastened on the outside of the posts unless directed otherwise by the Owner’s Representative. The fabric shall be properly stretched and securely fastened to the posts, and between posts the top and bottom of the fabric shall be fastened to the horizontal braces, where applicable, as specified, herein.

M. The fabric shall be fastened to end and corner posts with tension bars and stretcher bar bands, with fasteners spaced at twelve (12) inch intervals. All fabric shall be aligned so that top row of the fabric mesh is tied to the top rail every twelve (12) inches on center and so that the bottom of the fabric mesh stands one (1) inch above the finish grade and that the bottom row of the fabric mesh is tied to the bottom rail every twelve (12) inches on center. When applicable, all fabric shall be tied to the middle rails at twelve inches (12) on center. Fabric shall also be fastened to line posts at twelve (12) inches on center.

N. Fabric shall be aligned so that top and bottom extend one half the height of the “diamond” beyond outer edge of top and bottom of the horizontal rail. Horizontally-overlapping fence fabric sections shall overlap one full height of the “diamond” and be centered on the horizontal rail.

O. All fastener bands shall be pulled tight and raw ends of steel bands shall be secured in buckle by folding ear tabs around steel bands as per manufacturer's recommended installation procedure. No sharp edges shall protrude from band-it buckles.

P. Rolls of wire fabric shall be joined by weaving strands into the ends of the rolls to form a continuous mesh.

Q. Corner posts (as described above) shall be used wherever a change of direction occurs.

R. Gate hinges shall be offset to permit 180 degree gate opening. Contractor shall provide one pair of hinges for each leaf. Gates eight feet and taller in nominal height shall have three hinges per leaf. Hinges shall be spot-welded to post.

S. Double gates shall include two latches/catches.

T. All gates shall be equipped with one gate stop.

U. Gate framework joints shall be welded and coated in accordance with ASTM A780, employing zinc-rich paint.

V. For additional requirements, see Project Special Conditions.

END OF SECTION

SECTION 32 33 00
SITE FURNISHINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Aluminum team benches
2. Trash receptacles
3. Picnic tables
4. Benches with backrests
5. Benches without backrests
6. Bike rack

C. The locations of all site furnishings shall be marked in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 03 30 53 – Cast-in-Place Cement Concrete

1.03 REQUIRED SUBMITTALS

A. The Contractor shall provide complete product literature and applicable color samples for all site furnishings, for approval by the Owner's Representative, prior to ordering the furnishings.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. The Contractor shall be responsible for timing the delivery of site furnishing materials so as to minimize on-site storage time prior to installation. All stored materials shall be protected from weather, careless handling, and vandalism.

B. The Contractor shall store materials under waterproof covers on planking clear of ground and protect from handling damage, dirt, stain, water and wind.

C. The Contractor shall take all necessary precautions to prevent all items from chipping, cracking, or other damage during the transportation of these materials to the project site, unloading, and storage on the site. The Contractor shall lift items with wide-belt type slings wherever possible; they shall not use wire rope or ropes containing tar or other substances which might cause staining. If required, they shall use wood rollers and provide cushioning

at end of wood slides. Damaged items will not be allowed to be installed and should any damaged items be found in constructed work, such items shall be removed immediately and replaced, and the Contractor shall assume all expenses incurred therefrom.

D. Stored materials shall be adequately protected against moisture by one (1) stacking in such a manner as to allow a complete circulation of air under each stack, and two (2) covering each stack, including top and sides, with a waterproof paper or membrane. Coverings shall remain in place at all times, when not working from the particular stack.

1.05 EXAMINATION OF CONDITIONS

A. The Contractor shall fully inform themselves of existing conditions of the site and shall be fully responsible for carrying out all work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. The installer shall examine previous work, related work, and conditions under which this work is to be performed and notify the Contractor in writing of all deficiencies and conditions detrimental to the proper completion of this work. At the beginning of work, the installer shall accept substrates, subgrades, previous work, and conditions. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.

B. The Contractor shall be solely responsible for judging the potential need for storing materials temporarily and/or re-handling items prior to final installation.

1.06 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 ALUMINUM TEAM BENCHES

A. Team benches shall be anodized aluminum, 7.5 or 8 feet long without backrest. Subject to compliance with requirements, the Contractor shall provide products by one of the following or approved equal:

1. National Recreation Systems, (888) 568-9064, www.bleachers.net

2. Outdoor Aluminum, (800) 225-4249, www.outdooraluminum.com

3. Seating Solutions, (888) 959-7328, www.seatingsolutions.com

B. Each bench shall have minimum three 2.375” O.D. galvanized steel pipe legs for permanent installation.

C. Bench plank end caps shall be channel design with a matching finish and pop riveted at two points to underside of seat and foot boards. Die-formed end caps are not be acceptable.

D. Quantity of team benches: 2

2.02 TRASH RECEPTACLES

A. Trash receptacles shall be surface-mounted model # 287-32SH, black color, by DuMor Site Furnishings, Inc., (represented by O'Brien and Sons, Phone # 800-835-0056, www.obrienandsons.com); or approved equal.

B. Quantity of trash receptacles: 2

2.03 PICNIC TABLES

A. Square picnic tables with 3 and 4 seats shall meet the following specifications, and shall be in-ground mounted model 76-34 PL (4-seat) and 76-33 PL (3-seat), with gray color slats and black frame, by DuMor Site Furnishings, Inc., (rep. O'Brien and Sons, Phone # 800-835-0056, www.obrienandsons.com); or approved equal.

B. Picnic tables shall meet the following requirements:

1. 3" x 4" recycled high density polyethylene (HDPE) plastic slats, gray color
2. Steel post and supports, coated with zinc-rich epoxy primer and finished with polyester powder coat, black color
3. Center post: 4" square x 3/16" thick steel tube
4. Horizontal supports: 2-1/2" square x ¼" thick steel tubes

C. Quantities of picnic tables: 3 with three seats; and 1 with four seats

2.04 BENCHES WITH BACKRESTS

A. Benches with backrests shall be surface-mounted model # 117-60, black color, by DuMor Site Furnishings, Inc., (rep. O'Brien and Sons, Phone # 800-835-0056, www.obrienandsons.com); or approved equal.

B. Quantity of benches with backrests: 6

2.05 BENCHES WITHOUT BACKRESTS

A. Benches without backrests shall be surface-mounted model # 501-60HSNA, black color, by DuMor Site Furnishings, Inc., (rep. O'Brien and Sons, Phone # 800-835-0056, www.obrienandsons.com); or approved equal.

B. Quantity of benches without backrests: 1

2.06 BIKE RACKS

A. Bike rack shall be model # 125-40, with S-1 embedment, black powder-coat color, by DuMor Site Furnishings, Inc., (rep. O'Brien and Sons, Phone # 800-835-0056, www.obrienandsons.com); or approved equal.

B. Quantity bike racks: 1

PART 3 – EXECUTION

3.01 ALUMINUM TEAM BENCHES

A. Team benches shall be in-ground mounted in cement concrete footings. See the Drawing detail and Section 03 30 53 (Cast-in-Place Cement Concrete) for footing requirements.

B. All aluminum parts in contact with cement concrete shall be coated with zinc chromate paint to a minimum of a three (3) mils thickness.

C. The aluminum team benches shall be set and bolted in place. The Contractor shall dip all nuts in locktite or lochnut epoxy or approved equal, to secure permanently.

3.02 TRASH RECEPTACLES

A. Trash receptacles shall be assembled and secured to concrete surface in accordance with manufacturer's written instructions and the Drawing detail.

3.03 PICNIC TABLES

A. Picnic tables shall be in-ground mounted in cement concrete footings. See the Drawing detail and Section 03 30 53 (Cast-in-Place Cement Concrete) for footing requirements.

B. Picnic tables shall be assembled and installed in accordance with manufacturer's written instructions and the Drawing detail. Tables and attached seats shall be level.

3.04 BENCHES WITH AND WITHOUT BACKRESTS

A. Benches with and without backrests shall be assembled and installed in accordance with the manufacturer's written instructions and the Drawing detail.

B. The Contractor shall surface-mount benches to concrete surface with 1/2" x 3-3/4" galvanized expansion anchor bolts and steel plates provided by manufacturer.

3.05 BIKE RACK

A. Bike rack shall be in-ground mounted in cement concrete footings. See the Drawing detail and Section 03 30 53 (Cast-in-Place Cement Concrete) for footing requirements.

END OF SECTION

SECTION 32 84 00
IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. New automatic irrigation system

1.02 WORK INCLUDED

A. Work to be done includes furnishing all labor, materials, equipment and services required to complete all irrigation work indicated on the drawings, as specified herein, or both for the new landscape design. All equipment shall be manufactured in the U.S.A.

B. The mechanical point of connection for the irrigation system shall be to a new 1-1/2-inch domestic water supply, with new meter, backflow and cabinet provided generally where indicated on the drawings. See Civil for water supply information.

C. The electrical point of connection for the irrigation system shall be to a new 120-volt, 20-amp electrical circuit dedicated for irrigation use, originating from electrical enclosure. See electrical drawings for information on the 120-volt power supply

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

E. All necessary changes to the drawings to avoid any obstacles shall be made with the approval of the Owner's Representative.

F. Backfilling and bedding materials, together with the testing of the completed installation shall be included in this work.

G. The work shall be constructed and finished in every respect in a good, workmanlike and substantial manner, to the full intent and meaning of the drawings and specifications. All parts necessary for the proper and complete execution of the work, whether the same may

have been specifically mentioned or not, or indicated on the Drawings, shall be done or furnished in a manner corresponding with the rest of the work as if the same were specifically herein described.

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

1.03 SCOPE

A. The irrigation system shown on the drawings and described within these specifications represents a single controller irrigation system supplied from domestic water. The irrigation system designed for 20 gallons per minute maximum with a minimum 60-psi dynamic pressure at full system flow.

1.04 RELATED WORK

A. Carefully examine all Contract Documents for requirements that affect work of this section.

1. Earthwork
2. Utilities
3. Planting
4. Seeding and sodding.

1.05 ORDINANCES, PERMITS AND FEES

A. Work under this section shall comply with all ordinances and regulations of authorities having jurisdiction.

B. Obtain and pay for any and all permits, tests and certifications required for the execution of work under this section.

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

1.06 QUALITY ASSURANCE

A. Installer: Firm that has at least five (5) years experience in work of the type and size required by this section and which is acceptable to the Owner's Representative.

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

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

1. American Society for Testing & Materials (ASTM)

   a. ASTM: D1784 Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
   b. ASTM: D1785 Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and Cl200.
   c. ASTM: D2464 Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   d. ASTM: D2466 Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   e. ASTM: D2564 Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   f. ASTM: B43-98 Brass pipe.
   g. ASTM: B88-99 Seamless Copper Water Tube.
   h. ASTM: b828-00 Soldered Copper Joints.

2. National Standard Plumbing Code (NSPC)

3. National Electric Code (NEC)

4. National Sanitary Foundation (NSF)

5. American Society of Agricultural and Biological Engineers (ASABE)

6. Underwriters Laboratories, Inc. (UL)

7. Occupational Safety and Health Administration (OSHA)

1.07 TESTS

A. Observation: The Owner's Representative will be on site at various times to ensure the system is being installed according to the specifications and drawings.

B. Coverage Test: After completion of the system, test the operation of entire system and adjust drip irrigation as directed by the Owner's Representative. Demonstrate to the Owner's Representative that all irrigated areas are being adequately covered. Furnish and install materials required to correct inadequacies of coverage due to deviations from the drawings or where the system is obviously inadequate or inappropriate (see Part 3 - Execution).

C. The Owner's Representative shall be notified 7 days in advance for observations.

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

1.08 SHOP DRAWINGS

A. Provide copies of product specification sheets on all proposed equipment to be installed to the Owner's Representative for approval prior to the start of work, in accordance with

the parameters of Division 1. Work on the irrigation system may not commence until product sheets are submitted and approved. Submittals shall be marked up to show proper sizes, flows, etc.

B. Equipment shall include, but not be limited to:

1. Sprinklers and Nozzles
2. Valves: Manual and Automatic
3. Flow Sensor
4. Controller
5. Controller Enclosure
6. Grounding
7. Wireless Rain Sensor
8. Valve Boxes
9. Pipe and Fittings
10. Wire and Connectors
11. Quick Coupling Valve
12. Miscellaneous Materials

C. Project Record Documents:

1. Provide and keep up-to-date a complete redlined record set of drawings of the system as the project proceeds. Drawings shall be corrected daily, showing every change from the original drawings and specifications. Record drawings shall specify and exactly locate drip irrigation installed. Each valve box location to be referenced by distance from a minimum of two permanent locations. Controller, soil moisture sensors, manual flushing valves, quick coupling valves and all other equipment shall be indicated on the drawings. All wire routing, wire size and splices shall be indicated. Main line pipe and wire route shall have two (2) distinctly different graphic symbols (line types). This redlined record set of drawings shall be kept at job site and shall be used only as a record set.

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

1.09 DELIVERY, STORAGE AND HANDLING

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

1.10 GUARANTEE

A. Obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities.

B. In addition to the manufacturers guarantees, warrant the entire irrigation system, both parts and labor for a period of one (1) year from the date of acceptance by the Owner.

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

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

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

1.11 COORDINATION

A. At all times coordinate work closely with the Owner's Representative to avoid misunderstanding and to efficiently bring the project to completion. The Owner's Representative shall be notified as to the start of work, progression and completion, as well as any changes to the drawings before the change is made. Coordinate work with all subcontractors.

B. Pay for all damage to other work caused by work, workmen or subcontractors. Repairing of such damage shall be done by the contractor who originally installed the work or as directed by the Owner's Representative.

1.12 MAINTENANCE AND OPERATING INSTRUCTIONS

A. Include in bid an allowance for two (2) hours of instruction of Owner and/or Owner's personnel upon completion of check/test/start-up/adjust operations by a competent operator (The Owner's Representative office shall be notified at least one (1) week in advance of check/test/start-up/adjust operations).

B. Upon completion of work and prior to application for acceptance and final payment, a minimum of three (3) three ring, hard cover binders titled MAINTENANCE AND OPERATING INSTRUCTIONS FOR THE LAKE VIEW PLAYGROUND IMPROVEMENTS IRRIGATION SYSTEM, shall be submitted to the Owner's

Representative office. After review and approval, the copies will be forwarded to the Owner. Included in the Maintenance and Operating binders shall be:

1. Table of Contents

2. Written description of Irrigation System.

3. System drawings:

   a. One (1) copy of the original irrigation plan;
   b. One (1) copy of the Record Drawing;
   c. One (1) reproducible of the Record Drawing;
   d. One (1) copy of the controller valve system wiring diagram

4. Listing of Manufacturers.

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

   a. "APPROVED" submittals of all irrigation equipment;
   b. Operation:
   c. Maintenance: including complete troubleshooting charts.
   d. Parts list.
   e. Names, addresses and telephone numbers of recommended repair and service companies. A copy of the suggested "System Operating Schedule" which shall call out the controller program required (zone run time in minutes per day and days per week) in order to provide the desired amount of water to each area under "no-rain" conditions.

6. Winterization and spring start-up procedures.

7. Guarantee data.

PART 2 - PRODUCTS

2.01 GENERAL

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

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

2.02 PVC IRRIGATION PIPE

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

B. All mainline pipe shall be PVC, Class 200 Pressure Pipe, Type 1120, Solvent-Weld PVC, conforming to ASTM No. D1785 as manufactured by Certainteed, Cresline, JM or equal.

2.03 WIRE CONDUIT

A. Conduit as shown on the drawings shall be Schedule 40 PVC conduit with solvent-weld joints, as manufactured by Certainteed, Cresline, JM or equal.

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

C. Conduit for above ground wiring to controller shall be galvanized, rigid metallic conduit.

2.04 PVC IRRIGATION FITTINGS

A. Fittings for solvent weld PVC pipe shall be Schedule 40 solvent weld PVC fittings as manufactured by Dura, Lasco, Spears or equal.

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

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

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

E. All nipples to be schedule 80 PVC.

2.05 POLYETHYLENE IRRIGATION PIPE

A. Polyethylene (PE3408) pipe, SDR 15, Class 100, Type III, Grade 3, Class C conforming to ASTM D2239, with a minimum pressure rating of 100 psi as manufactured by Oil Creek or equal. Polyethylene pipe shall only be used for drip zone supply and exhaust headers.

2.06 POLYETHYLENE IRRIGATION FITTINGS

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

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

2.07 BRASS FITTINGS

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

2.08 ROTARY SPRINKLERS

A. Rotary sprinklers shall be gear-driven, rotary type heads, designed for in-ground installation with integral check valves and in-riser flow shut-off capability. Sprinkler shall be capable of covering a 18-25 foot radius and flow range of 0.5-2.0 gpm at 50-55 pounds per square inch of pressure. Sprinklers shall have a one hundred percent warranty for two years minimum against defects in workmanship.

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

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

D. Sprinklers shall be manufactured by Rain Bird model 5004-PL-SAM or approved equal.

E. Approved Performance Chart (25’ Spacing):

Model	Pressure	Arc	Nozzle	Flow	Radius
Rain Bird 5004-PL-SAM	45psi	90 Deg.	MPR 25Q	1.00	26’
Rain Bird 5004-PL-SAM	45psi	180 Deg.	MPR 25H	1.98	27’

2.09 ELECTRIC CONTROL VALVES

A. Electric control valves shall be 1-inch remote control, diaphragm type, fiberglass or reinforced nylon body plastic valves with manual flow control, manual bleed screw and 200 psi pressure rating.

B. Valves shall be manufactured by Rain Bird PEB or approved equal.

2.10 VALVE BOXES

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

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

C. Valve boxes for multiple electric valves shall be 12-inch standard valve boxes with metal detection and bolt down covers. When multiple electric valves are installed in the same area, they are to be installed two (2) valves per box in a 12-inch standard box.

D. Valve box for wire splices shall be 10 inch round valve boxes with detectable discs. All splices shall be in separate valve boxes and not included with isolation valves. 24 volt splices shall have gray lids.

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

F. Valve boxes shall be manufactured by Highline Products, Oldcastle Specification Grade, NDS Pro Series or approved equal.

2.11 AUTOMATIC CONTROLLER

A. Controller shall be electronic in construction with capability of 1 second to 6 hour run times per zone. Controllers to have minimum six independent programs, auto/off switch and be capable of manual, semi-automatic and automatic operation. Controller shall have water budgeting feature, cycle and soak feature, sensor input terminal, locking, weather resistant metal cabinet and internal transformer. Terminal strip connection shall be easily accessible. The controller shall be U.L. listed, 120-volt, 60 Hertz, A.C. type.

B. Controller shall be as manufactured by Rainbird, model ESP-LXME2P with IQ4GUSA cellular communication card to enable communication with the City of Worcester Rain Bird IQ4 centralized irrigation control system.

C. Contractor shall provide 1 year of cellular data service as part of their bid.

D. Station quantity shall be minimum of 8.

2.12 AUTOMATIC IRRIGATION CONTROLLER ENCLOSURE

A. Enclosure shall be vandal and weather resistant in nature manufactured entirely of 304-grade stainless steel. The main housing door shall be louvered at the bottom and equipped with a hollow center thermoplastic door seal. The entry lip shall be louvered on the backside. Filter screens shall cover all louvers. The top entry lid shall have two gas springs, for easy access, a continuous stainless steel piano hinge, and a three-point locking mechanism with provisions for padlock. Removable stainless-steel tray shall be provided and installed for the mounting of electronics and other equipment.

B. Enclosure shall be a NEMA 3R Rainproof Enclosure and UL-Listed.

C. Controller shall be mounted on provided concrete pad (see Drawing details).

D. Controller enclosure shall be 24 inches wide x 17 inches deep x 38 inches tall, as manufactured by Strong Box, model SB-22SS or approved

2.13 GROUNDING EQUIPMENT

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

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

2.14 CONTROLLER SURGE ARESSTOR

A. The modular surge arrester shall be a single phase, two pole arrester designed to protect single or split phase 120 volt or 120/240 volt electrical systems. Electrical connections shall be embedded in a UL recognized epoxy to seal and protect them from moisture and corrosion.

B. The surge arrestor shall be molded from weather and UV resistant polycarbonate, complying with the UL Standard for flame and strength resistance.

C. Surge Arrestor shall be manufactured by Intermatic model, AG2401C, Rainbird model LSP-1, Hunter Industries ICD-XXX decoder with surge suppression with ground wire, or approved equal.

D. Manufacturer's names and/or model numbers identified herein are intended to assist in establishing a general level of quality, configuration, functionality, and appearance required. This is NOT a proprietary specification and it should be noted that "Or equal" applies to all products denoted herein. It is understood that all manufactures will have minor variations in configuration, appearance, and product specifications and such minor variations shall not eliminate such manufacturers as an equal". It is the intent of this specification to encourage open and competitive involvement from multiple manufacturers that are able to supply similar products.

2.15 RAIN SENSOR

A. Wireless rain sensor shall be plastic in construction with adjustable interruption point, and 1/2-inch IPS threads. Rain sensor with receiver shall be manufactured by Hunter Industries, model Rain-Clik with or approved

2.16 NORMALLY OPEN MASTER VALVE

A. Normally open master control valve shall be 1-inch in size. Valve shall provide dirty water protection and have no minimum flow feature.

B. Valve shall come with two-piece upper diaphragm and lower seat assembly. Valve shall operate within a pressure range of 20psi-200psi and have an in-rush current of 0.45amps and a holding current of 0.30 amps at 24VAC.

C. Valve shall be designed with removable filter and metering rod assembly and non-continuous flow through the solenoid. Rubber parts shall be EPDM rubber parts.

D. Master valve shall be brass construction as manufactured by Buckner/Superior, model 3300100-RW or approved equal.

2.17 FLOW SENSOR

A. An irrigation main line flow sensor shall be provided and installed in accordance with drawings at each irrigation point of water service. Refer to drawings for location.

Contractor shall be responsible for installation, hook-ups, materials, components, and connection of flow sensors to the irrigation controller for complete automatic operation of the system.

B. Flow sensor shall have a working pressure of 140 psi and be mode of corrosion proof copper alloy with polyester coating.

C. Flow sensor shall be as manufactured by Baseline Irrigation, model BL-BFM100, installed as recommended by the manufacturer, and as indicated on drawing, and as specified.

2.18 QUICK COUPLING VALVE

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

B. The top of the valve body receiving the key shall be equipped with ACME threads and smooth face to allow the key to open and close the valve slowly. The quick coupling valve shall be equipped with a vinyl cover.

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

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

E. Contractor shall provide two (2) keys for quick couplers and two (2) 1-inch x 3/4-inch swivel hose ells.

F. Quick coupling valve, key and swivel shall be manufactured by Hunter Industries, model HQ-44RC-AW, HK-44 and HS-1 or approved equal.

2.19 WIRE

A. All valve control wire shall be minimum #14-awg, common #14-awg, single strand, solid copper, UL- approved direct burial AWG-U.F. 600V and shall meet all state and local codes for this service. Individual wires must be used for each zone valve. Common wire shall be white in color, control wire for rotor zones shall be red in color, and spare wires, installed where indicated on the drawings shall be blue. White color shall be used for common wire only.

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

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

2.20 ISOLATION VALVE

A. Isolation valve 1-1/2-inch in size shall be gate type, of bronze construction, US Manufacture, 200 WOG with steel cross handle and 200 psi rating. Gate valves to be as manufactured by Nibco, model T-113-K, or approved equal.

2.21 SWING JOINTS

A. Rotator type sprinklers shall be installed on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Quick coupling valves to be installed on 1-inch prefabricated PVC unitized swing joint assemblies with double o-ring seals, minimum 315 psi rating and minimum length of 12 inches with brass insert and stabilizer (unless stabilizer is an integral part of quick coupling valve).

2.22 CRUSHED STONE

A. Crushed stone shall be placed, compacted, and leveled in valve box excavations prior to installation of valve box. Stone shall not be poured into valve boxes after installation.

B. Crushed stone shall have minimum particle size of ¾".

2.23 SAND

A. Sand used for backfilling of trenches; under, around and over PVC lines shall be as specified in SECTION: EARTHWORK.

2.24 SPARE PARTS

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

1. Two (2) wrenches or keys for disassembling and adjusting each type of sprinkler head provided.
2. One (1) quick coupler key assembly for each type of quick coupling valve provided.
3. One (1) of each size electric control valve used in project.
4. Two (2) of each type sprinkler head and pattern (PC & FC) used in project.
5. Two (2) of each type nozzle used in project.

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

PART 3 - EXECUTION

3.01 GENERAL

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

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

C. All work indicated on the drawings shall be provided whether or not specifically mentioned in the specifications.

D. When ambiguities between drawings and specifications exist and specific interpretation or clarification is not issued prior to bidding, the interpretation or clarification will be made only by Owner's Representative. In the event the installation contradicts the directions given, the installation shall be corrected at no additional cost to Owner.

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

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

G. Layout of irrigation lines indicated on drawings is diagrammatic only. Location of irrigation equipment is contingent upon and subject to integration with the planting. Employ all data contained in the contract documents and shall verify this information at the construction site to confirm the manner by which it relates to the installation.

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

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

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

3.02 PIPE AND FITTINGS INSTALLATION

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

B. Loam or topsoil encountered within the limits of trench excavation for irrigation mains and branch lines shall be carefully removed to the lines and depths as shown on the Drawings and stockpiled for subsequent replacement in the upper 6 inches of the trench from which it is excavated. Such removal and replacement of the quantities of loam shall be considered incidental to the irrigation system and no additional compensation will be allowed therefore.

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

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

E. Do backfilling when pipe is cool. During hot weather cool pipe by operating the system for a short period, or by backfilling in the early part of the morning before the heat of the day.

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

G. Where feasible, Owner's Representative may authorize the use of flooding in lieu of tamping.

H. Restore grades and repair damage where settling occurs.

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

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

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

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

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

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

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

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

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

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

3.03 ELECTRICAL WIRE CONDUIT INSTALLATION

A. Electrical conduit shall be installed where indicated on drawings.

B. Conduit shall extend 18 inches beyond edges of walls and walkways.

3.04 ISOLATION VALVE INSTALLATION

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

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

3.05 VALVE BOX INSTALLATION

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

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

3.06 ELECTRIC CONTROL VALVE INSTALLATION

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

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

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

3.07 WIRING INSTALLATION

A. Wiring shall be installed along with the main line. Sufficient slack for expansion and contraction shall be maintained and wiring shall at no point be installed tightly. Provide and install an additional 8 inches to 12 inches slack at all changes of direction. Wiring in valve boxes shall be a sufficient length to allow the valve solenoid, splice, and all connections to be brought above grade for servicing. This additional slack shall be coiled for neatness in the valve box.

B. All wire shall be laid in trenches and shall be carefully backfilled to avoid any damage to the wire insulation or wire conductors themselves. The wires shall have a minimum of 16 inches of cover. Wire not to be installed that day shall not be laid out.

C. All in-ground wire connections shall be waterproofed with 3M DBY-6 splice kits. All splices shall be made in valve boxes (wire runs requiring splices between valve locations shall be provided and installed in splice box-valve box shall be used). Splice locations shall be shown on the record drawings.

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

3.08 CONTROLLER INSTALLATION

A. Install controller in new stainless steel pedestal enclosure per detail. Wire valves and rain sensor receiver into controller and set proper program

B. Wire controller to 120-volt electrical supply furnished and installed to controller location.

C. Install stainless steel pedestal to provided concrete pad using sleeve style masonry anchors spaced equally at six (6) locations minimum.

D. Coordinate final locations of electrical conduits for concrete pad with Owner's Representative

E. Keys shall be turned over to Owner's Representative,

3.09 CONTROLLER GROUNDING INSTALLATION

A. Grounding rod shall be driven into the ground its full length 12-feet from the controller and connected via a Cadweld or approved equal connection to #6 solid, bare copper wire. The copper wire is to be installed in as straight a line as possible, and if it is necessary to make a turn or bend, it shall be done in a sweeping curve with a minimum radius of 8 inches and a minimum included angle of 90 degrees. There shall be no splices in the bare copper wire. The top of the ground rod shall be driven below the ground surface. A 4-inch grated cover as specified, set a minimum of 1-inch below grade, shall be placed over the ground rod and Cadweld or approved equal connection for periodic maintenance. Cover shall be installed on a minimum of 6 inches of 4-inch ADS corrugated polyethylene, perforated drainage pipe. Plate shall be installed 36 inches below grade with 50 lbs of Power Set or approved equal ground enhancement material spread evenly below the plate and 50 lbs of Power Set or approved equal ground enhancement material spread evenly above the plate in accordance with the manufacturer's requirements. Plates shall also be covered with a 4 inch grated cover as specified, set a minimum of 1-inch below grade, to facilitate drainage onto the plate. Cover shall be installed on a minimum of 36 inches of 4-inch ADS or approved equal corrugated polyethylene, perforated drainage pipe.

1. When tested, grounding grid shall have an earth resistance no greater than 10 ohms. If earth resistance is greater than 10 ohms, additional grounding rods and/or plates and enhancement material shall be added to system until desired test results have been meet. The minimum requirements of the NEC shall be met, which are:

   a. a resistance reading of no more than 25 ohms or
   b. a two-electrode ground grid.

B. When tested, ground shall meet the requirements of the NEC.

3.10 RAIN SENSOR INSTALLATION

A. Install wireless rain sensor on light pole or approved location per manufacturer's recommendations. Coordinate final location of rain sensor with Owner's Representative. Rain sensor shall be in direct contact with the weather and not in contact with the irrigation spray. Install receiver inside the controller pedestal.

3.11 SPRINKLER INSTALLATION

A. Sprinklers shall be installed flush (perpendicular) to grade on swing pipe assemblies, minimum length 6 inches, maximum 18 inches.

B. Sprinklers shall not exceed maximum spacing indicated

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

3.12 QUICK COUPLING VALVE INSTALLATION

A. Provide and install quick coupling valve where indicated on the drawings.

B. Quick coupling valve to be mounted on 1-inch prefabricated PVC unitized swing joint assemblies with integral o-rings, minimum length 12 inches with brass insert and stabilizer as per details.

3.13 CHECK/TEST/START-UP/ADJUST

A. Flushing:

1. After all irrigation equipment is installed open the control valves and flush out the system under a full head of water.

2. Flush the entire system after installation is complete and be responsible for any clogged emitters for thirty (30) days after substantial completion of this portion of the landscape irrigation system.

B. Testing:

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

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

3. All testing shall be at no additional expense to the Owner.

3.14 CLEANING AND ADJUSTING

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

B. Adjust drip irrigation equipment, valve boxes, and quick coupling valves to grade as required, so that they will not be damaged by maintenance operations.

C. Continue drip irrigation coverage adjustment as required by settlement, etc., throughout the guarantee period.

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

3.15 ACCEPTANCE AND OPERATION BY OWNER

A. Upon completion of the work and acceptance by the Owner, the Owner's Representative(s) in the operation of the system (provide minimum 7 days written notice in advance of test). Furnish, in addition to the record drawings and operational manuals, copies of all available specification sheets and catalog sheets to the Owner's personnel responsible for the operation of the irrigation system.

B. Guarantee all parts and labor for a minimum period of one (1) year from date of acceptance.

3.16 CLEAN UP

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

B. Remove all debris resulting from work of this section.

C. Regrade, lightly compact, and replant around drip irrigation where necessary to maintain proper vertical positioning in relation to established grade.

D. Fill all depressions and eroded channels with sufficient soil mix to adjust grade to ensure proper drainage. Compact lightly, and replant filled areas in accord with drawings requirements.

END OF SECTION

SECTION 32 91 13
LOAM

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this Section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Loam for general turf and planting areas

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 31 23 10 – Earthwork
B. Section 32 92 19 – Seeding
C. Section 32 92 23 – Sodding

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. AOAC: Association of Official Agricultural Chemists
2. ASTM: American Society for Testing and Materials
3. USDA: United States Department of Agriculture

1.04 SUBMITTALS AND QUALIFICATIONS

A. The Contractor shall provide soil test analyses of loam to the Owner's Representative. Test analyses shall include both physical and chemical properties of each type of soil. Chemical analyses shall be performed in accordance with the current "Standards of the Association of Official Agricultural Chemists". The Contractor shall pay for testing.

1. Physical and chemical analyses shall be performed by a public extension service agency or a certified private testing laboratory in accordance with the current "Standards of the Association of Official Agriculture Chemists", and acceptable to the Owner's Representative.

2. Soil test report shall include a mechanical sieve analysis with soil classification. Organic content shall be reported. Chemical analysis shall include pH (1:1 soil-water ratio), buffer pH, soluble salts (1:2 soil-water ratio), nitrate nitrogen, ammonium nitrogen, phosphorus, potassium, calcium, aluminum, magnesium, manganese, ferric iron and sulfate.

3. Chemical test report shall clearly recommend appropriate limestone and fertilizer requirements.

4. Two tests shall be performed to determine organic material content: One prior to incorporation of organic matter additive, and another following incorporation.

B. The location and source of loam shall be submitted to the Owner's Representative.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver all items to the site in their original containers with all labels intact and legible at time of Owner's inspection.

B. The Contractor shall immediately remove from the site all materials which do not comply with the provisions of this Section of these Specifications.

C. Packaged Materials: The Contractor shall deliver packaged materials in containers showing weight, analysis, and name of manufacturer/source. They shall protect materials from deterioration during delivery, and while stored at site.

1.06 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 SCREENED LOAM

A. Screened loam shall be "Loam or Sandy Loam," determined by mechanical analysis (ASTM D-422) and based on the USDA Classification System.

B. Screened loam shall be a natural product consisting primarily of natural topsoil, free from subsoil, and obtained from an area which has never been stripped, as noted above. The location of the source of the loam shall be submitted to the Owner's Representative. Screened loam for general turf and planting areas shall not contain less than 5 percent nor more than 10 percent organic matter as determined by the loss on ignition of oven-dried samples, at 100°C ± 5°C. To adjust organic matter content, the soil may be amended, prior to site delivery, by the addition of composted leaf mold or peat moss. Use of organic amendments is accepted only if random soil sampling indicates a thorough incorporation of these materials.

C. Screened loam shall consist of fertile, friable, natural loam capable of sustaining vigorous plant growth. Loam shall be without admixture of subsoil and refuse, resulting in a homogeneous material free of stones greater than ½" in the longest dimension; free of lumps, plants, glass, roots, sticks, excessive stone content, debris, and extraneous matter as determined by the Owner's Representative. Screened loam shall fall within the pH range

of 6.0 to 6.5 except as where noted on plans and details. It shall be uncontaminated by salt water, foreign matter, and substances harmful to plant growth. The maximum soluble salt index shall be 100. Screened loam shall not have levels of aluminum greater than 200 parts per million.

D. The Owner will reject any material delivered to the site that, after post-delivery testing, does not meet these specifications. If the delivered screened loam does not meet the specifications stated in this document, it shall be removed by the Contractor at the Contractor's expense and at the time of rejection.

E. The Contractor shall take representative samples of loam and submit samples to a Soil Testing Laboratory for chemical and physical analysis. The Contractor shall indicate to the testing agencies that turf is to be planted and who the Owner is. The Contractor shall forward to the Owner two copies of analysis and recommendations of the testing agencies.

F. Topsoil, if stripped from the site, may be used provided that it can be made to comply with these Specifications for screened loam, and has not been found to contain contaminants above safe levels as per report(s) by BETA Group included in the bid package. Topsoil with unsafe contamination levels shall either be removed and disposed in accordance with the regulated soil removal requirements included in Section 31 23 10 (Earthwork); or used as fill beneath areas to be covered with asphalt, cement concrete, or resilient surfacing, provided that the topsoil meets the subgrade compaction requirements of Section 31 23 10 (Earthwork).

G. All loam provided from off-site sources shall meet specification requirements when brought to the site, in terms of physical properties and organic content. No mixing or amending of organic material in Loam will be permitted on site. No loam shall be spread prior to screening. The loam shall not be handled or moved when in a wet or frozen condition.

H. To assure imported loam fulfills specified requirements regarding textural analysis, organic matter content, and pH, soil testing results shall be obtained by the Contractor and submitted to the Owner's Representative for approval at least one (1) month before any soil is delivered to the site.

2.02 SOIL AMENDMENTS

A. Commercial fertilizer, peat, humus, or other additives shall be used by the Contractor to counteract soil deficiencies as recommended by the soil analysis and as directed by the Owner's Representative.

B. If stored at the site, the Contractor shall protect fertilizer from the weather elements at all times.

C. Fertilizer shall be commercial fertilizer containing at least sixty percent (60%) organic material.

1. Percentages of nitrogen, phosphorous and potash shall be based on laboratory test

recommendations as approved by the Owner's Representative. For purpose of bidding, the Contractor shall assume ten percent (10%) nitrogen, twenty percent (20%) phosphorus and six percent (6%) potash by weight. At least fifty percent (50%) of the total nitrogen shall contain no less than three percent (3%) water-insoluble nitrogen.

2. Fertilizer shall be delivered to the site, mixed as specified, in the original unopened standard size bags showing weight, analysis and name of manufacturer. Containers shall bear the manufacturer's guaranteed statement of analysis, or a manufacturer's certificate of compliance covering analysis shall be furnished to the Owner's Representative. The Contractor shall store fertilizer in a weatherproof place and in such a manner that it will be kept dry and its effectiveness will not be impaired.

D. Humus shall be natural humus. It shall be free from excessive amounts of zinc, low in wood content, free from hard lumps, and in a shredded or granular form. According to the methods of testing of the AOAC, the acidity range shall be approximately 5.5 pH to 7.5 pH and the organic matter shall be not less than 85% as determined by loss on ignition. The minimum water absorbing ability shall be 200% by weight on an oven-dry basis.

E. Manure shall be well-rotted, unbleached, stable manure not less than eight months and not more than two years old. It shall be free from sawdust, shavings, or refuse of any kind and shall not contain over twenty-five (25) percent straw. The Contractor shall furnish information as to the kind of disinfectant or chemicals, if any, that may have been used in storage of the manure.

F. Lime: Natural dolomitic limestone shall contain not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, and shall be ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.

G. Superphosphate shall be composed of finely ground phosphate rock as commonly used for agricultural purposes containing not less than 18% available phosphoric acid.

H. Aluminum Sulfate: Commercial grade.

I. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.

PART 3 - EXECUTION

3.01 FINE GRADING AND LOAMING

A. After the areas to be loamed have been brought to rough grade, and immediately prior to spreading the loam borrow or topsoil, the subgrade shall be loosened by disking or rototilling to a depth of at least three inches to permit bonding of the loam to the subsoil. The Contractor shall remove all stones greater than one (1) inch in diameter and all debris or rubbish. Such material shall be removed from the site, at no additional cost to the Owner.

B. The Contractor shall provide a minimum depth of six (6) inches of planting soil (loam) in all areas indicated for seeding, sodding, and planting, and all areas disturbed by excavation and construction operations.

C. Screened loam borrow or topsoil shall be placed and spread by the Contractor over approved areas to a depth sufficiently greater than six inches so that after natural settlement and light rolling, the completed work will conform to the lines, grades, and elevations indicated. The Contractor shall supply additional loam, after testing and approval as may be needed, to achieve the specified depths and finished grades under the Contract without additional cost to the Owner.

D. Disturbed areas outside the limit of construction shall be spread with six (6) inches of screened loam to the finished grade as specified herein above.

E. No subsoil or loam shall be handled in any way if it is in a wet or frozen condition.

F. Sufficient grade stakes shall be set by the Contractor for checking the finished grades. Stakes shall, at minimum, be set in the bottoms of swales and at tops of slopes. Grades shall be established which are accurate to one 0.05 foot either way. The Contractor shall connect contours and spot elevations with an even slope.

G. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, glass, roots, stumps, litter and other foreign matter, and stones over one inch in diameter shall be removed from the loam. Loam shall also be free of smaller stones in excessive quantities as determined by the Owner's Representative.

H. The whole surface shall then be rolled with a hand roller weighing not more than 100 pounds per foot of width. During the rolling, all depressions caused by settlements or rolling shall be filled with additional loam and the surface shall be re-graded and rolled until it presents a smooth and even finish to the required grade.

I. The Contractor shall obtain the Owner's Representative's written approval of fine grading and bed preparation before doing any seeding.

3.02 INCORPORATION OF SOIL AMENDMENTS

A. Loam shall not be placed until the Owner's Representative has approved the prepared subgrade.

B. For areas to receive sod, see Section 32 92 23 – Sod, Part 3, for incorporation of lime and fertilizer.

C. The Contractor shall incorporate humus in the soil as required by soil analysis, prior to delivery to site. The Contractor shall have loam re-tested with organic matter incorporated and shall obtain approval prior to bringing any loam to the site.

D. Soil amendments (not including humus) shall be spread and thoroughly incorporated into the layer of loam by harrowing or other methods approved by the Owner's Representative.

The following soil amendments shall be incorporated in all areas to be seeded with turfgrass (not in plant beds).

1. The Contractor shall spread and incorporate ground limestone into the loam as required by soil analysis to achieve a pH of 6.0 to 6.5, but no more than 200 pounds of limestone per 1,000 square feet of loam.

2. The Contractor shall spread fertilizer at the rate of forty (40) pounds per one thousand (1,000) square feet, or more as required by soil analysis.

3. The Contractor shall spread Superphosphate at the rate of twenty (20) pounds per one thousand (1,000) square feet.

END OF SECTION

SECTION 32 92 19
SEEDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this Section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Temporary seeding for erosion control
2. Any permanent seeding added to this contract
3. Maintenance of seeded areas during the construction period

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Related Sections: The following Sections contain requirements that relate to this Section.

1. Section 32 91 13 – Loam

1.03 QUALITY ASSURANCE

A. The contractor performing this work shall be a member in good standing of the Associated Landscape Contractors of America.

B. The contractor performing this work shall show previous evidence of having successfully installed and maintained landscape projects of similar scope to the subject project with regard to quantities of seeding involved, complexity, and a minimum of five (5) years of experience on projects similar to this one. The Owner's Representative shall have the right to review the qualifications and references of the Contractor for approval to work on this project.

C. Source Quality Control:

1. Analysis and standards: For materials other than those with manufacturer's certified analysis, the Contractor shall provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

D. Within 30 days after award of Contract and before any seeding materials are delivered to the job site, the Contractor shall submit to the Owner's Representative a complete list of all seed and other items proposed to be installed. At least 10 days prior to shipment and delivery of materials, the Contractor shall submit to the Owner's Representative a one (1) cubic foot representative sample, certifications, and certified test results for materials as

specified below. No material shall be ordered or delivered until the required submittals have been submitted and approved by the Owner's Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner reserves the right to reject, on or after delivery, any material that does not meet these specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall deliver all items to the site in their original containers with all labels intact and legible at time of Owner's inspection.

B. The Contractor shall immediately remove from the site all seeding materials which are not true to name, and all materials which do not comply with the provisions of this Section of these Specifications.

C. The Contractor shall use all means necessary to protect seeding materials before, during, and after installation and to protect the installed work and materials of all other trades.

D. Packaged Materials: The Contractor shall deliver packaged materials in containers showing weight, analysis, and name of manufacturer/source. They shall protect materials from deterioration during delivery, and while stored at the site.

1.05 PROJECT CONDITIONS

A. All areas to be seeded shall be inspected by the Contractor before starting work, and any defects, such as incorrect grading, etc., shall be reported to the Owner's Representative prior to beginning this work. The commencement of work by the Contractor shall indicate their acceptance of the areas to be seeded, and they shall assume full responsibility for the work of this Section.

1.06 REFERENCE STANDARDS

A. The work shall conform to the codes and standards of the following agencies and publications as further cited herein:

1. USDA: United States Department of Agriculture

1.07 QUALITY CONTROL / QUALIFICATIONS

A. The Contractor shall provide affidavits from manufacturers' major suppliers where required by these Specifications.

1.08 REQUIRED SUBMITTALS

A. The Contractor is required to submit the following items to the Owner's Representative prior to usage on this Project:

1. Seed - statement of composition percentages of purity and germination of each seed mix.

1.09 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 SOIL AMENDMENTS

A. See Section 31 91 13 (Loam) for soil amendment requirements.

2.02 SEED

A. Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year's crop and in no case shall weed seed content exceed 1% by weight. The seed shall be furnished and delivered in the proportions specified below in new, clean, sealed, and properly-labeled containers. All seed shall comply with State and Federal seed laws. The Contractor shall submit manufacturer's Certificate of Compliance. Seed that has become wet, moldy, or otherwise damaged shall not be acceptable.

B. Seed for general turf areas shall be composed of the following varieties, which shall be mixed in the approximate proportions indicated and shall test to minimum percentages, purity, and germination specified.

35 % Fine Fescue
33 % Kentucky Bluegrass
33 % Perennial Ryegrass

C. All turfgrass seed shall have a minimum purity of 98 percent and a germination rate of 85 percent.

D. All turfgrass seed shall be labeled to show that it is within the requirements of the USDA as to purity, germination and presence of restricted or prohibited weeds.

E. Any proposed product substitutions shall be presented to the Owner's Representative for approval prior to seeding.

2.03 MULCH

A. Mulch for non-hydroseeded turf areas shall be straw or salt marsh hay.

2.04 HYDRO MULCH AND SOIL STABILIZER

A. Wood Cellulose Fiber Mulch

1. Mulch to cover hydroseeded areas shall be fiber-processed from whole wood chips manufactured specifically for standard hydraulic mulching equipment. Fiber shall not

be produced from recycled material such as sawdust, paper, or cardboard.

2. Moisture content shall not exceed 10 percent, plus or minus 3 percent, as defined by the pulp and paper industry standards. Fiber shall have a water-holding capacity of not less than 900 grams of water per 100 grams fiber.

3. The mulch shall disperse into a uniform slurry when mixed with water. It shall be nontoxic to plant life or animal life.

4. The mulch shall contain a non-petroleum based tackifier and a green dye for visual monitoring during application, both non-injurious to plant growth.

B. Hydromulch mixture shall be Conwed Fibers (a division of Profile Products), 750 Lake Cook Rd, Suite 440 Buffalo Grove, IL 60089 Phone: 1-800-366-1180; or approved equivalent.

PART 3 - EXECUTION

3.01 PREPARATION OF SOIL

A. See Section 31 91 13 (Loam) for soil preparation and incorporation of soil amendments.

3.02 SEEDING

A. Seeding shall not take place until the Owner's Representative has approved loam placement. (See Section 31 91 13 – Loam.)

B. Immediately before seeding, the ground shall be restored, as necessary, to a loose friable condition by disking or other approved method to a depth of not less than 2". The surface shall be cleared of all debris and of all stones 1" or more in diameter.

C. Seeding shall be done only during the period from April 1 to May 30 or August 15 to October 15 (with the exception of temporary seeding for erosion control). The actual planting of seed shall be done, however, only during periods within this season which are normal for such work as determined by weather conditions and by accepted practice in this locality. At their option, and on their responsibility, the Contractor may plant seed under unseasonable conditions at no increased cost to the Owner.

D. Seeding of lawns shall be done only by experienced workers under the supervision of a qualified foreman.

E. The Contractor shall seed only when the bed is in a friable condition, not muddy or hard.

F. The Contractor shall seed all areas indicated on the Drawings to be seeded with specified grass seed, sowing evenly with an approved mechanical seeder at the rate of 5 pounds per 1,000 square feet. They shall spread seed when soil is moist. A Cultipacker, or approved similar equipment, may be used to cover the seed and to firm the seedbed in one operation. In areas inaccessible by a Cultipacker, the seeded ground shall be lightly raked and rolled

in two directions with a water ballast roller. Extreme care shall be taken during seeding and raking to insure that no change occurs in the finished grades and that the seed is not raked from one spot to another. Hydroseeding is an acceptable manner of seeding, providing the Contractor certifies in writing that the hydroseed mix is as herein specified, and applied at the equivalent rate of 5 pounds of seed per 1,000 square feet.

G. If covering and rolling is not properly accomplished by the seeding machine, the seed shall be lightly raked into the ground, after which the ground shall be rolled with a five hundred pound roller and thoroughly and evenly watered with a fine spray to penetrate the soil to a depth of at least two (2) inches.

H. Promptly after seeding, the Contractor shall wet the seedbed thoroughly, keeping all areas moist throughout the germination period.

I. Mulch shall be placed by the Contractor immediately after seeding. Straw or salt marsh hay that has been thoroughly fluffed shall be spread evenly and uniformly at the rate of two to three tons per acre. Lumps and thick mulch materials shall be thinned. All mulch anchor stakes, strings, and matting shall be removed before final acceptance of lawns.

J. Hydroseed mix: All work shall be installed using an approved spraying machine specifically used for this purpose. Amounts of fertilizer used shall be as the testing agency recommendations prescribe and as directed by the Owner's Representative. The Contractor shall submit to the Owner's Representative for approval prior to the start of any seeding work, a certified statement with the number of pounds and types of fertilizer, amounts and types of grass seed, and processed fiber per one hundred (100) gallons of water.

1. The Contractor shall add hydromulch to the hydroseed tank at the rate of sixty (60) pounds per acre.

K. Over-seeding: Existing turf areas within the construction limits that are not being graded and/or receiving topsoil shall be seeded as specified in this Section, except that the soil in these areas shall be aerated prior to seeding instead of being scarified, and shall not be rolled.

L. Temporary Seeding for Erosion Control:

1. Purpose: In the event that the work is suspended, the Contractor shall provide cover for the control of surface runoff and erosion to reduce damages from sediment to downstream areas until permanent vegetation or other stabilization measures can be established.
2. Applicability: Temporary seeding shall be done on any sediment-producing bare or denuded areas which may be subject to erosion and where temporary vegetation can be used to retard erosion for periods of two (2) months or more.
3. Temporary seeding shall be performed in accordance with this Section.
4. If the suspension of work is solely the Contractor's fault, and not due to circumstances out of their control, the Owner shall not be responsible to pay for the costs of temporary seeding.

3.03 MAINTENANCE OF SEEDED AREAS

A. Maintenance shall begin immediately after any area is seeded and shall continue until final acceptance. Maintenance during this period is the Contractor's responsibility.

1. Maintenance may continue until the next growing season if in the opinion of the Owner's Representative the season enters a winter dormancy and no maintenance should continue.

B. General acceptance by the Owner's Representative will be granted for seeded lawn areas when all areas have a close stand of grass which has received a minimum of three mowings, has no bare spots greater than two inches in diameter, and at least 90% of the grass established is permanent grass species. The Contractor shall maintain all seeded areas until final acceptance.

C. Maintenance shall include reseeding, mowing, watering, weeding, and fertilizing.

D. Watering of Seeded Areas:

1. First Week: The Contractor shall provide all labor and arrange for all watering necessary to establish an acceptable lawn. In the absence of an adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantities to maintain moist soil to a depth of at least two inches.

2. Second and Subsequent Weeks: The Contractor shall water the lawn as required to maintain adequate moisture, in the upper two inches of soil, necessary for the promotion of deep root growth.

3. Watering shall be done in a manner which will provide uniform coverage, prevent erosion due to application of excessive quantities of water over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one complete coverage to the seeded areas in an eight (8) hour period.

E. Protection:

1. Seeded areas shall be protected by stakes and caution tape or snow fence as directed by the Owner's Representative. Wire shall not be used.

2. Barriers shall be placed immediately after seeding and shall be maintained until acceptance.

F. Reseeding: After the grass in seeded areas has appeared, all areas and parts of areas which, in the opinion of the Owner's Representative, fail to show a uniform stand of grass, for any reason whatsoever, shall be reseeded and such areas and parts of areas shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass. Reseeding together with necessary fertilizing and trimming shall be done at the expense of the Contractor.

G. Mowing:

1. At the time of the first cutting, there shall be a uniform stand between 3 and 3-1/2" high, and mower blades shall be set between 2-1/2" and 3" high.

2. Mowing shall include removal of clippings.

H. Fertilizing: A second application of fertilizer, as specified herein, shall be applied after one (1) season of growth of a minimum of two (2) months duration, but only during the months of April, May, August, or September. Fertilizer shall be applied at the rate of three (3) pounds per one thousand (1,000) square feet.

I. Liming: If more than one initial application of limestone is required by the soils analysis to bring the pH of the stockpiled loam borrow & topsoil to a specified range, the Contractor shall be responsible for all additional required lime applications.

3.04 CLEANUP AND PROTECTION

A. During seeding work, the Contractor shall keep pavements clean and work area in an orderly condition.

B. The Contractor shall protect seeding work and materials from damage due to landscape operations, operations by other contractors or trades, and trespassers.

1. The Contractor shall maintain protection during installation and maintenance periods. They shall treat, repair, or replace damaged landscape work as directed by the Owner's Representative.

3.05 ACCEPTANCE

A. The Owner's Representative shall inspect all work for Acceptance upon written request by the Contractor. The request shall be received by the Owner at least 10 calendar days before the anticipated date of inspection. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Owner's Representative, they shall certify in writing to the Contractor as to the Acceptance of the work.

3.06 ACCEPTANCE IN PART

A. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so and when approval is given to the Contractor in writing to complete the work in parts. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

3.07 CLEANUP

A. When any of this work is done while buildings are occupied, pavements shall be kept clear at all times, broom cleaned to prevent tracking dirt into buildings.

B. After completion of all planting operations, the Contractor shall dispose of all debris and excess material to the satisfaction of the Owner. All pavements shall be swept and hosed

clean.

3.08 FINAL INSPECTION AND ACCEPTANCE

A. At the end of the guarantee period, the Owner's Representative shall inspect all guaranteed work for the Final Acceptance upon written request of the Contractor. The request shall be received at least 10 calendar days before the anticipated date for final inspection.

B. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Owner at that time, they shall certify in writing to the Contractor as to the Final Acceptance of the project.

END OF SECTION

SECTION 32 92 23
SODDING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Sod (perennial turf grass)
2. Maintenance of sodded areas during the construction period

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 32 91 13 – Loam
B. Section 32 84 00 – Irrigation System

1.03 REFERENCE STANDARDS AND SPECIFICATIONS

A. Reference herein to any technical society, organization, group or regulation are made in accordance with the following abbreviations and, unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.

1. Turfgrass Producers International

a. TPI GSS – Guideline specifications for turfgrass sodding.

1.04 REQUIRED SUBMITTALS

A. The Contractor is required to submit the following items to the Owner's Representative prior to usage on this Project:

1. Sod - statement of composition percentages of turfgrass from sod supplier

1.05 QUALITY ASSURANCE

A. The Contractor shall use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Sod

1. The Contractor shall protect sod from drying out and from contamination during delivery, on-site storage, and handling.

2. The Contractor shall lightly sprinkle with water, cover with moist burlap, straw, or other approved covering; and protect from exposure to wind and direct sunlight until planted. They shall provide covering that will allow air to circulate so that internal heat will not develop. Sod shall not be stored directly on concrete or bituminous surfaces.

B. Inspection

1. Sod and fertilizer shall be inspected by the Owner's Representative upon arrival at the Project Site for conformity to species, composition, and quality. Other materials shall be inspected for compliance with specified requirements. Unacceptable materials shall be removed from the job site.

C. Handling and Storage

1. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

2. The Contractor shall protect materials from deterioration during delivery and while stored at site.

3. Materials shall be stored in designated areas. Sod and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

D. Time Limitation

1. The Contractor shall place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS.

1.07 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 – PRODUCTS

2.01 SOD

A. Sod shall be nursery-grown and certified as classified in the TPI GSS. Sod shall also be machine-cut sod at a uniform thickness of ¾ inches with tolerance of ¼ inch, excluding top growth and thatch. Each individual sod piece shall be strong enough to support its own weight when lifted by the ends. Broken pads, irregularly shaped pieces, and torn or uneven ends, will be rejected.

B. Sod species shall be genetically pure, and free from weeds, pests, and disease.

C. Sod shall be composed of a blend of the following turfgrass types:

20 – 80 % Kentucky Bluegrass
20 – 80 % Fine Fescue

2.02 LOAM

A. See Section 32 91 13 – Loam.

2.03 SOIL AMENDMENTS

B. See Section 32 91 13 – Loam.

PART 3 – EXECUTION

3.01 GENERAL

A. Construction methods shall be those established as agronomically acceptable and feasible and which are approved by the Owner's Representative.

B. Sodding operations shall be conducted at the conclusion of construction activities and shall be performed only during periods when beneficial results can be obtained. When drought, excessive moisture, or other unsatisfactory conditions prevail, the work shall be stopped when directed. When special conditions warrant a variance to the sodding operations, proposed alternate times shall be submitted for approval.

3.02 SOIL PREPARATION

A. Loam for soil bed shall be made friable and receptive for sodding by disking or by other approved methods to the satisfaction of the Owner's Representative. In all cases, the final prepared soil surface shall meet the lines and grades for such surface as shown in the plans, or as directed by the Owner's Representative. In no event will sodding be permitted on hard or crusted soil surfaces.

B. All areas to be covered with sod shall be free from all weeds and stones. Removal of unacceptable weed growth shall be by approved methods, including non-selective herbicide, which does not rut or scar the surface, or cause excessive disruption of the slope line or grade.

C. Sodding Season: The calendar dates for sodding shall be:

Spring – March 15 to June 15
Fall – August 15 to October 15

D. If sod is placed during periods outside of the date ranges listed above, the Contractor shall be responsible for re-sodding with sod of the same grass seed mixture specified in Part 2 until the turf stand conforms to the requirements herein.

3.03 INCORPORATION OF SOIL AMENDMENTS

A. Lime:

1. Lime shall be applied at the rate determined by the results of laboratory tests conducted at a certified testing laboratory at the Contractor's expense.

2. Lime shall be mechanically spread at the rate determined by testing on all areas which are to be sodded up to a slope gradient of twenty-five percent (25%).

3. The lime shall be distributed uniformly and worked into the top four (4) inches minimum of the topsoil areas designated for sodding by disking or rototilling and shall be uniformly blended into the topsoil.

B. Fertilizer:

1. Fertilizer shall be applied in two (2) applications. The first application shall be within one (1) week before the sodding at the rate of thirty-five (35) pounds per thousand (1,000) square feet harrowed into the top two (2) inches of sod bed. The second application shall be done as a maintenance application per paragraph 3.09.

2. After the liming and tilling has been approved by the Owner's Representative, the Contractor shall apply fertilizer to all areas to be sodded. All fertilizer shall be uniformly spread by a mechanical spreader at the rate recommended by the testing laboratory. Fertilizer shall not be applied during the months of June, July or August.

3. After the areas to be sodded have been properly fertilized, the Contractor shall hand rake the fertilizer into the topsoil to a minimum depth of one (1) inch so that the material is uniformly blended by means of garden rakes. During this raking process, the areas to be sodded shall be cleared of all stones over one (1) inch in size and all other unsuitable material. All such undesirable material shall be removed from the site. These areas shall be fine graded to achieve sod sub-grade after compaction which shall be obtained by rolling, dragging or by an approved method which obtains an equivalent compaction to that produced by a hand roller weighing from 75 to 100 pounds per foot of width. All depressions caused by settlement or rolling shall be filled with additional loam and re-graded and prepared as specified above until it presents a reasonable smooth and even finish at the required sod sub-grade.

4. At least four (4) days shall elapse after the application of lime and fertilizer before sodding shall begin.

3.04 SOD PLACEMENT

A. The Contractor shall place sod a maximum of 36 hours after initial harvesting, in accordance with TPI GSS.

3.05 SODDING SLOPES AND SWALES

A. For slopes 2:1 and greater, sod shall be laid with long edge perpendicular to the contour.

B. For V-shaped swales and flat-bottomed swales, sod shall be laid with long edge perpendicular to flow of water.

C. Each piece of sod shall be anchored with wood pegs or wire staples maximum 2 feet on center.

D. On slope areas, placement of sod shall start at bottom of slope.

3.06 FINISHING

A. After completing sodding, the Contractor shall blend edges of sodded areas smoothly into surrounding areas. Air pockets shall be eliminated and a true even surface shall be provided. Frayed edges shall be trimmed and holes and missing corners shall be patched with sod.

B. Rolling: Immediately after sodding, the Contractor shall firm entire area except for slopes in excess of 3:1 with roller not to exceed 50 pounds for each foot of roller.

3.07 RESTORATION AND CLEAN UP

A. Clean-up shall include, but not be limited to, the removal of all debris from the turf establishment operations on the shoulders, pavement and/or elsewhere on adjacent properties publicly and privately owned. Excess and waste material shall be removed from the sodded areas and shall be disposed off-site.

B. Existing turf areas and facilities that have been damaged from the sodding operations shall be restored to original condition at Contractor's expense.

3.08 PROTECTION OF INSTALLED AREAS

A. Immediately upon completion of the sodding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed by Owner's Representative.

3.09 MAINTENANCE

A. Maintenance shall begin immediately after an area is sodded and shall continue until final acceptance.

B. Maintenance shall include mowing, watering, weeding, and fertilizing. Sod on the multi-purpose lawn area shall be watered with the new irrigation system. If the Owner's water supply is not available or not functioning, the Contractor will be held responsible to furnish water.

C. Watering of Sodded Areas:

1. First Week: The Contractor shall provide all labor and arrange for all watering necessary for rooting of sod. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary during the first week and in sufficient quantity to maintain moist soil to a depth of at least four inches (4”). Watering shall not be done during the heat of the day to help prevent wilting.

2. Second and Subsequent Weeks: The Contractor shall water the sod as required to maintain adequate moisture, until final acceptance, in the upper four inches (4”) of soil.

3. Where sod areas do not include an automatic irrigation system, watering shall be done in a manner which will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent the damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply one (1) complete coverage to the sodded areas in an eight (8) hour period.

D. Mowing: The first mowing of sodded areas shall not be attempted until the sod is firmly rooted and secure in place. Not more than 40% of the grass leaf shall be removed by the initial or subsequent mowings. Grass height shall be maintained between two inches (2”) and two and one half inches (2.5”) unless otherwise specified. Thereafter grass shall be maintained at two inches (2”) until acceptance.

E. Fertilizing: A second application of fertilizer, as specified herein, shall be applied approximately 6 weeks after the sod has been installed, as directed by the Owner’s Representative. Fertilizer shall be applied at the rate of ten (10) lbs. per 1,000 square feet.

3.10 WARRANTY AND REPLACEMENT

A. If a satisfactory stand of maintained turfgrass has been produced at the time of final inspection, it shall be guaranteed through one complete growing season. If re-sodding is required at the end of the warranty period, this work shall be done in conformance with the requirements of this Section.

B. If a satisfactory stand of maintained turfgrass has not been produced at the time of final inspection, necessary repairs shall be performed in conformance with the requirements of this Section. Upon completion of these repairs, the turfgrass shall be guaranteed as in paragraph A above.

END OF SECTION

SECTION 32 93 00
PLANTING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Furnishing and installing trees
2. Maintenance of trees during the construction period

C. The locations of all trees shall be marked in the field for review and approval by the Owner's Representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Section 32 91 13 – Loam
B. Section 32 92 23 – Sodding

1.03 QUALITY ASSURANCES

A. The Contractor shall adapt their operations to variations in weather or soil conditions as necessary for the successful establishment and growth of the plantings.

1.04 SUBMITTALS

A. If plant substitutions are proposed due to lack of availability of certain specified plants at nurseries in the region during the planting season, a list of proposed substituted plant species and/or varieties shall be submitted to the Owner's Representative for approval. Substitutions shall meet the requirements in Part 2 of this Section.

1.05 COORDINATION

A. The work specified in this Section shall be coordinated with all work shown/described on the Drawings and in other Sections of the Specifications.

PART 2 - PRODUCTS

2.01 PLANT LIST

A. A schedule of required plants is included on the Drawings.

2.02 NOMENCLATURE

A. The names of plants required under this contract conform to those given in the Standardized Plant Names, 1942 Edition, prepared by the American Joint Committee on Horticultural Nomenclature. Names of species and varieties not included therein conform generally with names accepted in the nursery trade.

2.03 QUANTITIES

A. Quantities necessary to complete the plantings as specified on the Drawings shall be furnished.

2.04 SIZES

A. Plants shall have a habit of growth that is normal for the species and shall be sound, healthy, vigorous, and free from insect pests, plant diseases, and injuries. All plants shall equal or exceed the measurements specified in the Plant Schedule, which are minimum acceptable sizes. They shall be measured before any pruning is done at time of planting. Requirements for the measurements, branching, grading, quality, balling and burlapping of plants in the Plant Schedule shall follow the code of standards currently recommended by the American Associations of Nurserymen, Inc., in the American Standard for Nursery Stock.

2.05 SUBSTITUTIONS

A. Substitutions will be permitted only upon submission of proof that any plant as specified is not obtainable during the scheduled planting season. Written authorization by the Owner's Representative will be required for any substitution. The nearest equivalent obtainable size or variety of plant having the same essential characteristics shall be used.

2.06 BALLED AND BURLAPPED MATERIALS

A. Plants designated "B&B" in the Plant Schedule shall be balled and burlapped. They shall be dug with firm, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Material shall be in a condition where the natural root collar of the plant is exposed at the top of the root ball. Balls shall be firmly wrapped with burlap or similar material and bound with twine, cord, or wire mesh. Where necessary to prevent breaking or cracking of the ball during the process of planting, the ball may be secured to a platform. Balls shall be kept moist and shaded until they are planted.

2.07 CONTAINER-GROWN MATERIALS

A. Plants designated "cont.", "gal.", or "pot" in the Plant Schedule are container-grown plants. Any container plants available as balled and burlapped may be substituted at the Contractor's option. If stored on the site, they shall be watered thoroughly at least once every 48 hours. Root systems of container grown plants shall be well developed but not in "pot bound" condition of dense encircling roots.

2.08 SOIL MIX FOR FILL AROUND ROOT BALLS

A. Shrubs: The soil removed for placement of shrubs shall be mixed with 20 percent composted ground pine bark.

B. Trees: The soil excavated for tree installation shall be un-amended.

2.09 MULCH

A. Double-shredded hardwood mulch shall be used as the mulch for all plant beds and planting areas indicated on the Drawings.

PART 3 - EXECUTION

3.01 PLANTING SEASON

B. The normal planting season is April 1 through October 15. After notification to proceed, planting operations shall be conducted under favorable weather conditions during the normal planting season. At the option of and on the full responsibility of the Contractor, planting operations may be conducted under unseasonable conditions without additional compensation.

3.02 WEATHER CONDITIONS AND PLANT PROTECTION

A. Planting shall not take place when soils on site are frozen or wet and in poor tilth.

B. The root zone of all plants not yet installed shall be protected from freezing, drying, and direct sunlight.

3.03 PLANTING OF BALLED AND BURLAPPED MATERIALS

A. Circular pits shall be excavated for all plants. Dimensions and depths of the planting pits shall be as indicated on the Drawing details. Burlap shall be removed from at least the top half of the root ball, after the plant is set in place.

B. The Contractor shall contact the Owner's Representative to inspect the root balls of balled and burlapped plants after they have been set in place (with top half of burlap removed), but before soil has been filled around them.

3.04 PLANTING OF CONTAINER-GROWN MATERIALS

A. Circular pits shall be excavated for all plants. Dimensions and depths of the planting pits shall be as indicated on the Drawing details. The root ball of the plant shall be loosened to alleviate encircling roots and to provide an increased root interface with fill soil.

3.05 LAYOUT

A. New plantings shall be located according to the Drawings. The Contractor shall mark the plant locations, and shall then contact the Owner's Representative for approval. In the

event that subsurface rock is encountered, planting in that area shall be immediately halted and the Owner's Representative notified so that the extent of the problem can be determined and, if necessary, alternative solutions formulated.

3.06 SETTING PLANTS

A. All plants shall be planted in prepared soil beds, and set on firm soil to such depth as indicated in the Drawing details. Trees and shrubs shall be set so that the plant's natural root collar is above finished grade in accordance with the Drawing details. No burlap shall be pulled from under the balls. Roots on bare-root plants shall be spread in their normal position. All broken or frayed roots shall be cut off cleanly. Topsoil or prepared soil shall be placed and compacted carefully to avoid injury to roots, to fill all voids and to minimize rocking of root ball. Add water and tamp the backfill until the backfill is completely saturated, then allow it to soak away. Fill the hole to finished grade, and form a shallow saucer around each plant by placing a ridge of topsoil around the edge of each pit. After the ground settles, additional soil shall be filled in to the level of the finished grade.

3.07 MULCHING

A. Plant beds, plant saucers, and other areas indicated on the Drawings shall be mulched with three double-shredded hardwood mulch, to the depths indicated in the Drawing details. The areas adjacent to newly planted trees and shrubs shall be un-mulched to the extent indicated on the Drawing details.

3.08 STAKING AND GUYING TREES

A. The Contractor shall not stake or guy trees unless trees are planted on steep slopes, in which case the Contractor shall contact the Owner's Representative for permission to stake those particular trees.

3.09 MAINTENANCE

A. General: Maintain work of this Section from time of installation until the final inspection immediately prior to commencement of the guarantee period. Maintenance shall include watering and protection of plantings and other necessary operations.

B. Preparation for Inspection: When the plantings are ready for final inspection, all mulched areas shall be free from weeds and mulched to the extent indicated in the Drawing details and these specifications. Plant tags shall be removed by the Contractor prior to the inspection for acceptance. At the time of acceptance following final inspection, the Contractor is relieved of routine maintenance responsibilities for the plantings under this contract.

3.10 FINAL INSPECTION, CLEAN-UP, AND COMPLETION

A. General: Final inspection shall be for the completed landscape and shall be made at the conclusion of the landscape work upon written notice requesting such inspection submitted by the Contractor to the Owner's Representative at least 10 days prior to the anticipated date.

B. Acceptance after Inspection: The Contractor will be notified in writing of acceptance of all work of this Section, exclusive of the possible replacement of plants subject to guaranty, or if there are any deficiencies in the requirements of completion of the work. Maintenance or other remaining work to be done shall be subject to re-inspection before acceptance.

C. Clean-up and Completion: Upon completion of work, the Contractor shall remove from the site all equipment and other articles used. All excess soil, stones, and debris shall be removed and legally disposed of. All work areas shall be left in a clean and neat condition.

3.11 GUARANTY AND REPLACEMENT

A. Guaranty: After acceptance at the time of final inspection, all plants shall be guaranteed for one (1) year. Plantings shall be alive and in satisfactory vigor at the end of the guaranty period.

B. Replacement: At the end of the guarantee period, inspection will be made by the Owner's Representative upon written notice requesting such inspection submitted by the Contractor at least ten days before the anticipated date. Any plant required under this contract that is dead or in poor vigor as determined by the Owner's Representative shall be removed from the site; these and any plants missing, due to the Contractor's negligence, shall be replaced as soon as conditions permit, but during the normal planting season.

C. Materials and Operations: All replacements shall be plants of the same kind as originally planted and shall be of size equal to that attained by adjacent plants of the same kind at the time replacement is made. They shall be furnished and planted as specified in this Section, and the cost shall be borne by the Contractor. Only one replacement in conformance with the provision of this Section will be required for each plant declared dead, in an unhealthy or badly impaired condition, or missing at the time of final inspection.

END OF SECTION

SECTION 33 10 00
WATER UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Installation of water service piping, valves, fittings, and structures

2. Installation of other water appurtenances

3. Installation of concrete equipment pads and sleeving

C. All work described above shall be marked out in the field for review and approval by the Owner's representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Worcester Special Conditions and Specifications – CAST IN PLACE CEMENT CONCRETE

B. Worcester Special Conditions and Specifications – GRAVEL BORROW

1.03 GENERAL PROVISIONS

A. This specification applies to work depicted on the Civil Drawings prepared by Quinn Engineering, Inc., herein referred to as the "Drawings" and specifically consisting of:

1. Sheets C-1 through C-3.

B. Attention is directed to PROJECT SPECIAL CONDITIONS which are hereby made a part of this Section of the Specifications.

C. All work conducted in association with this section shall conform to the applicable requirements of the Occupational Safety and Health Administration (OSHA).

D. In accordance with MA General Law Chapter 82 Section 40A and prior to construction, the Contractor shall contact DIGSAFE and other utility providers in order to determine the location of existing utilities within the project area. The Contractor is responsible for coordinating the work with the existing utilities so that disruption to the existing utilities is minimized.

E. Prior to construction, the Contractor shall notify and coordinate any planned disruptions to existing utilities that are required to perform the work with the appropriate utility provider and with the Owner's representative. Disruptions to existing utilities shall be planned so that the time of disruption is minimized.

1.04 INDUSTRY STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications, latest edition.

2. AASHTO: American Association of State Highway and Transportation Officials

3. ASTM: American Society for Testing and Materials

4. Mass DOT: Massachusetts Department of Transportation, Highway Division

5. MSSHB: Massachusetts Standard Specifications for Highways and Bridges

6. City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision)

1.05 PERMITS

A. The Contractor shall secure all necessary permits from the City of Worcester of Department of Public Works and Parks and City of Worcester Water Operations prior to construction. Securing permits shall be conducted in accordance with project specifications.

B. The Contractor shall apply for and obtain all permits necessary for the work depicted on the Drawings and specified in this section.

C. Permits shall be secured and paid for in accordance with these specifications.

1.06 QUALITY ASSURANCE

A. Pipe, fittings, valves, and appurtenances shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though samples may have been accepted as satisfactory at the place of manufacture. Products rejected after delivery shall be marked for identification and shall be removed from the job at once.

B. Contractor is responsible for compatibility between pipe materials, fittings, valves, and appurtenances.

C. All materials for each product shall be produced and obtained from a single manufacturer.

D. Installation shall be performed by qualified personnel.

E. Coordinate the work shown on the Drawings and specified herein with all other trades in order to provide a complete installation.

F. The Contractor shall provide all necessary miscellaneous items and appurtenances not identified on the Drawings or specified herein to provide a complete installation.

1.07 SUBMITTALS

A. Submit for approval prior to ordering and shipment technical information regarding

1. Piping, fittings, valves, taps
2. Cabinets, spigots
3. Stone, aggregate, soil, gravel, filter fabric, etc.
4. Any other items used as part of the water system

1.08 SITE CONDITIONS

A. The Contractor is responsible for verifying the layout of all materials prior to installation in relation to the locations specified on the Drawings and in relation to the existing conditions.

B. The Contractor shall provide barricades or barriers to protect the public from construction activities.

C. The work specified herein shall take place under weather conditions so as not to cause erosion or negatively impact any portion of the site.

1.09 WARRANTY

A. The Contractor shall warrant all materials and workmanship specified herein for a period of one year from the time of acceptance by the Owner.

1.10 DELIVERY, STORAGE AND HANDLING

A. All items shall be packaged and stored on site in such a manner so that the items are in new and excellent condition immediately prior to installation.

B. Pipe, fittings, valves, and other appurtenances shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 60 days. Temporary shading as required to meet this requirement shall be provided. Simple covering of products which allows temperature buildup or direct or indirect sunlight will not be permitted.

C. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

D. In handling the items, use special devices and methods as required to achieve the results specified herein.

1.11 COORDINATION

A. The work specified in this section shall be coordinated with all work shown/described on the Drawings and in the specifications with other portions of the work for the entire project.

B. The Contractor shall give the Engineer at least 48-hour notice when requesting inspections on site.

1.12 EXISTING UTILITIES

A. Existing utility information depicted on the Drawing has been provided to Quinn Engineering, Inc. unless otherwise noted. The Contractor is responsible for coordinating the locations of all existing utilities with the utility provider and "DIGSAFE". Quinn Engineering, Inc. does not warrant that all existing utilities have been depicted on the Drawings.

B. The Contractor shall take every precaution to limit disruption to existing utilities. Any existing utilities disrupted or affected by the Contractor because of his/her work shall be repaired at least to the condition that existed prior to construction. The Contractor shall coordinate repair of any utilities with the utility providers and any costs associated with the repair shall be borne by the Contractor.

1.13 DRAWINGS

A. The Contractor is responsible for reviewing the Drawings and existing site conditions with respect to this section.

B. The information depicted on the Drawings is believed to reflect the current site conditions unless otherwise noted on the Drawings. The Contractor is responsible for reviewing the existing site conditions in the areas of the proposed work and notify the Owner's representative as soon as possible if any discrepancies exist between the two.

C. The existing conditions depicted on the Drawings have been provided to Quinn Engineering, Inc. Quinn Engineering, Inc. does not warrant that all existing conditions, structures, utilities, etc. have been depicted.

PART 2 - PRODUCTS

2.01 COPPER AND POLYETHYLENE WATER PIPING

A. Water piping shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.02 WATER MAIN TAP, WATER PIPE FITTINGS, VALVES, AND APPURTENANCES

A. Water connections and appurtenances shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.03 MISC. CAST IN PLACE CEMENT CONCRETE & REINFORCEMENT

A. See Worcester Special Conditions and Specifications – CAST IN PLACE CEMENT CONCRETE

2.04 GRAVEL BORROW

A. See Worcester Special Conditions and Specifications.

2.05 ORDINARY BORROW

A. See 31 23 10 – Section 2.01

2.06 CRUSHED STONE

A. Crushed Stone shall conform to MA DOT Specification *M2.01.0* through *M2.01.6* for the applicable size of stone

2.07 SAND BORROW

A. Sand Borrow (used in areas outside of irrigation trenches) shall consist of clean inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coatings and deleterious materials. The allowable amount of material passing a No. 200 sieve as determined by AASHTO-T11 shall not exceed 10% by weight.

B. The maximum particle size for Sand Borrow shall be as follows:

M 1.04.0 Type a 1/4 in.

C. The use of processed glass aggregate shall not be allowed.

2.08 SUITABLE FILL

A. Suitable fill shall consist of material soil free from organic materials, loam, and any deleterious materials. Suitable fill shall not contain stones larger than 10” in any dimension and shall have less than 75% passing the No.4 sieve and a maximum of 20% passing the No. 200 sieve. Suitable fill shall not contain any building rubble, granite or concrete block, roofing materials, or other construction refuse. At the time of placement, suitable fill shall not contain frost, snow, ice, and shall not contain water greater than the optimal moisture content.

PART 3 - EXECUTION

3.01 WATER LINE AND UTILITY CABINET LAYOUT

A. The Contractor shall furnish the service s of a Professional Land Surveyor registered in the Commonwealth of Massachusetts to provide construction layout of the new (and any future) drain structures.

B. The survey layout shall be used to establish accurate locations and to ensure drain structures are installed in the locations depicted on the drawings and shall provide reference points for stub installations.

3.02 INSTALLATION OF WATER LINES

A. Unless otherwise specified in the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) installation of water lines shall conform to the details in the Drawings and City of Worcester Water Operations.

B. Excavations for water lines shall be sufficient to accommodate base courses and fill around the structures as indicated on the Drawings.

C. Gravel bases and backfill shall be placed and compacted to 95% MMD so that the structures do not settle and no selecting occurs immediately around the structures.

D. Concrete pads and cabinets be set level so that the walls are plumb and can accommodate the layout specified on the Drawings.

3.03 INSTALLATION OF WATER PIPE

A. Unless otherwise specified in the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) installation of water pipe shall conform details in the Drawings and City of Worcester Water Operations.

B. No pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. Sections of pipe that fail to meet this criterion shall be rejected. If a section of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site.

C. Pipes shall be laid in accordance with any applicable manufacture's specifications.

D. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid.

E. The trench for the pipe shall be excavated to the required line and grade and of sufficient width to permit thorough tamping of the fill material under the haunches and around the pipe.

F. Soft or unsuitable material encountered below the normal bedding line of the pipe shall be removed as directed, replaced with crushed stone and thoroughly compacted.

G. If any cross pipes, conduits, drains, or other unforeseen obstacles are encountered in the excavation, the grade of the bottom of the trench may be raised or lowered during the excavation operation as directed by the Engineer. Use concrete or other approved support under existing pipes passing through the excavation where said pipe would normally be supported by backfilled earth.

H. All pipes shall be laid true to the specified lines and elevations. Material placed around and under the pipe shall be free of stones.

I. Pipe bedding and blanket material shall be as shown on the Drawings as specified herein.

J. Where rock in either ledge or boulder formation is encountered, it shall be removed to a line 12 inches below the bottom of the outside of the pipe barrel. No part of any rock remaining in the trench shall come within 12 inches of any portion of the pipe.

K. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end.

3.04 INSPECTIONS, TESTING, AND DISINFECTION

A. The water utilities shall be subject to inspection by the City of Worcester Department of Public Works and City of Worcester Water Operations.

B. The City of Worcester of Public Works and City of Worcester Water Operations may require disinfection and testing of the water utilities after installation. Disinfection and testing shall be conducted in accordance with the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision).

C. The Contractor is responsible for coordinating all inspections, disinfection, and testing of the water utilities with the City of Worcester Department of Public Works and City of Worcester Water Operations.

D. All costs for inspections, disinfection and testing required by the City of Worcester Department of Public Works and City of Worcester Water Operations shall be borne by the Contractor. In addition, any costs associated with re-testing because of faulty workmanship shall be borne by the Contractor.

E. Any costs associated with repairing deficient materials or workmanship to obtain a passing test shall be borne by the Contractor.

3.05 CLEANUP

A. The Contractor shall remove all debris, excess materials, equipment related to the water service installation from the site.

END OF SECTION

SECTION 33 42 00
STORMWATER CONVEYANCE

PART 1 - GENERAL

1.01 DESCRIPTION

A. The City of Worcester Bid Form, General Conditions, Supplementary Conditions, and applicable parts of the Special Conditions form a part of this Specification and the Contractor shall consult them in detail for instructions.

B. The Contractor shall provide all labor, equipment, and materials; and perform all operations necessary to complete the work of this section as indicated on the Drawings and specified herein which shall include but is not limited to the following:

1. Installation of storm drainage piping & structures
2. Installation of underground detention systems
3. Installation of other drainage appurtenances

C. All work described above shall be marked out in the field for review and approval by the Owner's representative prior to installation.

1.02 RELATED WORK SPECIFIED IN OTHER SECTIONS

A. Worcester Special Conditions and Specifications – CAST IN PLACE CEMENT CONCRETE

B. Worcester Special Conditions and Specifications – GRAVEL BORROW

1.03 GENERAL PROVISIONS

A. This specification applies to work depicted on the Civil Drawings prepared by Quinn Engineering, Inc., herein referred to as the "Drawings" and specifically consisting of:

1. Sheets C-1 through C-3.

B. Attention is directed to PROJECT SPECIAL CONDITIONS which are hereby made a part of this Section of the Specifications.

C. All work conducted in association with this section shall conform to the applicable requirements of the Occupational Safety and Health Administration (OSHA).

D. In accordance with MA General Law Chapter 82 Section 40A and prior to construction, the Contractor shall contact DIGSAFE and other utility providers in order to determine the location of existing utilities within the project area. The Contractor is responsible for coordinating the work with the existing utilities so that disruption to the existing utilities is minimized.

E. Prior to construction, the Contractor shall notify and coordinate any planned disruptions to existing utilities that are required to perform the work with the appropriate utility provider and with the Owner's representative. Disruptions to existing utilities shall be planned so that the time of disruption is minimized.

1.04 INDUSTRY STANDARDS

A. Except as modified by governing codes and by the Contract Documents, the Contractor shall comply with applicable provisions and recommendations of the following:

1. Commonwealth of Massachusetts, Department of Public Works, Standard specifications for Highways and Bridges, Supplemental Specifications, latest edition.

2. AASHTO: American Association of State Highway and Transportation Officials

3. ASTM: American Society for Testing and Materials

4. Mass DOT: Massachusetts Department of Transportation, Highway Division

5. MSSHB: Massachusetts Standard Specifications for Highways and Bridges

6. City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision)

1.05 PERMITS

A. The Contractor shall secure all necessary permits from the City of Worcester of Department of Public Works and Parks and City of Worcester Water Operations prior to construction. Securing permits shall be conducted in accordance with project specifications.

B. The Contractor shall apply for and obtain all permits necessary for the work depicted on the Drawings and specified in this section.

C. Permits shall be secured and paid for in accordance with these specifications.

1.06 QUALITY ASSURANCE

A. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

B. Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

C. All materials for each product shall be produced and obtained from a single manufacturer.

D. Installation shall be performed by qualified personnel.

E. Coordinate the work shown on the Drawings and specified herein with all other trades in order to provide a complete installation.

F. The Contractor shall provide all necessary miscellaneous items and appurtenances not identified on the Drawings or specified herein to provide a complete installation.

1.07 SUBMITTALS

A. Submit for approval prior to ordering and shipment technical information regarding

1. Drain manholes, drain basins

2. Piping, manifolds,
3. Covers, grates, frames
4. Stone, aggregate, soil, gravel, filter fabric, etc.
5. Underground stormwater chambers
6. Any other items used as part of the stormwater conveyance system

1.08 SITE CONDITIONS

A. The Contractor is responsible for verifying the layout of all materials prior to installation in relation to the locations specified on the Drawings and in relation to the existing conditions.

B. The Contractor shall provide barricades or barriers to protect the public from construction activities.

C. The work specified herein shall take place under weather conditions so as not to cause erosion or negatively impact any portion of the site.

1.09 WARRANTY

A. The Contractor shall warrant all materials and workmanship specified herein for a period of one year from the time of acceptance by the Owner.

1.10 DELIVERY, STORAGE AND HANDLING

A. All items shall be packaged and stored on site in such a manner so that the items are in new and excellent condition immediately prior to installation.

B. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 60 days. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup or direct or indirect sunlight will not be permitted.

C. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

D. In handling the items, use special devices and methods as required to achieve the results specified herein.

1.11 CONFORMANCE WITH THE AMERICANS WITH DISABILITIES ACT AND THE MASSACHUSETTS ARCHITECTURAL ACCESS BOARD

A. Materials and work identified on the Drawings and specified herein shall conform to the Americans with Disabilities Act Standards for Accessible Design (28 FCR Part 36) and the Massachusetts Architectural Access Board (521 CMR).

B. The Contractor shall notify the Owner’s representative of any discrepancies between the Drawings and work specified herein and the above referenced standards prior to installation.

1.12 COORDINATION

A. The work specified in this section shall be coordinated with all work shown/described on the Drawings and in the specifications with other portions of the work for the entire project.

B. The Contractor shall give the Engineer at least 48-hour notice when requesting inspections on site.

1.13 EXISTING UTILITIES

A. Existing utility information depicted on the Drawing has been provided to Quinn Engineering, Inc. unless otherwise noted. The Contractor is responsible for coordinating the locations of all existing utilities with the utility provider and "DIGSAFE". Quinn Engineering, Inc. does not warrant that all existing utilities have been depicted on the Drawings.

B. The Contractor shall take every precaution to limit disruption to existing utilities. Any existing utilities disrupted or affected by the Contractor because of his/her work shall be repaired at least to the condition that existed prior to construction. The Contractor shall coordinate repair of any utilities with the utility providers and any costs associated with the repair shall be borne by the Contractor.

1.14 DRAWINGS

A. The Contractor is responsible for reviewing the Drawings and existing site conditions with respect to this section.

B. The information depicted on the Drawings is believed to reflect the current site conditions unless otherwise noted on the Drawings. The Contractor is responsible for reviewing the existing site conditions in the areas of the proposed work and notify the Owner's representative as soon as possible if any discrepancies exist between the two.

C. The existing conditions depicted on the Drawings have been provided to Quinn Engineering, Inc. Quinn Engineering, Inc. does not warrant that all existing conditions, structures, utilities, etc. have been depicted.

PART 2 - PRODUCTS

2.01 REINFORCED CONCRETE DRAIN MANHOLES

A. Reinforced concrete drain manholes shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.02 FRAMES AND COVERS

A. Frames and covers shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.03 MISC. CAST IN PLACE CEMENT CONCRETE & REINFORCEMENT

A. See Worcester Special Conditions and Specifications – CAST IN PLACE CEMENT CONCRETE

2.04 REINFORCED CONCRETE PIPE

A. Reinforced concrete pipe (RCP) shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.05 AWWA C900 DRAIN PIPE (DR18)

A. AWWA C900 drain pipe (DR 18) shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.06 BRICK, MORTAR AND RELATED MATERIALS

A. Brick, mortar and related materials used in drain system construction shall conform to the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) available from the City of Worcester Department of Public Works & Parks or online at https://www.worcesterma.gov/uploads/c4/7f/c47f1f64fe71fe482b6b171f215b2e27/standard-specs.pdf

2.07 NYLOPLAST IN-LINE DRAIN

A. PVC surface drainage inlets shall be of the inline drain type as indicated on the contract drawing and referenced within the contract specifications.

B. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer.

C. The surface drainage inlets shall be as manufactured by Nyloplast a division of Advanced Drainage Systems, Inc., or prior approved equal.

D. The inline drain required for this contract shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the furnished configuration.

E. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the inline drain body by use of a swage mechanical joint. The raw material used to manufacture the pipe stock that is used to manufacture the inline drain body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454.

F. The grates furnished for all surface drainage inlets shall be ductile iron grates for sizes 8", 10", 12", 15", 18", 24" and 30" shall be made specifically for each fitting so as to provide a round bottom flange that closely matches the diameter of the surface drainage inlet. Grates for inline drains shall be capable of supporting H-20 wheel loading for traffic areas or H-10 loading for pedestrian areas. 12" and 15" square grates will be hinged to the frame using pins. Metal used in the manufacture of the castings shall conform to ASTM A536 grade 70-50-05 for ductile iron. Grates shall be provided painted black.

2.08 GRAVEL BORROW

A. See Worcester Special Conditions and Specifications.

2.09 ORDINARY BORROW

A. See 31 23 10 – Section 2.01

2.10 CRUSHED STONE

A. Crushed Stone shall conform to MA DOT Specification *M2.01.0* through *M2.01.6* for the applicable size of stone

2.11 SAND BORROW

A. Sand Borrow (used in areas outside of irrigation trenches) shall consist of clean inert, hard, durable grains of quartz or other hard durable rock, free from loam or clay, surface coatings and deleterious materials. The allowable amount of material passing a No. 200 sieve as determined by AASHTO-T11 shall not exceed 10% by weight.

B. The maximum particle size for Sand Borrow shall be as follows:

M 1.04.0 Type a 1/4 in.

C. The use of processed glass aggregate shall not be allowed.

2.12 SUITABLE FILL

A. Suitable fill shall consist of material soil free from organic materials, loam, and any deleterious materials. Suitable fill shall not contain stones larger than 10” in any dimension and shall have less than 75% passing the No.4 sieve and a maximum of 20% passing the No. 200 sieve. Suitable fill shall not contain any building rubble, granite or concrete block, roofing materials, or other construction refuse. At the time of placement, suitable fill shall not contain frost, snow, ice, and shall not contain water greater than the optimal moisture content.

2.13 GRANITE CURB

A. Granite curb used to replace the existing curb shall be Type VA4 and shall conform with MA DOT Specification *M9.04.1 GRANITE CURB.*

PART 3 - EXECUTION

3.01 DRAIN STRUCTURE LAYOUT

A. The Contractor shall furnish the service s of a Processional land Surveyor registered in the Commonwealth of Massachusetts to provide construction layout of the new (and any future) drain structures.

B. The survey layout shall be used to establish accurate locations and to ensure drain structures are installed in the locations depicted on the drawings and shall provide reference points for stub installations.

3.02 INSTALLATION OF DRAIN MANHOLES

A. Unless otherwise specified in the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated March 20, 2019 (or subsequent revision) installation of drain manholes shall conform to the following:

B. Excavations for reinforced concrete manholes shall be sufficient enough to accommodate base courses and fill around the structures as indicated on the Drawings.

C. Gravel bases and backfill shall be placed and compacted to 95% MMD so that the structures do not settle and no selecting occurs immediately around the structures.

D. Manhole shall be set level so that the walls are plumb and can accommodate the inverts specified on the Drawings.

E. Construct inverts within drain manholes with the inverts and elevations shown on the Drawings.

F. Slabs, cones, brick leveling course, hood and rims/grates shall be constructed as shown on the Drawings.

3.03 BRICK WORK:

A. Unless otherwise specified in the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated March 20, 2019 (or subsequent revision) brick work shall conform to the following:

B. Bricks shall be moistened by suitable means, as directed, until they are neither so dry as to absorb water from the mortar nor so wet as to be slippery when laid.

C. Each brick shall be laid as a header in a full bed and joint of mortar without requiring subsequent grouting, flushing or filling, and shall be thoroughly bonded.

D. Brick inverts (where applicable) shall conform accurately to the size of the adjoining pipes. Side inverts shall be curved and main inverts (where direction changes) shall be laid out in smooth curves of the longest possible radius which is tangent to the centerlines of adjoining pipe.

3.04 INSTALLATION OF GRAVITY DRAIN PIPE

A. Unless otherwise specified in the City of Worcester Department of Public Works & Parks Standard Specifications & Details dated August 29, 2024 (or subsequent revision) installation of gravity drain pipe shall conform to the following:

B. No pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. Sections of pipe that fail to meet this criterion shall be rejected. If a section of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site.

C. Pipes shall be laid in accordance with any applicable manufacture's specifications.

D. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid.

E. The trench for the pipe shall be excavated to the required line and grade and of sufficient width to permit thorough tamping of the fill material under the haunches and around the pipe.

F. Soft or unsuitable material encountered below the normal bedding line of the pipe shall be removed as directed, replaced with crushed stone and thoroughly compacted.

G. If any cross pipes, conduits, drains, or other unforeseen obstacles are encountered in the excavation, the grade of the bottom of the trench may be raised or lowered during the excavation operation as directed by the Engineer. Use concrete or other approved support under existing pipes passing through the excavation where said pipe would normally be supported by backfilled earth.

H. All pipes shall be laid true to the specified lines and grades. For all pipe, the bell end shall be toward rising grade and each section of pipe shall have a firm bearing throughout its length. Material placed around and under the pipe shall be free of stones larger than 3 inches in diameter.

I. Pipe bedding and blanket material shall be as shown on the Drawings as specified herein.

J. Where rock in either ledge or boulder formation is encountered, it shall be removed to a line 12 inches below the bottom of the outside of the pipe barrel. No part of any rock remaining in the trench shall come within 12 inches of any portion of the pipe.

K. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end.

3.05 NYLOPLAST IN-LINE DRAIN INSTALLATION

A. The specified PVC surface drainage inlet shall be installed using conventional flexible pipe backfill materials and procedures.

B. The backfill material shall be crushed stone or other granular material meeting the requirements of Class 1, Class 2, or Class 3 materials as defined in ASTM D2321.

C. Bedding and backfill for surface drainage inlets shall be well placed and compacted uniformly in accordance with ASTM D2321.

D. The drain basin body will be cut at the time of the final grade.

E. No brick, stone or concrete block will be required to set the grate to the final grade height. For H-20 load rated installations, a concrete ring will be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

F. For other installation considerations such as migration of fines, ground water, and soft foundations refer to ASTM D2321 guidelines

3.06 GRANITE CURB

A. Granite curb shall be installed in accordance with MA DOT Specification *SUBSECTION 501: CURB, CURB INLETS, CURB CORNERS AND EDGING.*

B. Joints mortared in accordance with MA DOT *SECTION 501.67 POINTING*.

C. Curb shall be installed to provide the reveal indicated on the Drawings.

3.07 CLEANING OF NEW PIPING AND STRUCTURES

A. At the conclusion of the work, thoroughly clean all new drain basins, manholes, and pipelines by flushing with water or other means. All dirt, stones, wood, or other deleterious material found in the pipes shall be removed and disposed of accordingly. In no case shall debris within the pipe be allowed to flow to the downstream drain system.

3.08 CLEANUP

A. The Contractor shall remove all debris, excess materials, equipment related to the storm drain installation from the site.

END OF SECTION