FILE NO. 30724

CONFORMED SET

SPECIFICATIONS FOR THE CITY OF CAMBRIDGE, MASSACHUSETTS

THE PORT INFRASTRUCTURE PHASE II PROJECT PACKAGE 1

In the City of Cambridge, Massachusetts

APRIL 2026

Prepared By:

Kleinfelder
Stantec
Bowman
Ronald W. Buia, Inc

COMMONWEALTH OF MASSACHUSETTS
BENJAMIN M. STODDARD
CIVIL
No. 51854
REGISTERED PROFESSIONAL ENGINEER

COMMONWEALTH OF MASSACHUSETTS
CONOR MURPHY
CIVIL
No. 54506
REGISTERED PROFESSIONAL ENGINEER
4/6/2026

COMMONWEALTH OF MASSACHUSETTS
CHRISTIAN E. OLANDER
CIVIL
No. 50676
REGISTERED PROFESSIONAL ENGINEER

COMMONWEALTH OF MASSACHUSETTS
RONALD W. BUIA
No. 29334
REGISTERED PROFESSIONAL ENGINEER

MASSACHUSETTS
CHRISTOPHER FEE
NO. 1567
REGISTERED LANDSCAPE ARCHITECT

THIS PAGE INTENTIONALLY LEFT BLANK

File No COC-CIFB-FY26-30724
PROJECT MANUAL

The Port Infrastructure Phase II Project
Package 1

CITY OF CAMBRIDGE
PUBLIC WORKS DEPARTMENT

TABLE OF CONTENTS

SUBJECT		PAGES
DIVISION OF BIDDING AND CONTRACT REQUIREMENTS		
00020	Invitation to Bid	00020-1 to 00020-2
00100	Instructions to Bidders	00100-1 to 00100-6
00150	Abbreviations, References, Permits and Fees	00150-1 to 00150-3
00210	Cambridge Employment Plan	00210-1 to 00210-3
00211	Cambridge Responsible Employer Plan	00211-1 to 00211-4
00215	Living Wage Ordinance	00215-1 to 00215-14
00221	City Cori Policy	00221-1 to 00221-2
00222	City Cori Ordinance	00222-1 to 00222-2
00230	Truck Ordinance and Regulations	00230-1 to 00230-9
00300*	**Form for General Bid**	**00300-1 to 00300-41**
00310*	**Bid Bond**	**00310-1**
00311*	**MBE Forms**	**00311-1 to 00311-7**
00312*	**Notarized Statement of Bidder's Qualifications**	**00312-1 to 00312-15**
00313*	**General Contractor's Certification**	**00313-1**
00315*	**Projected Workforce Certification**	**00315-1**
00317*	**OSHA Requirements**	**00317-1**
00318*	**CREP General Contractor Certification Forms**	**00318-1**
00322*	**CORI Compliance Form**	**00322-1**
00323*	**Americans with Disabilities Act**	**00323-1**
00326*	**Written Information Security Policy (WISP) Affirmation**	**00326-1**
00330*	**Wage Theft Prevention Certification**	**00330-1 to 00330-2**
00335*	**MA Diesel Retrofit Program Statement of Intent to Comply**	**00335-1**
00500	Agreement	00500-1 to 00500-2
00610	Performance Bond	00610-1 to 00610-2
00620	Payment Bond	00620-1 to 00620-2
00660	Certificate of Authority	00660-1
00670	Department of Labor Standards Wage Rates	00670-1 to 00670-36
00680	Department of Labor Standards Statement of Compliance	00680-1 to 00680-2
00800	General Terms and Conditions	00800-1 to 00800-57
00825	Supplemental General Conditions	00825
00825A	Special Conditions	
	Attachment I	City of Cambridge Department of Public Works Division of Urban Forestry - Tree Protection during Construction
	Attachment II	General Laws of Massachusetts – Part I – Title XIV Public Ways and Works – Chapter 82 – Section 40 (Dig Safe)
	Attachment III	Ordinance Number 1329 (Dumpster Licenses)
	Attachment IV	Massachusetts Diesel Retrofit Program
	Attachment V	Excerpts from Massachusetts General Laws
00900	Fuel, Asphalt, Concrete, Steel Price Adjustment	

***These forms must be submitted with the bid.**

DIVISION 1 - GENERAL REQUIREMENTS

01010	Summary of Work
01025	Measurement and Payment
01040	Project Coordination and Meetings
01045	Cutting and Patching
01060	Permits and Regulatory Requirements
01063	Sequencing of Work
01070	Abbreviations
01090	Reference Standards
01105	Rodent Control
01108	Health and Safety Procedures
01200	General Requirements for Utility Work
01300	Submittals
01301	Schedule of Values
01311	Scheduling and Reporting
01390	Pre-Construction Survey
01400	Quality Control
01500	Temporary Facilities and Controls
01505	Mobilization
01520	Field Office
01560	Temporary Environmental Controls
01568	Erosion Control, Sedimentation and Containment of Construction Materials
01570	Maintenance and Protection of Traffic
01600	Products, Materials and Equipment
01630	Restoration of Grounds and Cleaning Up
01701	Project Closeout
01740	Warranties and Bonds

DIVISION 2 – SITE WORK

02010	Subsurface Investigation
02015	Geotechnical Monitoring and Instrumentation
02051	Demolition, Modification, and Abandonment
02080	Soil and Waste Management
02095	Transportation and Disposal of Soil and Fill
02100	Site Preparation and Tree Pruning
02140	Dewatering
02160	Temporary Excavation Support Systems
02210	Earth Excavation, Backfill, Fill and Grading
02252	Manholes
02500	Paving and Surfacing
02520	Flexible Porous Paving
02524	Curbs, Walks, and Driveways
02535	Illicit Connections
02555	Manhole Lining

02577 Pavement Markings
02590 Brick Masonry
02604 Catch Basins
02609 Reinforced Concrete Pipe
02615 Ductile Iron Pipe for Gravity Storm Drain and Sanitary Force Main
02622 Polyvinyl Chloride Pipe
02630 Ductile Iron Pipe and Fittings for Water Mains
02640 Valves and Appurtenances
02645 Hydrants
02647 Connecting to Existing Water Mains
02660 Water Services
02675 Disinfection of Water Mains
02685 Temporary Bypass Piping and Service Connections for Water Mains
02704 Pipeline Pressure and Leakage Testing
02710 Removal of Protruding Sewer Lateral
02750 Root Intrusion Removal
02760 Pipeline Cleaning and Internal Inspection
02761 Flow Bypass
02767 Cured-In-Place Pipelining and Sectional Lining
02890 Traffic Signals
02900 Landscaping
02901 Planting Soils
02902 Structural Planting Medium
02903 Biocell
02904 Precast Porous Concrete Pavement
02910 Tree Planting
02950 Back of Sidewalk Restoration
02980 Site Improvements

DIVISION 3 - CONCRETE

03300 Concrete
03315 Grout
03410 Plant-Precast Structural Concrete

DIVISION 5 – MISCELLANEOUS METALS

05500 Miscellaneous Metals

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

07160 Bituminous Dampproofing

DIVISION 15 – FLAP GATES

15252 Flap Gates

DIVISION 16 – SPECIAL CONSTRUCTION

16050 Electrical Work General
16110 Electrical Raceway Systems
16120 Wires and Cables
16130 EV Charging Stations
16135 Roadway Lighting Infrastructure

APPENDIX

Appendix A Environmental Conditions Summary – Complete Streets Project
Appendix B Geotechnical Data Report – The Port Infrastructure Improvements, Complete Streets
Appendix C CCTV Logs of Sewer and Drain
Appendix D MBTA License Agreement

END OF TABLE OF CONTENTS

SECTION 00825
SUPPLEMENTAL GENERAL CONDITIONS

FOR CONSTRUCTION, RECONSTRUCTION, ALTERATION,
REMODELING, OR REPAIR OF ANY
CITY OF CAMBRIDGE PUBLIC WORK

TABLE OF CONTENTS

Page
ARTICLE 1 PROTECTION OF LIVES, HEALTH AND PROPERTY…… ..... …SGC-2
ARTICLE 2 ACCESS TO THE WORK....……SGC-3
ARTICLE 3 CONTRACTOR TO LAY OUT CONTRACTOR'S OWN WORK…SGC-3
ARTICLE 4 PROJECT MEETINGS……..... .. SGC-3
ARTICLE 5 PROJECT SIGN DETAILS...……..... SGC-4
ARTICLE 6 SUBSURFACE DATA……..SGC-4
ARTICLE 7 ADDITIONAL DEFINITIONS.....SGC-4
ARTICLE 9 INSURANCE REQUIREMENTS..... SGC-5
ARTICLE 11 QUANTITIES AND UNIT PRICES.....SGC-5

ARTICLE 1 - PROTECTION OF LIVES, HEALTH AND PROPERTY

1.1 The Contractor will be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work. The Contractor shall take all necessary precautions for the safety of and will provide the necessary protection to prevent damage, injury, or loss to:

1.2 All employees on the work and other persons who may be affected thereby;

1.3 All the work and all materials or equipment to be incorporated therein, whether in storage on or off the site; and

1.4 Other existing property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

1.5 Notwithstanding any other provisions of this contract, the Contractor shall at Contractor's expense promptly restore to its prior condition all property (regardless of by whom owned or where located) damaged as a result of Contractor's operations.

1.6 The Contractor shall comply with all applicable laws, ordinances, rules, regulations, and orders of any public body having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss. The Contractor shall erect and maintain as required by the conditions and progress of the work, all necessary safeguards for safety and protection, and in addition the Contractor shall comply with all applicable recommendations of the Manual of Accident Prevention in Construction of the Associated General Contractors of America, Inc. The Contractor shall notify owners of adjacent utilities when prosecution of the work may affect them. All damage, injury, or loss to any property referred to in section 1.4 or 1.5 above, caused directly or indirectly, in whole or in part by the Contractor and subcontractor, or anyone directly or indirectly employed by any of them; or anyone for whose acts any of them may be liable will be remedied by the Contractor; except damage or loss attributable to the fault of drawings or specifications, or to the acts or omissions of the Engineer, the Owner, or the Engineer, or anyone employed by either of them; or anyone for whose acts either of them may be liable and not attributable directly or indirectly in whole or in part to the fault or negligence of the Contractor.

1.7 The Contractor shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent, unless otherwise designated in writing by the Contractor to the Owner.

1.8 The Contractor and all subcontractors shall immediately report all accidents, injuries, or health hazards to the Owner or its designated representatives in writing for information purposes only. This shall not relieve the Contractor or all subcontractors from mandatory reporting requirements, or any other requirements under the Occupational Safety and Health Act of 1970.

1.9 This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Workforce Development, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (Industrial Bulletin No. 12)." Contractors shall be familiar with the requirements of these regulations, and MUCTD and ADA safety requirements.

ARTICLE 2 - ACCESS TO THE WORK

2.1 The Owner and agents and employees of the Owner may at all times enter upon the work and areas occupied by the Contractor, and the Contractor shall provide safe and proper facilities for such entrance and for the inspection of the work.

2.2 The Contractor shall at all times provide proper facilities for access and inspection by representatives of the Commonwealth of Massachusetts to all work under this project wherever it is in preparation or progress.

ARTICLE 3 - CONTRACTOR TO LAY OUT CONTRACTOR'S OWN WORK

3.1 The Owner will establish such general reference points for all detailed layout, staking, and grade control as in its judgment will enable the Contractor to proceed with the work. The Contractor at its own expense shall provide all materials and equipment and such qualified helpers, including a registered engineer and/or land surveyor, as the Owner may require for utilizing the general reference points, and also, protect and preserve all stakes, benches, and other markers used to identify the reference points and be responsible for the accuracy of all lines, grades, and measurements. See also, DWPC Construction Grants Policy Memorandum No. CG-3.

ARTICLE 4 - PROJECT MEETINGS

4.1 First Progress Meeting: Prior to the commencement of Work at the site, the first progress meeting will be held at a mutually agreed time at the Owner's office which shall be attended by the Contractor's Project Manager, its superintendent and CQC Manager, and its Subcontractors as the Contractor deems appropriate. Other attendees will be:

Resident Project Representative.
Representatives of Owner.
Governmental representatives as appropriate.
Others as requested by Contractor or Owner.

4.2 The Contractor shall bring to the meeting the submittals specified in the GENERAL CONDITIONS, SUPPLEMENTAL GENERAL CONDITIONS AND THE SPECIAL CONDITIONS and Section 01 33 00.

4.4 The purpose of the meeting is to designate responsible personnel and establish a Working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the Contractor prior to the meeting date. However, the Contractor should be prepared to discuss all of the items listed below.

Contractor's tentative schedules.
Transmittal, review, and distribution of Contractor's submittals.
Processing applications for payment.
Maintaining record documents.
Critical Work sequencing.
Field decisions and Change Orders.
Use of project site, office and storage areas, security, housekeeping, and Owner's needs.
Major equipment deliveries and priorities.
Contractor's assignments for safety and first aid.

4.5 The Owner will preside at the meeting and will arrange for keeping and distributing the minutes to all persons in attendance.

4.6 The Contractor and its Subcontractors should plan on the meeting taking no less than one full Working day.

4.7 Weekly Progress Meetings: See Article 5.6.6 of the GENERAL CONDITIONS.

ARTICLE 5 - PROJECT SIGN DETAILS

5.1 The Contractor shall furnish and erect two (2) signs at the project site at the location directed. The Contractor shall maintain the signs, including repainting, in a satisfactory condition for the life of this Contract. Upon completion of the project and when directed, the sign shall become the property of the Contractor and shall be satisfactorily removed and disposed of by the Contractor off the site. The costs of furnishing, erecting, and maintaining the project signs shall be considered to be included in the prices stipulated for the various items of work as listed in the Bid; no direct payment will be made for this work. The signs shall meet the following criteria:

¾" thick exterior high density overlay plywood
Signs shall be 5 feet wide by 3 feet high, mounted at least 4 feet above the ground
Signs shall be multi-colored and with font style and font size as directed by the Owner
Signs shall include graphic logo for the City of Cambridge, DPW's "The Works" logo, the Engineers, and the Contractor.
The lettering on the signs shall be provided as indicated and to additional requirements as directed.

ARTICLE 6 - SUBSURFACE DATA

6.1 Subsurface soil and rock information and investigations have been obtained, made, and plotted for use by the Owner for the purpose of design of the project. The subsurface soils and rock data shown on the Drawings and in the Specifications are based on the geotechnical and environmental reports prepared for the work proposed. These reports, which are included in the appendices, are for the general information of bidders and the Contractor and the attention of Bidders and Contractors is directed to the fact that by reason of methods commonly used for obtaining and expressing such boring data, these information and data may be limited and subject to error or misunderstanding. The terms used to describe soils, rock, groundwater, and such other conditions are subject to local usage, and to the interpretation of the person obtaining and making the records. The borings have been made with reasonable care, substantially at the locations indicated and to the depths shown. Groundwater levels shown in the reports in Appendix A are those reported by the driller to be existing at the particular boring location at the time subsurface investigations were made, and do not necessarily represent permanent groundwater levels; it shall be the responsibility of the Contractor to determine for itself annual and seasonal variations in groundwater levels which may affect the Contractor's work. Each bidder is expected to examine the site and the compiled record of investigations and information and then, based upon those inspections, interpretations, and such other investigations as the bidder may desire, decide the character of material to be encountered and excavated, the suitability of the materials that are to be used for backfilling and such other purposes, groundwater conditions, difficulties, or obstacles likely to be encountered, and other conditions affecting the work. No warranty, either expressed or implied by the Owner, Engineer, or their agents, is made as to the accuracy of the subsurface information and data shown on the Drawings, and the Engineer, the Owner, together with their agents, will not assume responsibility for any consequences delays, expense, or losses which may occur or have occurred in the event that such indications shall be found to be incomplete, incorrect, or misleading; nor shall such variations or inaccuracies in the indications of subsurface information and data constitute grounds for revision in contract price or the time of completion.

ARTICLE 7 - ADDITIONAL DEFINITIONS

7.1 Earth – Earth, whenever used as a name of material excavated or to be excavated, shall mean all kinds of material except rock.

7.2 Loam – “Loam”, “Soil”, or “Top Soil” shall mean the material composing the surface layer of ground containing varying amounts of organic matter.

7.3 Rock – Rock, whenever used as a name of material excavated or to be excavated, shall mean the sound bedrock properly removed by blasting, wedging or barring, also such boulders as exceed one cubic yard in volume removed or to be removed from the excavation.

7.4 Ton – Ton shall mean 2,000 pounds.

ARTICLE 9 – INSURANCE REQUIREMENTS

9.1 Insurance requirements provided in Article 8 of Section 00800 “General Terms and Conditions” shall include the City of Cambridge, Kleinfelder, and Stantec.

9.2 Engineers providing professional design services to the Contractor are required to carry Professional Liability Insurance in the amount of at least $1,000,000, unless otherwise specified, and meeting all requirements laid out in this Section and Section 00800 “General Terms and Conditions”.

ARTICLE 11 – QUANTITIES AND UNIT PRICES

The unit prices for each of the several items in the proposal of each Bidder shall include its prorated share of overhead, so that the sum of the products obtained by multiplying the quantity shown for each item by the unit price bid represents the total bid. Any Bid not conforming to this requirement may be rejected as informal. The special attention of all Bidders is called to this provision, should conditions make it necessary to revise the quantities, no limit will be fixed for such increased or decreased quantities nor extra compensation allowed, provided the net monetary value of such additive or subtractive changes in quantities of such items of work (i.e., difference in cost) shall not increase or decrease the original contract price by more than twenty-five percent (25%) except for work not covered in the Contract Documents as provided for in Section 00800, Article 11 CHANGES IN THE WORK.”

END OF SECTION 00825

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 00825A

SPECIAL CONDITIONS

FOR CONSTRUCTION, RECONSTRUCTION, INSTALLATION, DEMOLITION, MAINTENANCE OR REPAIR OF ANY CITY OF CAMBRIDGE PUBLIC WORK

TABLE OF CONTENTS

ARTICLE 1 SCOPE OF THE WORK
ARTICLE 2 SPECIAL CONSIDERATIONS
ARTICLE 3 WORK TO BE ACCOMPLISHED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS
ARTICLE 4 CONTRACTOR TO CHECK DIMENSIONS AND SCHEDULES
ARTICLE 5 FIRST AID TO INJURED
ARTICLE 6 PROTECTION AGAINST HIGH WATER AND STORM
ARTICLE 7 SEQUENCE OF WORK
ARTICLE 8 COMPETENT HELP TO BE EMPLOYED
ARTICLE 9 STREETS AND SIDEWALKS TO BE KEPT OPEN
ARTICLE 10 LIGHTS, BARRIERS, WATCHMEN AND INDEMNITY
ARTICLE 11 WORK OUTSIDE REGULAR HOURS
ARTICLE 12 PUBLIC TRANSPORTATION INTERFERENCE
ARTICLE 13 WORK IN COLD WEATHER
ARTICLE 14 TUNNELING
ARTICLE 15 RESERVED MATERIALS
ARTICLE 16 DISPOSAL OF MATERIALS, ACCESS TO HYDRANTS AND GATES, AND MATERIALS TRIMMED-UP FOR CONVENIENCE OF PUBLIC TRAVEL OR ADJOINING TENANTS
ARTICLE 17 LENGTH OF TRENCH TO BE OPENED, AND MAINTAINING PREMISES FREE FROM OBSTRUCTIONS
ARTICLE 18 INTERFERENCE WITH EXISTING STRUCTURES
ARTICLE 19 FENCING, TURF, TOPSOIL AND OTHER REPLACED ITEMS
ARTICLE 20 MATERIALS
ARTICLE 21 DEFECTIVE MATERIALS, INSPECTION AND TESTING OF MATERIALS FURNISHED, SAMPLES AND ORDERING LISTS
ARTICLE 22 CONTRACTOR'S OFFICE
ARTICLE 23 SANITARY REGULATIONS
ARTICLE 24 SPIRITOUS LIQUORS
ARTICLE 25 FINISHING AND CLEANING UP
ARTICLE 26 CLEAN-UP AT CONTRACTOR'S EXPENSE
ARTICLE 27 RIGHTS OF ACCESS
ARTICLE 28 EXISTING UTILITIES OR CONNECTIONS
ARTICLE 29 COMPLETENESS OF WORK
ARTICLE 30 PLANK CROSSING
ARTICLE 31 CLEANING FINISHED WORK

ARTICLE 32 DUST CONTROL
ARTICLE 33 CARE OF THE WORK
ARTICLE 34 INDEMNIFICATION
ARTICLE 35 CONSTRUCTION SCHEDULE
ARTICLE 36 WORK BY OTHERS
ARTICLE 37 FIRE PREVENTION AND PROTECTION
ARTICLE 38 RECORD DRAWINGS
ARTICLE 39 CONSTRUCTION STAGING
ARTICLE 40 STREETS TO BE KEPT OPEN - ADDITIONAL REQUIREMENTS
ARTICLE 41 WORK WITHIN THE LIMITS OF PRIVATE PROPERTY
ARTICLE 42 DISTURBANCE OF BOUNDS
ARTICLE 43 ARCHAEOLOGICAL FINDS DURING CONSTRUCTION AND RELATED ACTIVITIES
ARTICLE 44 NOT USED
ARTICLE 45 PROSECUTION OF THE WORK - SUPPLEMENTAL REQUIREMENTS
ARTICLE 46 EQUIPMENT RESTRICTIONS
ARTICLE 47 CONTRACTOR RECORDS
ARTICLE 48 CONTRACTOR DRAWINGS
ARTICLE 49 PIPE TESTING
ARTICLE 50 EXCAVATION IN PUBLIC WAYS
ARTICLE 51 LEAKAGE TEST
ARTICLE 52 TEST REPORTS, CERTIFICATES OF COMPLIANCE AND SHIPPING LISTS
ARTICLE 53 SERVICES OF MANUFACTURER'S REPRESENTATIVES
ARTICLE 54 NOT USED
ARTICLE 55 SAFETY AND HEALTH REGULATIONS
ARTICLE 56 SPECIAL PROVISIONS
ARTICLE 57 STATE GOVERNMENT PROVISIONS
ARTICLE 58 COMMUNITY AND STAKEHOLDER MEETINGS
ARTICLE 59 PERMITS
ARTICLE 60 MASSACHUSETTS GENERAL LAWS

APPENDED:
Attachment I City of Cambridge Department of Public Works, Division of Urban Forestry - Tree Protection During Construction
Attachment II General Laws of Massachusetts – Part I – Title XIV Public Ways and Works – Chapter 82 – Section 40 (Dig Safe)
Attachment III Ordinance Number 1329 (Dumpster Licenses)
Attachment IV Massachusetts Diesel Retrofit Program
Attachment V Excepts of Massachusetts General Laws

SPECIAL CONDITIONS

ARTICLE 1 - SCOPE OF THE WORK: The Contractor shall furnish all plant, labor, materials, supplies, equipment and other facilities and things necessary or proper for, or incidental to, the work contemplated by this Contract as required by and in strict accordance with the Drawings, Specifications and Addendum (or Addenda), and/or required by, and in strict accordance with, such changes as are ordered and approved pursuant to this Contract, and the Contractor shall perform all other obligations imposed on the Contractor by this Contract. The Contractor shall be responsible for all materials delivered and work performed until completion and final acceptance. Upon completion of this Contract, the work shall be delivered complete and undamaged.

ARTICLE 2 - SPECIAL CONSIDERATIONS AND NOTICES:

a. The Contractor shall be responsible for the control of flows in the existing sewers and drains affected by the work under this Contract. The use of stop logs, bagging, sand bags, or any other suitable method approved by the Owner may be used to interrupt flows within the work areas, provided pumping is used to maintain sewerage and drainage flows and water levels in the incoming sewer and drainage systems during construction operations. Pumped sewage and drainage shall be discharged into other sewers and drains, respectively, as approved by the Owner. The Contractor shall submit for review his proposed methods of flow controls.

b. The Contractor shall supply the Owner, prior to the start of construction operations, with a telephone number and location of a place where he may be contacted at any time during the performance of this contract.

c. All flows within the existing sewers shall be maintained. Existing combined sewers may flow at full capacity during storms. All plugs or similar devices used to block sewers or storm drains shall be removed at the end of each work day unless otherwise directed by the Owner due to special conditions. All plugs or similar devices to block sewers and storm drains shall be recorded as to location and time installed, and shall be recorded as to location and time removed. This accounting shall be enforced in order to avoid the potential for sewage or stormwater back-ups due to blocked pipelines. Copies of the recorded information shall be provided to the Engineer on a daily basis.

d. All damaged areas outside the Contract work limits shall be restored to its original condition at the expense of the Contractor.

e. Removal of portions of the existing manholes and existing storm catch basins may be required to permit construction operations. Portions of manholes and catch basins removed shall be replaced in conformance with the catch basin or manhole details contained in the Contract Drawings or shall consist of the same design as the structure removed unless otherwise specified by the Contract Documents or by the Engineer.

f. The Contractor shall take all necessary precautions during the performance of the work to prevent causing a surcharge in the existing sewers and drains.

g. The Contractor's attention is directed to Articles 9, 10 and 40 of these Special Conditions and Specification Section 01570, Maintenance of Traffic of the Technical Specifications.

h. The Contractor shall contact Mr. David Lefcourt, City Arborist, at the City of Cambridge Urban Forestry Division at telephone number 617-349-6433 immediately upon notification to proceed by the City. All construction operations shall be coordinated with the Urban Forestry Division to avoid damage to existing trees. Any permitted pruning of the trees shall be accomplished with a representative of the Urban Forestry Division present at the construction site. The Contractor will need to comply with the City of Cambridge Department of Public Works Division of Urban Forestry, Tree Protection During Construction policy attached at the end of these Special Conditions.

i. The Contractor shall be made aware of the following Cambridge events scheduled for the 2026 through 2029 calendar years and beyond which may affect the Contractor's work. This partial list is provided for information purposes only and is subject to change:

Head of the Charles Regatta –October 2026, October 2027, October 2028, October 2029
MIT Spring Term Final Examination Period – May 2026, May 2027, May 2028, May 2029
MIT graduation – June 2026, June 2027, June 2028, June 2029
Harvard Spring Term Final Examination Period – May 2026, May 2027, May 2028, May 2029
Harvard graduation – June 2026, June 2027, June 2028, June 2029

Contractor shall be prepared to stop work due to weather conditions, parades, and other City and local school functions at the request of either City. The stoppage will result in no payment to the Contractor until the work is resumed when notified by the City.

ARTICLE 3 - WORK TO BE ACCOMPLISHED IN ACCORDANCE WITH THE DRAWINGS AND SPECIFICATIONS: The work during its progress and at its completion, shall conform to the lines and grades shown on the drawings and to the directions given by the Owner from time to time, subject to such modifications or additions as the Owner shall determine to be necessary during the execution of the work; and in no case will any work be paid for in excess of such requirements. The work shall also be accomplished in accordance with the data in these Specifications.

ARTICLE 4 - CONTRACTOR TO CHECK DIMENSIONS AND SCHEDULES: The Contractor shall be responsible for checking all dimensions and quantities shown on the drawings or schedules given to him by the Owner, and shall notify the Owner of all errors therein which he may discover by examining and checking the same. The Contractor shall not take advantage of any error or omission in these Specifications, Drawings or schedules. The Owner will furnish all instructions should such error or omission be discovered, and the Contractor shall carry out such instructions as if originally specified.

ARTICLE 5 - FIRST AID TO INJURED: The Contractor shall keep in its field office ready for immediate use, all articles necessary for giving first aid to injured employees. The Contractor shall also provide arrangements for the immediate removal and hospital treatment of any employee injured on the work who may require the same.

ARTICLE 6 - PROTECTION AGAINST HIGH WATER AND STORM:

a. The Contractor shall take all precautions to prevent damage to the work or equipment by flooding, high winds, high waters or by storms, including hurricanes. The Owner may prohibit the carrying out of any work at any time when in its judgement, high winds, high waters or storm conditions are unfavorable or not suitable, or at any time, regardless of the weather, when proper precautions are not being taken to safeguard previously constructed work or work in progress.

b. In case of damage caused by the failure of the Contractor to take adequate precautions, the Contractor shall repair or replace equipment damaged and shall make such repairs or rebuild such parts of the damaged work, as the Owner may require, at no additional expense to the Owner.

ARTICLE 7 - SEQUENCE OF WORK: The Contractor shall be required to prosecute the work in accordance with a schedule prepared by the Contractor and approved by the Owner and Engineer prior to commencement of the work and in accordance with the additional requirements specified herein, and approved by the Owner. The Contractor shall include cost loading, monthly payment requisitions and project status reporting requirements within the Schedule. This schedule shall state the methods and shall forecast the times for doing each portion of the work. Before beginning any portion of the work, the Contractor shall give the Owner advance notice and ample time for making the necessary preparations. Construction sequencing information provided in the Contract Documents are for information purposes in order to aid the Contractor in the sequencing of the work.

ARTICLE 8 - COMPETENT HELP TO BE EMPLOYED: The Contractor shall employ only experienced forepersons, craftspersons and other workers competent in the work in which they are to be engaged.

ARTICLE 9 - STREETS AND SIDEWALKS TO BE KEPT OPEN:
(See also SC Article 40 and Section 01570 of the Technical Specifications)

a. The Contractor shall at all times keep the streets and sidewalks in which the Contractor may be at work open for pedestrian and vehicular traffic and for vehicles maintaining public services. The Contractor shall bridge or construct plank crossings over the trenches at street crossings, roads or private ways. No sidewalk shall be obstructed where it is possible to avoid it. See Article 17b for restrictions on plank or steel plate crossings in the event of snow.

b. Having obtained approval from the Owner to close a street to traffic, the Contractor shall notify the Fire Chief and the Chief of Police of Somerville and Cambridge; then provide a system of detour signs, approved by the Owner.

ARTICLE 10 - LIGHTS, BARRIERS, WATCHMEN, AND INDEMNITY:
a. The Contractor shall put up and maintain such barriers, barricades, fencing, lighting and warning lights, danger warning signals and signs that will prevent accidents during the construction work and protect the work and insure the safety of personnel and the public at all times and places; the Contractor shall indemnify and protect the Owner and the Engineer in every respect from any injury or damage whatsoever caused by any act or neglect of the Contractor or its subcontractors or their servants or agents.

b. All construction warning and traffic control signs, barricades, lights, and pedestrian safety controls shall be in compliance with the Massachusetts Department of Transportation, Highway Division (MassDOT), Standard Specifications for Highways and Bridges, Section 850 (Traffic Controls for Construction and Maintenance Operations), latest edition; the Massachusetts Manual on Uniform Traffic Control Devices (MUTCD), Part IV, latest edition; American Disabilities Act (ADA); regulations set forth by the City of Cambridge Department of Public Works, and Section 01570 of the Technical Specifications.

Reflective sheeting for barricades and signs shall conform to Subsection M9.30.2 (Encapsulated Lens Reflective Sheeting) of the Standard Specifications for Highways and Bridges.

c. In addition to the above, when and as necessary or when required by the Owner, the Contractor shall post signs and employ watchmen at the site for excluding unauthorized persons from the work at all times, for which the Contractor will not be paid additional compensation.

d. All detours required for pedestrian and vehicular traffic shall be in conformance with regulations set forth by the City of Cambridge Department of Public Works (DPW) and MUTCD requirements (see also Article 40). It shall be the Contractor's responsibility to contact and make all necessary arrangements for detours with the Department of Public Works prior to the beginning of construction operations.

e. The Contractor shall be responsible for excluding at all times from lands within easement areas, or other state or municipally owned areas, all persons not directly connected with the work or authorized by the Owner to be in the work areas.

ARTICLE 11 - WORK OUTSIDE REGULAR HOURS: Night work or work on Saturdays, Sundays, or legal holidays, requiring the presence of an engineer or inspector, will not be permissible except in case of emergency, and only upon the approval of the Owner. Should it be desired or required by the Owner to operate an organization for continuous night work or for emergency night work, the lighting, safety and other facilities which are deemed necessary by the Owner for performing such night work shall be provided by the Contractor. For night work, work on Saturdays, Sundays or legal holidays, if any be performed, the Contractor will receive no extra payment, but compensation shall be considered as having been included in the prices stipulated for the appropriate items of work as listed in the Bid. See Section 01010 of the Technical Specifications for work hour restrictions. See notes on plans for additional restrictions.

ARTICLE 12 - PUBLIC TRANSPORTATION INTERFERENCE: Whenever it may be necessary to interfere with any public transportation systems notice shall be given to the corporation owning the same, and reasonable time shall be given to said corporation to arrange the schedule for operation of same, as may be necessary.

ARTICLE 13 - WORK IN COLD WEATHER:

a. The Owner will determine when conditions are unfavorable for work and may order the work or any portion of it suspended whenever, in his opinion, if the conditions are not such as to insure first class work. In general, work shall be prosecuted throughout the year and the Contractor will be expected to keep work going, and employment of labor as continuous as possible.

b. All methods and materials used in the performance, and for the protection of, the work in cold weather shall be subject to the approval of the Owner. The Contractor shall take necessary precautions to protect the work from damage and for removing ice and frost from materials, including heating the water, sand and coarse aggregate, and for protecting the newly laid masonry. The Contractor will be responsible for snow removal and sidewalk maintenance and de-icing at the time of a snow event within the areas of work and as required for the work to proceed. The Contractor will receive no extra payment for any labor, apparatus, tools or materials necessary to comply with the above requirements, but compensation shall be considered to be included in the prices stipulated for the appropriate items of work as listed in the Bid. Contractor will provide contact phone number to Owner and Engineer for party responsible for snow removal.

c. See Article 17b for restrictions on plank or steel plate crossings in the event of snow.

ARTICLE 14 - TUNNELING : Tunneling will not be permitted without the consent of the Owner.

ARTICLE 15 - RESERVED MATERIALS: Materials found on the work suitable for any special use in the project shall be reserved for that purpose. When approved by the Owner, the Contractor may use in the various parts of the work, without charge therefore, any suitable materials taken from the excavations.

ARTICLE 16 - DISPOSAL OF MATERIALS, ACCESS TO HYDRANTS AND GATES, AND MATERIALS TRIMMED-UP FOR CONVENIENCE OF PUBLIC TRAVEL OR ADJOINING TENANTS: The materials from trenches and other excavations and those used in the construction of the work shall be deposited in such a manner that they will not endanger the work and that free access may be had at any time to all hydrants and gates in the vicinity of the work. The materials shall be kept trimmed-up in such a manner as to be of as little inconvenience as possible to the public travel or the adjoining tenants. All suitable excavated materials not utilized as refill or backfill at the site of excavation or other locations on the project shall be removed and legally disposed of by the Contractor at no additional expense to the Owner. All unsuitable excavated material including rock shall be removed and legally disposed of by the Contractor at no additional expense to the Owner.

ARTICLE 17 - LENGTH OF TRENCH TO BE OPENED AND MAINTAINING PREMISES FREE FROM OBSTRUCTIONS:

a. The length of trench opened at any time, from point where ground is being broken to completed backfill and also the amount of space in streets or public and private lands occupied by equipment, trench and supplies, shall not exceed the length or space considered reasonably necessary and expedient by the Owner. In determining the length of open trench or spaces for equipment, materials, supplies and other necessities, the Owner will consider the nature of the lands or streets where work is being done, types and methods of construction and equipment being used, inconvenience to the public or to private parties, possible dangers and other proper matters. All work must be constructed with a minimum of inconvenience and danger to the public and all other parties concerned.

b. Whenever any trench obstructs pedestrian and vehicular traffic in or to any public way, private driveway or property entrance, or on private property, the Contractor shall take such means as may be necessary to maintain pedestrian and vehicular traffic and access in accordance with Article 10. Until such time as the work may have attained sufficient strength to support backfill, or if for any other reason it is not

expedient to backfill the trench immediately, the Contractor shall construct and maintain suitable plank or steel plate crossings and bridges, as approved by the Owner, to carry essential traffic in or to the street, driveway or property in question as specified or directed. Plank or steel plate crossings will not be allowed to be used to cover open trenches or excavations in the event of snow. In this event, the trench or excavation must be backfilled immediately and temporary pavement installed.

c. Suitable signs, lights, and such items required to direct traffic shall be furnished and maintained by the Contractor in accordance with Article 10.

d. The Contractor must keep streets and premises free from unnecessary obstructions, debris and all other materials. The Owner may, at any time, order all equipment, materials, surplus from excavations, debris and all other materials lying outside that length of working space promptly removed, and should the Contractor fail to remove such material within 24 hours after notice to remove the same, the Owner may cause any part or all of such materials to be removed by such persons as it may employ, at the Contractor's expense, and may deduct the costs thereof from payments which may be or may become due to the Contractor under the Contract. In special cases, where public safety urgently demands it, the Owner may cause such materials to be removed without prior notice.

e. Storage of materials on the public way is not allowed except where placed temporarily to be used immediately in the work.

f. The Contractor shall provide storage areas off the site of the work, as required, and shall include the cost of same in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 18 - INTERFERENCE WITH EXISTING STRUCTURES:

a. Whenever it may be necessary to cross or interfere with existing culverts, drains, sewers, cable television, water pipes or fixtures, guardrails, fences, gas pipes, electrical, or telephone cables or conduits, or fixtures or other structures needing special care, public or private, due notice shall be given to the owner of the aforementioned utility, and the work shall be done according to the Owner's directions. Whenever required, all objects shall be strengthened to meet any additional stress that the work herein specified may impose upon it, and any damage caused shall be thoroughly repaired. If so directed by the Owner, the locations of any existing work shall be changed to meet the requirements of the sewerage system or appurtenances or the sewerage system may be relocated, if necessary, to leave all in good working order. The entire work shall be the responsibility of the Contractor and the work shall be performed at no additional expense to the Owner.

b. The Contractor shall be responsible for any damage to all known mains or utilities encountered during the progress of the work and shall repair and be responsible for correcting all damages to such existing utilities and structures at no additional expense to the Owner. The Contractor shall contact the proper utility or authority to correct or make any changes due to utility or other obstructions during the work of construction of the sewerage and drainage systems, but the entire responsibility and expense shall be with the Contractor.

c. All items required to be removed and replaced due to construction and all existing items damaged by the Contractor shall be replaced or repaired by the Contractor to the complete satisfaction of the property owners and/or the Owner at no additional expense to the Owner, unless otherwise specified.

ARTICLE 19 - FENCING, TURF, TOPSOIL, AND OTHER REPLACED ITEMS: Where construction is through cultivated or sodded lands, the Contractor shall save the turf and topsoil separately and replace the same after the trench is filled, leaving the land as nearly as possible in its original condition. Trees, fences, walls, grassed and landscaped areas, walks, and play and recreational areas, and such other items must be restored or repaired to the satisfaction of the Owner, if damaged by work under this Contract, at no additional expense to the Owner.

ARTICLE 20 - MATERIALS: All materials furnished and used in the completed work shall be new, of best quality workmanship and design, and recognized as standard in good sewer construction practices.

Whenever a Specification number or reference is given, the subsequent amendments shall be included. The standards set forth in the selection of materials and supplies are intended to conform with those standards adopted by the Owner. Preference in manufacturer shall be given to adopted standards and the Contractor shall further familiarize himself with the requirements of the Owner when the occasion or choice of materials or supplies so demand.

ARTICLE 21 - DEFECTIVE MATERIALS, INSPECTION AND TESTING OF MATERIALS FURNISHED, SAMPLES AND ORDERING LISTS:

a. No materials shall be laid or used which are known, or may be found, to be in any way defective. Notice shall be given to the Owner of any defective or imperfect material. Defective or unfit material found to have been laid shall be removed and replaced by the Contractor with sound and unobjectionable material without additional expense to the Owner.

b. All materials furnished by the Contractor are subject to thorough inspections and tests by the Owner.

c. The Contractor shall submit samples as required by the Owner of the various materials used in the Contract for testing purposes.

d. All ordering lists shall be submitted by the Contractor to the Owner for approval and shall be approved before the ordering of the materials.

ARTICLE 22 - CONTRACTOR'S OFFICE: The Contractor shall maintain during the performance of this Contract, an office at the site of the work at which the Contractor or its authorized agent shall be present at all times while the work is in progress. The Contractor shall be responsible for equipping its office at the work with all office facilities which may be required. Instructions from the Owner left at this office shall be considered as delivered to the Contractor. Copies of the Contract, Drawings, and Specifications shall be kept at said office ready for use at any time. The obtaining of a suitable site for the location of the office shall be the responsibility of the Contractor; however, the location and site shall be subject to approval of the Owner; all costs in connection with the obtaining and use of a suitable office site shall be the responsibility of the Contractor.

ARTICLE 23 - SANITARY REGULATIONS:

a. Adequate sanitary conveniences for use of workers on the premises, properly secluded from public observation, shall be provided and maintained by the Contractor in accordance with requirements of local and State health authorities and in such manner and at such points as shall be approved, and their use shall be strictly enforced. Sanitary waste shall be treated and disposed of in a manner satisfactory to and as directed by the Owner and the local and State health authorities; under no circumstances shall sanitary wastes be allowed to flow on the surface of the ground.

b. The Contractor shall rigorously prohibit the committing of nuisances by persons connected with the work upon the lanes or right- of-way of the Owner, about the work, or upon adjacent public or private property.

c. The cost of the sanitary conveniences and maintenance of same will not be paid for separately, but compensation will be considered to be included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 24 - SPIRITUOUS LIQUORS: The Contractor shall neither permit nor suffer the introduction or use of spirituous liquors upon the work embraced in this Contract.

ARTICLE 25 - FINISHING AND CLEANING UP: In completing the backfilling of the trenches, the Contractor shall replace all surface material to the satisfaction of the Owner, and shall then immediately remove all surplus material, and all tools and other property belonging to him, leaving the entire street or

surroundings free and clean and in good order at no additional expense to the Owner. The backfilling and removing of surplus materials shall follow closely upon the completion of the work. The Contractor shall exercise special care in keeping right-of-way and private and public lands, upon which work is to be performed, clean and free of debris at all times and to remove tools and other property belonging to the Contractor when they are not being used.

ARTICLE 26 - CLEAN-UP AT CONTRACTOR'S EXPENSE: In case the Contractor shall fail or neglect, after backfilling, to promptly remove all surplus materials, tools and other incidentals, or promptly do the required repaving when ordered, the Owner may after 24 hours notice, cause the work to be done, and the cost thereof shall be deducted from any monies then or thereafter due the Contractor.

ARTICLE 27 - RIGHTS OF ACCESS: Nothing herein contained or shown on the Drawings shall be construed as giving the Contractor exclusive occupancy of the work areas involved. The Owner or any other contractor employed by the Contractor, the various utilities companies, contractor or subcontractor employed by the Federal, State or local governmental agencies or other utility firms or agencies involved in the general project or upon public rights-of-way, may enter upon or cross the areas of work or occupy portions of it as directed or permitted. When the territory of one contract is the convenient means of access to the other, each contractor shall arrange its work in such manner as to permit such access to the other and prevent unnecessary delay to the work as a whole.

ARTICLE 28 - EXISTING UTILITIES OR CONNECTIONS:

a. The location of existing underground pipes, cables, conduits and structures as shown has been collected from the best available sources and the Owner together with its agents does not imply or guarantee the data and information in connection with underground pipes, cables, conduits, structures and such other parts as to their completeness nor their locations as indicated. The Contractor shall contact utility owners and request marking location of all their lines in the work areas. The Contractor shall assume that there are existing water, gas, and other utility connections to each and every building enroute, whether they appear on the Drawings or not. Any expense and/or delay occasioned by these utilities and structures or damage thereto, including those not shown, shall be the responsibility of the Contractor at no additional expense to the Owner. See General Notes on Contract Drawings.

b. Before proceeding with construction operations at any location, the Contractor shall make such supplemental investigations, including test pits, as it deems necessary and approved by the Owner to uncover and determine the exact location of utilities, structures, or other conditions, and the Contractor shall have no claims for damages due to encountering subsurface structures, utilities, or other conditions. The Contractor shall also have no claims for damages due to encountering subsurface structures, utilities or other conditions which are made known to the Contractor prior to construction operations.

ARTICLE 29 - COMPLETENESS OF WORK: In addition to the specified or described portions of work, all other work and all other materials, equipment and labor of whatever description which are necessary or required to complete the work, or for carrying out the full intent of the Drawings and Specifications, as interpreted by the Owner, shall be provided by the Contractor, and payment therefore shall be considered as having been included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 30 - PLANK CROSSINGS: As required or directed by the Owner, the Contractor shall install in selected locations suitable plank, steel plate or timber crossings substantially built and reinforced to sustain vehicular traffic across trench or other excavations. Crossings shall be constructed with wide and usable approaches for use by the traveling public, private property owners, or emergency equipment. No separate payment will be made for this work but the cost shall be included in the price the Bid. (See Article 17).

ARTICLE 31 - CLEANING FINISHED WORK: After the work is completed, the sewers, drains, manholes, catchbasins, and other structures shall be carefully cleaned free of dirt, broken masonry, mortar, construction and other debris and left in first class condition ready for use. All temporary or excess material shall be legally disposed of and the work left broom-clean to the satisfaction of the Owner.

ARTICLE 32 - DUST CONTROL: The Contractor shall exercise every precaution and means to prevent and control dust arising out of all construction operations from becoming a nuisance to abutting property owners or surrounding neighborhoods. Pavements adjoining the excavation or pipe trenches shall be kept broomed off and washed clean. The Contractor will be responsible for street sweeping within the areas of work delineated by the Contract Documents. Earth stockpiles along trenches when permitted, stockpiles, and surfaces of refilled trenches shall be kept moist at all times, as directed. No extra payment will be made for providing the dust control conforming to the requirements specified above, but compensation therefore shall be considered to be included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 33 - CARE OF THE WORK: The Contractor shall be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence in connection with the prosecution of the work and shall be responsible for the proper care and protection of all material delivered and work performed until completion and final acceptance, whether or not the same has been covered by partial payments made by the Owner.

ARTICLE 34 - INDEMNIFICATION:

a. To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, the Engineer and their agents and employees from and against all claims, damages, losses and expenses, including but not limited to attorney's fees, arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself) including the loss of use resulting therefrom, and (2) is caused in whole or in part by any negligent act or omission of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or otherwise reduce any other right or obligation of indemnity which would otherwise exist as to any party or person described in this Article 34.

b. In any and all claims against the Owner, the Engineer or any of their agents or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, the indemnification obligation under this Article 34 shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any Subcontractor under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

ARTICLE 35 - CONSTRUCTION SCHEDULE: In addition to other requirements specified, the Contractor shall confer with the Owner for the purpose of drafting a construction schedule satisfactory to the Owner which is to include all the work of this Contract. The Contractor shall perform the work of this Contract to conform to the construction schedule as approved by the Owner, except that the Owner reserves the right to amend and alter the construction schedule as approved at any time in a manner which it deems to be in the best interest of the Owner so to do. The Contractor shall arrange its work under this Contract to conform with the construction schedule as it may be revised from time to time by the Owner at no additional expense to the Owner. The Contractor shall notify the Owner immediately of any circumstances which affect the performance of the work in accordance with the current construction schedule.

ARTICLE 36 - WORK BY OTHERS: The Owner reserves the right to do any other work which may connect with or become a part of, or be adjacent to the work embraced by this Contract at any time by contract work or otherwise. The Contractor shall not interfere with or obstruct in any way the work of such other persons as the Owner may employ, and shall execute its own work in such manner as to aid the executing of work by others as may be required. No backfilling of trenches or excavations will be permitted until such work by the Owner is completed.

ARTICLE 37 - FIRE PREVENTION AND PROTECTION:

a. All State and municipal rules and regulations with respect to fire prevention, fire-resistant construction, and fire protection shall be strictly adhered to, and all work and facilities necessary therefore shall be provided and maintained by the Contractor in an approved manner at no expense to the Owner.

b. All fire protection equipment such as water tanks, hoses, pumps, extinguishers, and other materials and apparatus, shall be provided for the protection of the contract work, temporary work and adjacent property. Trained personnel experienced in the operation of all fire protection equipment and apparatus shall be available on the sites whenever work is in progress and at such other times as may be necessary for the safety of the public and the work at no expense to the Owner.

ARTICLE 38 - RECORD DRAWINGS:

a. The Contractor shall maintain to the satisfaction of the Engineer at the site a set of Drawings on which shall be recorded accurately as the work progresses, the actual "as built" locations and dimensions of all his work, indicating thereon all variations from the Contract Drawings. This record of "as built" conditions shall include the work of all subcontractors, and any discrepancies found in the course of the work between actual locations of existing utility lines and structures and the locations shown on the Drawings, details at test pits and all excavations that reveal existing detail, connections to existing structures and lines and their construction and conditions, buildings, services, vacant lots, etc., and shall be available at all times for inspection by the Engineer. Progress sets of “as built” drawings shall be reviewed at construction progress meetings.

b. The Contractor shall submit monthly progress red line Record Drawing updates with each Pay Application. Progress Record Drawing red lines shall show daily progress of all construction and the information required as indicated above. Pay Applications which do not have a set of Progress Record Drawing red lines attached will not be processed until which time as the Progress Record Drawing red lines have been received by the Owner and Engineer and have been approved for completeness.

c. Prior to final acceptance of the work, all recorded data as gathered above shall be submitted to the Owner by the Contractor. The final record drawings will be prepared by the Owner with the information provided by the Contractor as specified above.

d. The survey data shall be obtained by Global Positioning Survey (GPS) and certified by a Professional Land Surveyor registered in the Commonwealth of Massachusetts.

e. No separate payment will be made for this work, but compensation therefor shall be considered as having been included in the prices stipulated for the appropriate items of work as listed in the Bid.

ARTICLE 39 - CONSTRUCTION STAGING: Construction staging areas will be limited to only those areas approved by the Owner.

ARTICLE 40 - STREETS TO BE KEPT OPEN-ADDITIONAL REQUIREMENTS:

Minimum requirements for keeping streets within the project areas open shall be as follows:
The Contractor shall submit for approval by the Owner, proposed traffic management and pedestrian safety plans in conformance with the requirements set forth in Section 01570 of the technical specifications. Construction will not be allowed to proceed until approval of the Contractor's proposed traffic control and pedestrian safety plans unless otherwise directed by the Owner. The Contractor shall secure and pay for all permits, fees, and bonds in connection with his operations. All streets shall be open to traffic and abutters at all times during construction of this contract. Requests by the Contractor to close or to provide one-way traffic flow in a street shall be submitted by the Contractor to the Owner a minimum of five (5) working days in advance of the Contractor's proposed construction operations affecting the street. The request for approval shall include the contractors proposed traffic control plan and schedule. Submission of incomplete or deficient planning and schedules shall result in denial of the request. Delays or costs incurred by Contractor for failure to comply with the requirements set forth herein will be borne by the Contractor at no cost to the City. The Contractor shall furnish, provide, erect, and maintain all signs, necessary barricades, suitable and sufficient red lights, lights, reflectorized signs or signals and danger signals in accordance with Article 10 of the Special Conditions, and Section 01570 of the Technical

Specifications. The Contractor shall arrange for sufficient number of police and watchpersons and take all necessary precautions for the protection of the work, control of traffic and safety of the public.

ARTICLE 41 - WORK WITHIN THE LIMITS OF PRIVATE PROPERTY:

a. Particular attention is hereby directed to the fact that some of the work included under this Contract may be done within the limits of properties that are state-owned and/or privately-owned. The Owner has, or will, secure the necessary limited temporary or permanent easements for construction purposes. The Contractor will be permitted to use the areas of the Owner's easements subject to all conditions and requirements applicable to the use of said easements, including restoration of grassed and landscaped areas, fences, etc., which are disturbed. The Contractor shall be responsible for determining at all times all conditions and requirements as they may affect the Contractor's operations and the work of this Contract and shall conduct its operations and activities in the performance of the work under this Contract in accordance with all such conditions and requirements and such additional requirements as may be required by the Owner. All other means and rights of ingress and egress to the work areas and all other areas required for work space, in addition to the said Owner's easements, shall be the entire responsibility of the Contractor. All costs in connection therewith shall be considered to be included in the prices stipulated for the appropriate items of work as listed in the bid. The Contractor shall niether use nor occupy public or private lands outside the limits of the Owner's easements and rights-of-way unless permits in writing have first been obtained by the Contractor from the owners of the public and/or private land and copies of such permits filed with the Owner. The Contractor shall be responsible for cooperating with state and private property owners and for the coordination and prosecution of the work of this Contract. Any abuse to lands of state or private owners shall be immediately corrected by the Contractor at its expense to the complete satisfaction of the owners, and such precautionary or preventive measures as required by the Owner shall be taken or made to prevent further additional nuisances, interference or inconvenience to the abutting owners.

b. It shall be the Contractor's full responsibility to familiarize itself with the limitations imposed on the work of construction within the various properties of state or private ownership and rights- of-way by the existing occupancy or use. To this end, the Contractor shall be required to make every effort to fully and satisfactorily protect trees, shrubs, lawns, gardens, fences, walks, driveways, yards or structures; protect all work by the erection or placing of safety guards or barriers, lights and such other incidentals; and where required, the Contractor shall construct temporary plank crossings, steel plates or timbers to permit full use of private facilities at all times at no additional expense to the Owner. All other applicable provisions for control of work within the areas of public travel set forth elsewhere herein shall also apply to work within the limits of private ownership.

c. The Contractor shall cooperate with state and private property owners and shall also contact the Owner for additional information regarding the requested (or required) length of time needed as a notice to be given to the state and private property owners before the Contractor enters the state or privately-owned property in order to start the construction work. In some cases, a certain time to start the work and a certain limited length of time may be permitted by the state and private property owners for any required shutdowns or construction operations so the work of the Contractor will not interfere with the private operations of the state or private property owners.

d. Before proceeding with construction operations, the Contractor shall provide suitable and substantial gates or other approved forms of wire gap in every existing fence within the limits of the Owner's easements and through which the Contractor intends to move or pass equipment and materials. It shall be the responsibility of the Contractor to determine with the owner of each fence all requirements, in addition to those specified above, relating to the construction of gates or other forms of wire gap; conditions to be observed in their use and for the rebuilding of fences. It shall be the responsibility of the Contractor to comply with all requirements as specified herein and as determined with the owners of the fences. Any damage to fences as a result of the Contractor's operations shall be made good by the Contractor in a manner satisfactory to the Owner.

e. No separate payment will be made for the requirements specified under "WORK WITHIN THE LIMITS OF PRIVATE PROPERTY," and all costs in connection therewith shall be included in the price of the Bid.

ARTICLE 42 - DISTURBANCE OF BOUNDS: The Contractor shall replace all bounds disturbed by his operation at his own expense. The bounds shall be reset by a land surveyor registered in the Commonwealth of Massachusetts.

ARTICLE 43 - ARCHAEOLOGICAL FINDS DURING CONSTRUCTION AND RELATED ACTIVITIES: During the life of this Contract the Contractor is herewith required to immediately notify the following organizations in the event that any articles such as "fire cracked stones," "stone flaking material," or any other such related items of historical significance are discovered.

a. City Engineer

b. State Archaeologist of Massachusetts

c. Resident Engineer or Inspector

ARTICLE 44 - NOT USED

ARTICLE 45 - PROSECUTION OF THE WORK-SUPPLEMENTAL REQUIREMENTS: The Contractor shall establish liaison with other contractors working in adjacent areas under other construction programs to assure that their work is closely coordinated with his work to prevent any delay in the overall program.

ARTICLE 46 - EQUIPMENT RESTRICTIONS: The sizes of equipment to be used for the construction will be restricted in certain areas, where larger equipment could cause damage to sidewalks and curbs on narrow streets, or to trees adjacent to the work and tree limbs overhanging the work. The Contractor shall submit the sizes of equipment he proposes to use on each street to the Owner for approval.

ARTICLE 47 - CONTRACTOR RECORDS: The Contractor shall comply with all applicable provisions of M.G.L., Chapter 30, Section 39R relative to Contractor's Records. The Contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the Contract. A complete copy of Section 39R shall be available for review at Engineer's office.

ARTICLE 48 - CONTRACT DRAWINGS: The work shall conform to the Contract Drawings, titled Inman Square Intersection Safety Improvement Project, all of which form a part of these specifications.

ARTICLE 49 - PIPE TESTING: All sewer pipe shall be tested in accordance with the Contract documents and sound engineering practice. If, after 60 days following submission of a monthly payment estimate for pipe items, the pipe for which payment is requested has not been successfully tested, the owner may withhold up to 10% of the amount requested for such pipe items until the pipe has been so tested. However, in the case of a major (pipe diameter 24 inches or greater) interceptor pipe installation, sums retained by the owner pursuant to this policy memorandum shall not exceed two per centum (2%) of the costs of such pipe items.

ARTICLE 50 - EXCAVATIONS IN PUBLIC WAYS: See Notice Requirements relative to excavations in public ways (Chapter 353 of the Acts of 1983) inserted at the end of these Special Conditions.

ARTICLE 51 - LEAKAGE TESTS:

a. The sewers and appurtenant structures connected thereto shall be made as nearly watertight as practicable. Where practical, as determined by the Owner, leakage tests will be performed for the new sewers and sewer manholes. Leakage into or from the sewers and structures will be determined by infiltration tests, exfiltration tests, or Low Pressure Air Acceptance tests as specified herein and as directed. The maximum allowable amount of infiltration into the sewers or exfiltration from the sewers, as

determined respectively by the infiltration or exfiltration tests, including manholes, shall be at a rate of not greater than 125 gallons per inch of pipe diameter per mile of pipes per 24 hours, and there shall be no gushing or spurting streams of water into or from the sewers or manholes. The phrase "per mile of pipes" shall refer to the total length of sewers measured through manholes. Where the groundwater level can be maintained at a height of not less than one foot above the top of the pipe for the full length of the section of sewer pipe being tested for leakage, the leakage into the sewers and manholes shall be determined as specified under "Infiltration Tests." When the ground water cannot be maintained at a level of not less than one foot above the top of the pipe for the full length of the section of sewer being tested, the leakage from the sewers and manholes shall be determined as specified under "Exfiltration Tests."

b. Infiltration Tests. The tests shall be conducted at such times as the groundwater level is at a height of not less than one foot above the top of the pipe for the full length of the section of sewer being tested. The groundwater leakage into the pipes will be measured by the Owner at such point or points as he may direct. The Contractor shall construct such weirs or other means of measurement as shall be required and shall do such pumping as shall be necessary to enable the tests to be satisfactorily made.

c. Exfiltration Tests. Where exfiltration tests are required, the section of the sewer to be tested shall be subjected to an internal pressure. The lower end of the section of sewer to be tested shall be closed and the entire section of the sewer, including manholes, shall be filled with clean water so as to obtain a minimum head of 2 feet above the top of the pipes; the length of the section of sewer pipeline being tested shall be such that with the head of water 2 feet above the top of pipe at the upper end of the section of pipeline being tested, the pipeline being tested will not exceed 8 feet. The rate of leakage from each section of the sewers being tested will be determined by the Owner by measuring the amount of water required to maintain the minimum head of 2 feet above the top of the pipes for the full length of each section of the sewers being tested.

d. Low Pressure Air Acceptance Test. The Contract may perform the leakage tests using the low pressure air test where approved by the Owner. This test shall conform to Uni-Bell Plastic Pipe Association recommended practice, UNI-6, latest revision, for all PVC pipes and to the additional requirements listed herein.

1. The pipeline shall be considered acceptable if the time interval for the 1.0 psi pressure drop is not less than the holding time as calculated in accordance with UNI-6, latest revision.

e. Testing as described above cannot readily be performed on many sewers due to the presence of existing building service connections which could offset test results or surcharge during testing, resulting in basement flooding. Testing of such sewers will be limited, as determined by the Owner, to physical inspection of the pipe sections from adjacent manholes or closed circuit television inspection. Any defective pipe, joints, or other construction shall be replaced or repaired by the Contractor at no additional expense to the Owner.

f. The Contractor shall do all the work, provide all necessary weirs, gauges, or such other measuring devices as required, do all pumping and furnish all labor, equipment and materials necessary for the proper performance of leakage tests at no additional expense to the Owner. Leakage tests shall not be performed in Owner's absence.

g. Should the leakage test on any section of the sewers, including manholes, show a rate of leakage into or from the sewers exceeding the maximum allowable rate specified herein, the Contractor shall locate and repair or replace defective joints or pipe and work in a manner satisfactory to the Owner, and retest at no additional expense to the Owner until the rate of leakage from each section or joint of the sewers being tested does not exceed the rate specified herein.

h. When hydrants are used with the consent of the City, the Cambridge Water System shall be protected with backflow prevention devices per Massachusetts Department of Environmental Protection (DEP) Regulation 310 CMR 22.22 and the Cambridge Water Department Cross Connection Control

Program. This includes, but is not limited to, street sweepers, sewer flushing and paving equipment, and hookups for any purpose.

ARTICLE 52 - TEST REPORTS, CERTIFICATES OF COMPLIANCE AND SHIPPING LISTS:
In addition to other requirements specified herein, the Contractor shall furnish to the Owner the materials, manufacturers notarized test reports and methods of tests to show compliance of materials furnished with all specification requirements, and manufacturer's notarized certificates of compliance stating that all materials to be furnished under these Specifications conform with all specification requirements; each shipment of materials shall be accompanied with the manufacturer's notarized certificate of conformance and a shipping list itemizing the amounts of each item shipped. All testing of all materials furnished under these Specifications shall be provided by the Contractor at no additional expense to the Owner.

ARTICLE 53 -SERVICES OF MANUFACTURER'S REPRESENTATIVES: The Contractor shall furnish, at no additional expense to the Owner, the services of materials and manufacturer's representatives for such lengths of time as may be necessary to properly instruct the Contractor's personnel and the Owner in the proper handling and installation of the material in accordance with the manufacturer's printed recommendation.

ARTICLE 54 - NOT USED

ARTICLE 55 - SAFETY AND HEALTH REGULATIONS: This project is subject to the Safety and Health regulations of the U.S. Department of Labor set forth in 29 CFR, Part 1926, and to the Massachusetts Department of Labor and Industries, Division of Industrial Safety "Rules and Regulations for the Prevention of Accidents in Construction Operations (Chapter 454 C.M.R. 10.00 et seq.)". Contractors shall be familiar with the requirements of these regulations and the safety requirements of the MUTCD and ADA.

ARTICLE 56 - SPECIAL PROVISIONS - The Owner reserves the right to assess special penalties if the Contractor’s actions during construction result in the following situations:

a. Closing of a traffic lane or lanes not previously permitted nor approved by the Owner or Engineer in writing prior to the commencement of work

b. Working during hours not stipulated by permit nor approved by the Owner or Engineer in writing prior to the commencement of work.

c. Damage to Public Shade Trees: See “City of Cambridge Department of Public Works, Division of Urban Forestry Tree Protection During Construction” which is included in ATTACHMENT-I of Section-00825A Special Conditions.

Penalties shall be assessed on a per occurrence basis at up to $500per occurrence and shall be deducted from the progress payments due to the Contractor.

ARTICLE 57 - STATE GOVERNMENT PROVISIONS:
a. State Government Provisions included herein, have been selected from those to which specific references have been made elsewhere in the Contract Documents. Each and every other provisions of law of clause required by law to be inserted in this Contract shall be deemed to be also inserted herein in accordance with paragraph GC-2.3.2 of the General Conditions.

b. The OWNER and CONTRACTOR also agree that the provisions of Mass General Law Chapter 82 Section 40, which are included in ATTACHMENT II of SECTION 00825A apply to the work to be performed under this Contract and that these provisions supersede any conflicting provisions of this Contract.

c. The OWNER and CONTRACTOR also agree that the provisions of Mass General Law Chapter 149 Sections 27 and 27B relating to Minimum Wage Rates apply to the work to be performed under this

Contract and that these provisions supersede any conflicting provisions of this Contract. Copies of minimum wage rates established for labor categories employed on this Contract are included in SECTION 00670. A copy of the required payroll reports to be submitted to the OWNER on a weekly basis is included in SECTION 00680.

ARTICLE 58 – COMMUNITY AND STAKEHOLDER MEETINGS: The CONTRACTOR is required to attend at least six (6) community and/or stakeholder meetings held during working hours, or at night, for the purpose of informing the residents, businesses and other interested parties about the schedule and project and answering questions. The on-site superintendent and project manager must both attend these meetings.

ARTICLE 59 – PERMITS: The CONTRACTOR shall refer to the Technical Specifications Section 01060 for a list of all permits and regulatory requirements.

ARTICLE 60 – MASSACHUSETTS GENERAL LAWS: The following Massachusetts General Laws apply to the contract. The list is not meant to be all inclusive:

- M.G.L. c.30 s39F Payment to Subcontractor (See General Conditions 13.8.2)
- M.G.L. c.30 s39I Deviation from Plans and Specifications (See General Conditions 11.2.1)
- M.G.L. c.30 s39J No Arbitrary Decisions are Final (See General Conditions 16.6.3)
- M.G.L. c.30 s39L Construction of Work by Foreign Corporations
- M.G.L. c.30 s39M(b) Substitution of Equal Products (See General Conditions 5.13.1)
- M.G.L. c.30 s39N Differing Site Conditions (See General Conditions 16.4.1)
- M.G.L. c.30 s39O Equitable Adjustment for Delays (See General Conditions 12.3.6)
- M.G.L. c.30 s39P Decision on Interpretation of Specifications (See General Conditions 16.6.1)
- M.G.L. c.30 s39R Contractor's Records (See Special Conditions Article 47)
- M.G.L. c.149 s34 Limitations on Hours of Work (See General Conditions 5.5.4)
- M.G.L. c.149 s44J Advertising Invitations to Bid
- M.G.L. c.82 s40 Excavations; Notices; Penalties

END OF SECTION 00825A - SPECIAL CONDITIONS

(ATTACHMENTS I, II, III, IV, V TO SECTION 00825A FOLLOWS)

Attachment I

City of Cambridge Department of Public Works
Division of Urban Forestry
Tree Protection During Construction

[THIS PAGE INTENTIONALLY LEFT BLANK]

City of Cambridge Department of Public Works
Division of Urban Forestry

Tree Protection During Construction

Public trees are protected by Massachusetts state law, Chapter 87. Section 12 states that a fine of up to five hundred dollars, ($500.00) per incident of damage to public shade trees can be levied. Each branch broken or improperly pruned, each improper wounding of the trunks of the trees, and each root improperly pruned shall constitute an infraction. Section 12 further provides that anyone who negligently or willfully damages a tree will be liable to the City for all damages.

During all construction projects, the utmost care shall be taken by the contractor to avoid unauthorized, unnecessary or improper wounding of public or private shade trees. Prior to construction, the contractor shall provide a tree protection plan and work schedule. A Massachusetts Certified Arborist (MCA) and/or International Society of Arboriculture (ISA) Certified Arborist shall be sub-contracted by the contractor to provide a protection plan and perform specified work. ***All plans and schedules shall be subject to review and approval by the City Tree Warden.*** **Infraction of Massachusetts state law Chapter 87 or failure to provide a protection plan and work schedule will result in fines or the immediate cancellation of the contract.**

Pre-construction tree protection measures shall include the following:

1. Wrapping the trunks of trees with a diameter at breast height (DBH) of 6” or greater with a durable material such as two by four lumber sufficient to protect tree trunks from mechanical damage. Removal of protective wrapping shall be done by the contractor after construction in complete.

2. The proper pruning (raise pruning) of low branches to a height no greater than fourteen feet (14”) above the roadway and eight feet (8”) above the sidewalk. This includes trees endangered by traffic re-routing as the result of construction operations.

3. Traffic control plans shall be designed in such a way as to direct traffic away from tree trunks and branches.

4. Tunneling shall be the preferred method of excavation adjacent to tree roots to avoid root pruning. If root pruning is unavoidable, certified personnel with the permission of the City Arborist shall execute the operation with sufficiently sharpened had tools and in such a fashion s to have minimum negative impact on tree health and safety.

5. Trucks and heavy equipment shall not pass over or park on roots of public shade trees. A protection zone shall be established by erecting a ridged fence outside the perimeter of the dripline of the tree. For occasional or one time access over roots, ½’ plywood overlapped may be used. Permeable materials such as gravel or wood chips shall be placed over root systems of trees which are not covered by hardscape and over which trucks and heavy equipment must travel during construction operations, when such travel is unavoidable, to prevent soil compaction and root damage. Material shall be replaced as needed.

6. All tree protection measures and operations shall be subject to review, approval or change by the City Tree Warden.

THIS PAGE INTENTIONALLY LEFT BLANK

Attachment II

General Laws of Massachusetts – Part I – Title XIV Public Ways and Works – Chapter 82 – Section 40

[THIS PAGE INTENTIONALLY LEFT BLANK]

GENERAL LAWS OF MASSACHUSETTS

PART I.

TITLE XIV.
PUBLIC WAYS AND WORKS

CHAPTER 82. THE LAYING OUT, ALTERATION, RELOCATION AND DISCONTINUANCE OF PUBLIC WAYS, AND SPECIFIC REPAIRS THEREON

FILING OF PETITIONS

Chapter 82: Section 40 Definitions

Section 40. The following words, as used in this section and sections 40A to 40E, inclusive, shall have the following meanings:

""Company", natural gas pipeline company, petroleum or petroleum products pipeline company, public utility company, cable television company, and municipal utility company or department that supply gas, electricity, telephone, communication or cable television services or private water companies within the city or town where such excavation is to be made.

""Description of excavation location", such description shall include the name of the city or town, street, way, or route number where appropriate, the name of the streets at the nearest intersection to the excavation, the number of the buildings closest to the excavation or any other description, including landmarks, utility pole numbers or other information which will accurately define the location of the excavation.

""Emergency", a condition in which the safety of the public is in imminent danger, such as a threat to life or health or where immediate correction is required to maintain or restore essential public utility service.

""Excavation", an operation for the purpose of movement or removal of earth, rock or the materials in the ground including, but not limited to, digging, blasting, augering, backfilling, test boring, drilling, pile driving, grading, plowing in, hammering, pulling in, jacking in, trenching, tunneling and demolition of structures, excluding excavation by tools manipulated only by human power for gardening purposes and use of blasting for quarrying purposes.

""Excavator", any entity including, but not limited to, a person, partnership, joint venture, trust, corporation, association, public utility, company or state or local government body which performs excavation operations.

""Premark", to delineate the general scope of the excavation or boring on the paved surface of the ground using white paint, or stakes or other suitable white markings on nonpaved surfaces. No premarking shall be acceptable if such marks can reasonably interfere with traffic or pedestrian control or are misleading to the general public. Premarking shall not be required of any continuous excavation that is over 500 feet in length.
""Safety zone", a zone designated on the surface by the use of standard color-coded markings which contains the width of the facilities plus not more than 18 inches on each side.

""Standard color-coded markings", red - electric power lines, cables, conduit or light cables; yellow - gas, oil, street petroleum, or other gaseous materials; orange - communications cables or conduit, alarm or signal lines; blue - water, irrigation and slurry lines; green - sewer and drain lines; white - premark of proposed excavation.

""System", the underground plant damage prevention system as defined in section 76D of chapter 164.

Chapter 82: Section 40A Excavations; notice
Section 40A. No excavator installing a new facility or an addition to an existing facility or the relay or repair of an existing facility shall, except in an emergency, make an excavation, in any public or private way, any company right-of-way or easement or any public or privately owned land or way, unless at least 72 hours, exclusive of Saturdays, Sundays and legal holidays but not more than 30 days before the proposed excavation is to be made, such excavator has premarked not more than 500 feet of the proposed excavation and given an initial notice to the system. Such initial notice shall set forth a description of the excavation location in the manner as herein defined. In addition, such initial notice shall indicate whether any such excavation will involve blasting and, if so, the date and the location at which such blasting is to occur.
The notice requirements shall be waived in an emergency as defined herein; provided, however, that before such excavation begins or during a life-threatening emergency, notification shall be given to the system and the initial point of boring or excavation shall be premarked. The excavator shall ensure that the underground facilities of the utilities in the area of such excavation shall not be damaged or jeopardized.
In no event shall any excavation by blasting take place unless notice thereof, either in the initial notice or a subsequent notice accurately specifying the date and location of such blasting shall have been given and received at least 72 hours in advance, except in the case of an unanticipated obstruction requiring blasting when such notice shall be not less than four hours prior to such blasting. If any such notice cannot be given as aforesaid because of an emergency requiring blasting, it shall be given as soon as may be practicable but before any explosives are discharged.

Chapter 82: Section 40B Designation of location of underground facilities
Section 40B. Within 72 hours, exclusive of Saturdays, Sundays and legal holidays, from the time the initial notice is received by the system or at such time as the company and the excavator agree, such company shall respond to the initial notice or subsequent notice by designating the location of the underground facilities within 15 feet in any direction of the premarking so that the existing facilities are to be found within a safety zone. Such safety zone shall be so designated by the use of standard color-coded markings. The providing of such designation by the company shall constitute prima facie evidence of an exercise of reasonable precaution by the company as

required by this section; provided, however, that in the event that the excavator has given notice as aforesaid at a location at which because of the length of excavation the company cannot reasonably designate the entire location of its facilities within such 72 hour period, then such excavator shall identify for the company that portion of the excavation which is to be first made and the company shall designate the location of its facilities in such portion within 72 hours and shall designate the location of its facilities in the remaining portion of the location within a reasonable time thereafter. When an emergency notification has been given to the system, the company shall make every attempt to designate its facilities as promptly as possible.

Chapter 82: Section 40C Excavator's responsibility to maintain designation markings; damage caused by excavator

Section 40C. After a company has designated the location of its facilities at the location in accordance with section 40B, the excavator shall be responsible for maintaining the designation markings at such locations, unless such excavator requests remarking at the location due to the obliteration, destruction or other removal of such markings. The company shall then remark such location within 24 hours following receipt of such request.

When excavating in close proximity to the underground facilities of any company when such facilities are to be exposed, non-mechanical means shall be employed, as necessary, to avoid damage in locating such facility and any further excavation shall be performed employing reasonable precautions to avoid damage to any underground facilities including, but not limited to, any substantial weakening of structural or lateral support of such facilities, penetration or destruction of any pipe, main, wire or conduit or the protective coating thereof, or damage to any pipe, main, wire or conduit.

If any damage to such pipe, main, wire or conduit or its protective coating occurs, the company shall be notified immediately by the excavator responsible for causing such damage.

The making of an excavation without providing the notice required by section 40A with respect to any proposed excavation which results in any damage to a pipe, main, wire or conduit, or its protective coating, shall be prima facie evidence in any legal or administrative proceeding that such damage was caused by the negligence of such person.

Chapter 82: Section 40D Local laws requiring excavation permits; public ways

Section 40D. Nothing in this section shall affect or impair local ordinances or by-laws requiring a permit to be obtained before excavation in a public way or on private property; but notwithstanding any general or special law, ordinance or by-law to the contrary, to the extent that any permit issued under the provisions of the state building code or state fire code requires excavation by an excavator on a public way or on private property, the permit shall not be valid unless the excavator notifies the system as required pursuant to sections 40 and 40A, before the commencement of the excavation, and has complied with the permitting requirements of chapter 82A.

Chapter 82: Section 40E Violations of secs. 40A -- 40E; punishment

Section 40E. Any person or company found by the department of telecommunications and energy, after a hearing, to have violated any provision of sections 40A to 40E, inclusive, shall be fined $500 for the first offense and not less than $1,000 nor more than $5,000 for any subsequent offense within 12 consecutive months as set forth by the rules of said department; provided, however, that nothing herein shall be construed to require forfeiture of any penal sum by a state

or local government body for violation of section 40A or 40C; and provided, further, that nothing herein shall be construed to require the forfeiture of any penal sum by a residential property owner for the failure to premark for an excavation on such person's residential property.

Attachment III
Ordinance Number 1329 (Dumpster Licenses)

ORDINANCE NUMBER 1329

Final Publication Number 3203. First Publication in the Chronicle on July 30, 2009.

City of Cambridge

In the Year Two Thousand and Nine

AN ORDINANCE

In amendment to the Ordinance entitled "Municipal Code of the City of Cambridge"

Be it ordained by the City Council of Cambridge, as follows:

Cambridge Municipal Code is hereby amended by adding a new chapter 8.25 entitled Dumpster Licenses:

CHAPTER 8.25

DUMPSTER LICENSES

Sections:

Section 8.25.010 Purpose.

Because the unregulated maintenance and operation of dumpsters, including construction site dumpsters presents a threat to the public health, safety, environment, and general welfare, no person, business, or any other entity shall operate, keep, store, or maintain a Dumpster or Temporary Dumpster (defined below) without first obtaining the Dumpster License required by this chapter, and shall maintain said Dumpster in accordance with said License, this chapter, and any regulation promulgated hereunder.

Section 8.25.020 Definitions.

As used in this chapter, the following words and phrases shall have the meanings given in the following clauses. Where words and phrases are not defined in the following clauses, such words and phrases shall have their ordinarily accepted meanings such as the context implies.

A. "Dumpster" shall mean any container, receptacle, compactor unit, trailer, roll-off, or similar unit with or without wheels that is used for temporary storage, containment, or transport of refuse, debris, trash, garbage, food waste, solid waste, recyclable material, incidental demolition debris, or other discarded or like materials. It shall not apply to ordinary household trash cans of a volume of 50 gallons or less, recycling receptacles of 96 gallons or less, to plastic bags storing these materials in compliance with the regulations of the City of Cambridge, or to

solid waste disposal trucks operated by a company duly licensed by the City of Cambridge License Commission or used or operated by the City of Cambridge.

B. "Temporary Dumpster" shall mean a Dumpster that is used in connection with construction, demolition, fairs or for similar temporary needs, the Dumpster License for which shall be issued for a period not to exceed 30 days, renewable for additional 30 day periods upon application, not to exceed a total period of twelve months.

C. "Lot" shall mean a parcel of land in identical ownership throughout, bounded by other lots or by streets, which is designated by its owner to be used, developed or built upon as a unit, to which a Dumpster serves for waste disposal.

D. "Dumpster License" (also referred to hereafter as "License") shall mean the License required by this chapter and issued by the Inspectional Services Department upon satisfactory review of the Dumpster License Application and Dumpster Plan.

E. "Dumpster Plan" shall mean an operational and maintenance plan for each Dumpster governed by this chapter. The Dumpster Plan shall also include all information included in the Dumpster License Application (defined in 8.25.040 below).

F. "Responsible Party" shall mean the owner or other person using the Dumpster with an interest in any part or parts of the Lot upon which the Dumpster is used, maintained or stored, any tenant upon the Lot, the property manager for the Lot, and/or any other users of a Dumpster on the Lot.

Section 8.25.030 Applicability.

The Dumpster Ordinance shall apply to all existing and future Dumpsters located within the City.

Section 8.25.040 Dumpster License.

A. License Required. No Dumpster, including a Temporary Dumpster, shall be used, without first obtaining a License from the Commissioner of Inspectional Services, but not including a Dumpster used for one day special events permitted by the City of Cambridge. If a Dumpster is to be located upon a public way, then a permit from the City of Cambridge Traffic, Parking and Transportation Department must also be obtained. If the Commissioner of Inspectional Services determines that a submitted Dumpster License Application is accurate and adequate to keep the site free from debris, refuse, trash, solid waste or like material that is injurious to the public health, safety, and environment, the Commissioner may issue a License for the establishment or Dumpster. Performance of the activities scheduled in the Dumpster Plan shall be a condition of the License and nonperformance of the activities scheduled in the Dumpster Plan shall be a violation of the License and conditions of this chapter.

B. Contents of License Application. A complete Application (also referred to hereafter as "Application") consists of a completed Application form and a Dumpster Plan attached thereto. The Dumpster License Application form shall be in a form approved by the Commissioner of Inspectional Services. It shall be the responsibility of all Responsible Parties to submit and sign the Application and to take possession of and be jointly responsible for the License. In the event that a Responsible Party terminates use of the Dumpster, then the owner of the Lot shall be required to obtain a new License with any new Responsible Party. All Responsible Parties shall agree to follow the Dumpster Plan, and be jointly and severally liable with the owner of the Lot, and indemnify the City of Cambridge for any damages caused by non-compliance with the duties contained in this ordinance.

C. Dumpster Plan. A Dumpster Plan shall, at a minimum, include the following information, or other information as required by the Inspectional Services Department:

1. The address of the Lot on which the Dumpster is located;
2. The name, address, and telephone number of the owner of the Lot;
3. The name, address, and telephone number of the tenant operator(s) of the establishment(s) located on the Lot which will use the Dumpster;
4. The type of establishment(s) located on the Lot which will use the Dumpster and nature of its (or their) business;
5. A description of how employees or residents are notified about the proper use of a Dumpster and copy of all written materials given to employees or residents;
6. A plot plan accurately depicting the Lot;
7. The location of any Dumpster and associated fencing or screening on the Lot, and the location of the Dumpster in relation to all abutting property;
8. A weekly schedule detailing the times and days of the week for cleaning the Dumpster and Lot, and maintaining the Lot free of windblown litter and refuse;
9. The name of the owner of the Lot or Responsible Party or designee responsible for overseeing the cleaning and maintenance of the Lot;
10. The name, address, contact name, and telephone number of the waste hauling company responsible for servicing the establishment or Dumpster; and the name, address, contact name, and telephone number of the person or entity signing the contract with the waste hauling company;
11. The date, time, and frequency of service by the waste hauling company including proof of recycling and anticipated volume of refuse and recycling based on the previous year's invoices, if applicable;
12. Any and all permits and/or Licenses issued by the Massachusetts Department of Environmental Protection relating to the management, storage, and disposal of solid wastes and hazardous materials and hazardous wastes generated, stored, or disposed on the Lot;
13. Any and all permits and/or Licenses issued by the Cambridge Fire Department, the Inspectional Services Department, the Department of Public Works or other relevant City or governmental agencies;
14. The name, address, and phone number of the pest control company servicing the establishment or Dumpster;
15. Any other information required by the Inspectional Services Department to ensure that the Lot is maintained in a sanitary condition free of debris, refuse, trash, solid waste or like material that is injurious to the public health, safety, and environment; and
16. A copy of the contract with the waste hauling company responsible for servicing the Dumpster.

Section 8.25.050 Dumpster License Fee.

The fee for the License shall be one hundred ($100.00) dollars. The License shall be applied for annually.

Section 8.25.060 Term of License.

The term of each License shall be one (1) year, except that a License for a Temporary Dumpster shall be for a period not to exceed 30 days, renewable for additional 30 day periods, not to exceed a total period of twelve months. Annually on a date set by the Commissioner of Inspectional Services or designee, all persons who operate or maintain Dumpsters shall file, renew, or amend a Dumpster Plan and obtain a new License.

Section 8.25.070 Location Requirements.

All Dumpsters shall be located at a distance from the Lot line, as approved by the Inspectional Services Department, so as not to interfere with the safety, convenience, or health of abutters, residents, and the public. All Dumpsters shall be placed so that any liquid or runoff from the Dumpster shall not enter any catch basins or storm drains. All Dumpsters shall be placed so as not to interfere with the physical integrity of the curb, sidewalk, and public parking. The location of all Dumpsters shall also be subject to approval by the Cambridge Fire Department and a City of Cambridge Traffic, Parking and Transportation Permit is required for any dumpster to be placed upon a public way.

Section 8.25.080 Container Requirements.

All Dumpsters shall be in new or good condition free of damage caused by wear or misuse that would allow leaks or access by rodents. All Dumpsters shall be covered and secured at all times except when being filled or emptied. Temporary Dumpsters shall be covered when not in use (including overnight) at a minimum with a tight-fitting tarp. All Dumpsters shall be deodorized and washed on a regular schedule. The Commissioner of Inspectional Services, or designee, may require more frequent cleaning, if necessary. If rodent activity or other site hygiene issues are prevalent, the Commissioner of Inspectional Services may require additional design/containment requirements utilizing best available technology.

Section 8.25.090 Screening/Fencing Requirements.

All Dumpsters governed by this ordinance shall be screened or fenced off from view from public ways, sidewalks, and adjoining properties at all sites other than construction sites, unless requirements are waived by the Commissioner of Inspectional Services.

Section 8.25.100 Posting Requirements.

The Dumpster Plan and License shall be posted in a visible location on the Lot or establishment thereon, accessible to an inspector on the premises. All Dumpsters shall display a clearly visible decal or stencil showing the name and telephone numbers of the company/contractor servicing the Dumpster.

Section 8.25.110 Other Requirements.

It is the responsibility of the owner of the Lot and/or Responsible Party to ensure that all other approvals, licenses and permits required by the City of Cambridge and Commonwealth of Massachusetts have been obtained, including but not limited to the mandatory recycling provisions of Chapter 8.24 of the Cambridge Municipal Code. The Dumpster License shall be

applicable only to the owner or tenants or establishments licensed to use the Dumpster and only to the Lot to which the Dumpster serves, and no trash or other items from any other Lots, properties, buildings or other sources may be placed in or transferred to the Dumpster in question. The issuance of this License shall under no circumstances be construed as a waiver from any other license or permit required. It is the responsibility of the owner of the Lot and/or Responsible Party to take appropriate action to immediately cause the Dumpster to be emptied of its contents when full. It is the responsibility of the owner of the Lot and/or Responsible Party to maintain the area free of odors, debris, litter, overflow, and all other nuisances including pests.

Section 8.25.120 Inspections.

A. Authority. In order to properly carry out their respective responsibilities under this Ordinance, and to ensure that the public health, safety and environment are protected from the hazards posed by unsanitary and unhealthy conditions, the Inspectional Services Department is authorized to examine and/or survey at any reasonable time all establishments and Dumpsters licensed hereunder.

B. Systematic Area Inspections. The Inspectional Services Department is authorized to develop and adopt plans and regulations for systematic, periodic area-wide inspections of Dumpsters and establishments required to obtain a License.

C. Interference with Inspection. If any owner, occupant, or other person refuses, impedes, inhibits, interferes with, restricts, or obstructs entry and free access to the Lot, operation, or premises where inspection is authorized by this chapter, the Inspectional Services Department may seek in a court of competent jurisdiction an inspection warrant that allows for the inspection of the Lot and apprises the owner of the Lot and/or Responsible Party concerning the nature of the inspection, the scope of the inspection, and justification for it and may seek the assistance of the Police Department in presenting said warrant.

Section 8.25.130 Violation.

A. The operation or maintenance of any Dumpster governed by this chapter without a License; the failure to operate or maintain the same in accordance with a validly issued License; the interference with an inspection, including inspections conducted pursuant to a validly issued inspection warrant; and/or any other violations of the terms of this ordinance, shall constitute a violation and a citation shall be issued by the Commissioner of Inspectional Services or designee. Each day during which a violation exists shall constitute a separate offense, including but not limited to any days in which the Commissioner of Inspectional Services or designee is forced to obtain and/or exercise an inspection warrant.

B. Notice of violation shall be sent or hand delivered to the offender, the owner of the Lot or Responsible Party at the Lot or establishment thereon, to their last known address, or to addresses listed on the Dumpster Plan. Any violation herein shall be considered a municipal charge as described in G.L. c. 40, §57.

Section 8.25.140 Administrative Hearings.

A. Right to Hearing. Any person upon whom a notice of violation has been served may request a hearing from the Inspectional Services Department by filing a written petition requesting a hearing on the matter with the Inspectional Services Department within seven days after the day the notice of violation was sent or hand delivered.

B. Hearing Notice. Upon receipt of a petition, the Inspectional Services Department shall inform the petitioner of the date, time, and place of the hearing in writing.

C. Time for Hearing. The hearing shall commence within thirty days after the day on which the notice of violation was served. The time period in which the cited violations must be remedied shall be stayed upon receipt of the petition for a hearing until such time as the hearing is held.

D. Hearing of Petitioner. At the hearing, the petitioner shall be given an opportunity to be heard, to present witnesses or documentary evidence, and to show why the notice of violation should be modified or withdrawn. Failure to hold a hearing within the time period specified herein shall not affect the validity of any notice of violation.

E. Final Decision after Hearing; Failure to Comply with Final Order.

1. Within seven (7) days after the conclusion of the hearing, the Inspectional Services Department shall sustain, modify, or withdraw the notice of violation and shall inform the petitioner in writing of its decision and the reasons therefor. If the Department sustains or modifies the notice of violation, said violation shall be remedied within the time period allotted in the original notice of violation or in the modification.

2. If a written petition for a hearing is not filed with the Inspectional Services Department within seven (7) days after the notice of violation has been served, or if after a hearing the notice of violation has been sustained in full or in any part, each day's failure to comply with the notice of violation within the time allotted as issued or modified shall constitute an additional offense, including any days prior to the filing of a written petition, and any days subsequent to the issuance of the written decision by the Commissioner of Inspectional Services, or a designee.

Section 8.25.150 Penalties.

A. Failure to Obtain License. If an owner of a Lot or Responsible Party stores or maintains a Dumpster without first obtaining a License, the Commissioner of Inspectional Services may issue a violation pursuant to the process described in Section 8.25.130, not to exceed three hundred dollars. Each day during which a violation exists shall constitute a separate offense. The Commissioner of Inspectional Services may also seek an injunction from a court of competent jurisdiction prohibiting the operation of the establishment or Dumpster until a License is secured.

B. Failure to Comply With Terms of License. If a Licensee fails to comply with the terms of a License, the Commissioner of Inspectional Services may issue a violation pursuant to the process described in Section 8.25.030, not to exceed three hundred dollars. Each day during which a violation exists shall constitute a separate offense. The Commissioner of Inspectional Services may also suspend the License, after an administrative hearing, and seek an injunction from a court of competent jurisdiction prohibiting the operation of the establishment or Dumpster until the Licensee proves to the court its compliance with the License. If a Licensee fails to comply with the terms of the License three (3) times in the preceding twelve (12) month period, the Commissioner of Inspectional Services or a designee may suspend, cancel, or revoke the License after an administrative hearing. In the event of suspension or cancellation of the License, other municipal agencies issuing licenses and permits will be so notified.

C. Failure to Comply with Notice of Violation. Any person who fails to comply with any notice of violation or other order issued pursuant to this chapter by the Inspectional Services Department, or duly appointed agents or representatives, shall be issued a violation pursuant to the process described in Section 8.25.130, not to exceed three hundred dollars. Each day during which a violation exists shall constitute a separate offense.

D. Interference After Inspection Warrant Presented. Any owner of a Lot or Responsible Party who refuses, impedes, inhibits, interferes with, restricts or obstructs entry and free access to every part of the structure, site, operation or premises where inspection is sought under this chapter after an inspection warrant has been obtained and presented in accordance with Section 8.25.120, shall be issued a violation pursuant to the process described in Section 8.25.130, not to exceed three hundred dollars. Each day during which a violation exists shall constitute a separate offense.

E. Fines. All fines and penalties assessed and collected under this chapter may be enforced pursuant to G.L. c. 40, Section 21D.

Section 8.25.160 Severability.

If any section provided for under this chapter shall be declared invalid for any reason whatsoever, that decision shall not affect any other portion of this chapter, which shall remain in full force and effect; and to this end the provisions of this chapter are hereby declared severable.

Section 8.25.170 Regulatory Authority.

The Commissioner of Inspectional Services shall have the authority to promulgate rules and regulations necessary to enforce this chapter.

Section 8.25.180 Delegation of Authority.

The Commissioner of Inspectional Services may delegate enforcement of this Chapter to any City department authorized to enforce public safety, health, or environmental laws and regulations, including but not limited to any enforcement officer with the Department of Public Works, the Traffic, Parking, and Transportation Department, the License Commission, or the Police Department.

Section 8.25.190 Effective Date.

This chapter shall take effect January 1, 2010.

In City Council September 14, 2009.
Passed to be ordained as amended by a yea and nay vote:-
Yeas 9; Nays 0; Absent 0.
Attest:- D. Margaret Drury, City Clerk.

A true copy;

ATTEST:-

D. Margaret Drury
City Clerk

Attachment IV

Massachusetts Diesel Retrofit Program

[THIS PAGE INTENTIONALLY LEFT BLANK]

DIESEL RETROFIT PROGRAM

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

Diesel Construction Equipment Standard

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

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

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

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

Exemptions

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

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

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

Contractor Certification

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

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

Recordkeeping

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

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

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

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

[THIS PAGE INTENTIONALLY LEFT BLANK]

Attachment V

Excerpts from Massachusetts General Laws

[THIS PAGE INTENTIONALLY LEFT BLANK]

NOTICE: - This is NOT the official version of the Massachusetts General Laws (MGL). While reasonable efforts have been made to assure the accuracy of the data provided, do not rely on this information without first checking an official edition of the MGL.

If you are in need of legal advice or counsel, consult an attorney.

MASSACHUSETTS GENERAL LAWS

(Updated to July 12, 2013)

TABLE OF CONTENTS

CHAPTER 30

38A…….	MGL - 2
39F	MGL - 2
39I	MGL - 6
39J	MGL - 7
39L	MGL - 8
39M	MGL - 9
39N	MGL - 12
39O	MGL - 13
39P	MGL - 14
39R	MGL - 15

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 38A Price adjustment clause

Contracts for road, bridge, water, and sewer projects awarded as a result of a proposal or invitation for bids under chapter 7C, section 11C of Chapter 25A, section 39M of this chapter and sections 44A to 44H, inclusive, of chapter 149 shall include a price adjustment clause for each of the following materials: fuel, both diesel and gasoline; asphalt; concrete; and steel. A base price for each material shall be set by the awarding authority or agency and shall be included in the bid documents at the time the project is advertised. The awarding authority or agency shall also identify in the bid documents the price index to be used for each material. The price adjustment clause shall provided for a contract adjustment to be made on a monthly basis when the monthly cost change exceeds plus or minus 5 per cent.

Chapter 30: Section 39F Construction contracts; assignment and subrogation; subcontractor defined; enforcement of claim for direct payment; deposit, reduction of disputed amounts

Section 39F. (1) Every contract awarded pursuant to sections forty-four A to L, inclusive, of chapter one hundred and forty-nine shall contain the following subparagraphs (a) through (i) and every contract awarded pursuant to section thirty-nine M of chapter thirty shall contain the following subparagraphs (a) through (h) and in each case those subparagraphs shall be binding between the general contractor and each subcontractor.

(a) Forthwith after the general contractor receives payment on account of a periodic estimate, the general contractor shall pay to each subcontractor the amount paid for the labor performed and the materials furnished by that subcontractor, less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(b) Not later than the sixty-fifth day after each subcontractor substantially completes his work in accordance with the plans and specifications, the entire balance due under the subcontract less amounts retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, shall be due the subcontractor; and the awarding authority shall pay that amount to the general contractor. The general contractor shall forthwith pay to the subcontractor the full amount received from the awarding authority less any amount specified in any court proceedings barring such payment and also less any amount claimed due from the subcontractor by the general contractor.

(c) Each payment made by the awarding authority to the general contractor pursuant to subparagraphs (a) and (b) of this paragraph for the labor performed and the materials furnished by a subcontractor shall be made to the general contractor for the account of

that subcontractor; and the awarding authority shall take reasonable steps to compel the general contractor to make each such payment to each such subcontractor. If the awarding authority has received a demand for direct payment from a subcontractor for any amount which has already been included in a payment to the general contractor or which is to be included in a payment to the general contractor for payment to the subcontractor as provided in subparagraphs (a) and (b), the awarding authority shall act upon the demand as provided in this section.

(d) If, within seventy days after the subcontractor has substantially completed the subcontract work, the subcontractor has not received from the general contractor the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount retained by the awarding authority as the estimated cost of completing the incomplete and unsatisfactory items of work, the subcontractor may demand direct payment of that balance from the awarding authority. The demand shall be by a sworn statement delivered to or sent by certified mail to the awarding authority, and a copy shall be delivered to or sent by certified mail to the general contractor at the same time. The demand shall contain a detailed breakdown of the balance due under the subcontract and also a statement of the status of completion of the subcontract work. Any demand made after substantial completion of the subcontract work shall be valid even if delivered or mailed prior to the seventieth day after the subcontractor has substantially completed the subcontract work. Within ten days after the subcontractor has delivered or so mailed the demand to the awarding authority and delivered or so mailed a copy to the general contractor, the general contractor may reply to the demand. The reply shall be by a sworn statement delivered to or sent by certified mail to the awarding authority and a copy shall be delivered to or sent by certified mail to the subcontractor at the same time. The reply shall contain a detailed breakdown of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor and of the amount due for each claim made by the general contractor against the subcontractor.

(e) Within fifteen days after receipt of the demand by the awarding authority, but in no event prior to the seventieth day after substantial completion of the subcontract work, the awarding authority shall make direct payment to the subcontractor of the balance due under the subcontract including any amount due for extra labor and materials furnished to the general contractor, less any amount (i) retained by the awarding authority as the estimated cost of completing the incomplete or unsatisfactory items of work, (ii) specified in any court proceedings barring such payment, or (iii) disputed by the general contractor in the sworn reply; provided, that the awarding authority shall not deduct from a direct payment any amount as provided in part (iii) if the reply is not sworn to, or for which the sworn reply does not contain the detailed breakdown required by subparagraph (d). The awarding authority shall make further direct payments to the subcontractor forthwith after the removal of the basis for deductions from direct payments made as provided in parts (i) and (ii) of this subparagraph.

(f) The awarding authority shall forthwith deposit the amount deducted from a direct payment as provided in part (iii) of subparagraph (e) in an interest-bearing joint account

in the names of the general contractor and the subcontractor in a bank in Massachusetts selected by the awarding authority or agreed upon by the general contractor and the subcontractor and shall notify the general contractor and the subcontractor of the date of the deposit and the bank receiving the deposit. The bank shall pay the amount in the account, including accrued interest, as provided in an agreement between the general contractor and the subcontractor or as determined by decree of a court of competent jurisdiction.

(g) All direct payments and all deductions from demands for direct payments deposited in an interest-bearing account or accounts in a bank pursuant to subparagraph (f) shall be made out of amounts payable to the general contractor at the time of receipt of a demand for direct payment from a subcontractor and out of amounts which later become payable to the general contractor and in the order of receipt of such demands from subcontractors. All direct payments shall discharge the obligation of the awarding authority to the general contractor to the extent of such payment.

(h) The awarding authority shall deduct from payments to a general contractor amounts which, together with the deposits in interest-bearing accounts pursuant to subparagraph (f), are sufficient to satisfy all unpaid balances of demands for direct payment received from subcontractors. All such amounts shall be earmarked for such direct payments, and the subcontractors shall have a right in such deductions prior to any claims against such amounts by creditors of the general contractor.

(i) If the subcontractor does not receive payment as provided in subparagraph (a) or if the general contractor does not submit a periodic estimate for the value of the labor or materials performed or furnished by the subcontractor and the subcontractor does not receive payment for same when due less the deductions provided for in subparagraph (a), the subcontractor may demand direct payment by following the procedure in subparagraph (d) and the general contractor may file a sworn reply as provided in that same subparagraph. A demand made after the first day of the month following that for which the subcontractor performed or furnished the labor and materials for which the subcontractor seeks payment shall be valid even if delivered or mailed prior to the time payment was due on a periodic estimate from the general contractor. Thereafter the awarding authority shall proceed as provided in subparagraph (e), (f), (g) and (h).

(2) Any assignment by a subcontractor of the rights under this section to a surety company furnishing a bond under the provisions of section twenty-nine of chapter one hundred forty-nine shall be invalid. The assignment and subrogation rights of the surety to amounts included in a demand for direct payment which are in the possession of the awarding authority or which are on deposit pursuant to subparagraph (f) of paragraph (1) shall be subordinate to the rights of all subcontractors who are entitled to be paid under this section and who have not been paid in full.

(3) "Subcontractor" as used in this section (i) for contracts awarded as provided in sections forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall mean a person who files a sub-bid and receives a subcontract as a result of that filed sub-

bid or who is approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, (ii) for contracts awarded as provided in paragraph (a) of section thirty-nine M of chapter thirty shall mean a person approved by the awarding authority in writing as a person performing labor or both performing labor and furnishing materials pursuant to a contract with the general contractor, and (iii) for contracts with the commonwealth not awarded as provided in forty-four A to forty-four H, inclusive, of chapter one hundred forty-nine shall also mean a person contracting with the general contractor to supply materials used or employed in a public works project for a price in excess of five thousand dollars.

(4) A general contractor or a subcontractor shall enforce a claim to any portion of the amount of a demand for direct payment deposited as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the other and the bank shall not be a necessary party. A subcontractor shall enforce a claim for direct payment or a right to require a deposit as provided in subparagraph (f) of paragraph 1 by a petition in equity in the superior court against the awarding authority and the general contractor shall not be a necessary party. Upon motion of any party the court shall advance for speedy trial any petition filed as provided in this paragraph. Sections fifty-nine and fifty-nine B of chapter two hundred thirty-one shall apply to such petitions. The court shall enter an interlocutory decree upon which execution shall issue for any part of a claim found due pursuant to sections fifty-nine and fifty-nine B and, upon motion of any party, shall advance for speedy trial the petition to collect the remainder of the claim. Any party aggrieved by such interlocutory decree shall have the right to appeal therefrom as from a final decree. The court shall not consolidate for trial the petition of any subcontractor with the petition of one or more subcontractors or the same general contract unless the court finds that a substantial portion of the evidence of the same events during the course of construction (other than the fact that the claims sought to be consolidated arise under the same general contract) is applicable to the petitions sought to be consolidated and that such consolidation will prevent unnecessary duplication of evidence. A decree in any such proceeding shall not include interest on the disputed amount deposited in excess of the interest earned for the period of any such deposit. No person except a subcontractor filing a demand for direct payment for which no funds due the general contractor are available for direct payment shall have a right to file a petition in court of equity against the awarding authority claiming a demand for direct payment is premature and such subcontractor must file the petition before the awarding authority has made a direct payment to the subcontractor and has made a deposit of the disputed portion as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1).

(5) In any petition to collect any claim for which a subcontractor has filed a demand for direct payment the court shall, upon motion of the general contractor, reduce by the amount of any deposit of a disputed amount by the awarding authority as provided in part (iii) of subparagraph (e) and in subparagraph (f) of paragraph (1) any amount held under a trustee writ or pursuant to a restraining order or injunction.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39I Deviations from plans and specifications

Section 39I. Every contractor having a contract for the construction, alteration, maintenance, repair or demolition of, or addition to, any public building or public works for the commonwealth, or of any political subdivision thereof, shall perform all the work required by such contract in conformity with the plans and specifications contained therein. No wilful and substantial deviation from said plans and specifications shall be made unless authorized in writing by the awarding authority or by the engineer or architect in charge of the work who is duly authorized by the awarding authority to approve such deviations. In order to avoid delays in the prosecution of the work required by such contract such deviation from the plans or specifications may be authorized by a written order of the awarding authority or such engineer or architect so authorized to approve such deviation. Within thirty days thereafter, such written order shall be confirmed by a certificate of the awarding authority stating: (1) If such deviation involves any substitution or elimination of materials, fixtures or equipment, the reasons why such materials, fixtures or equipment were included in the first instance and the reasons for substitution or elimination, and, if the deviation is of any other nature, the reasons for such deviation, giving justification therefor; (2) that the specified deviation does not materially injure the project as a whole; (3) that either the work substituted for the work specified is of the same cost and quality, or that an equitable adjustment has been agreed upon between the contracting agency and the contractor and the amount in dollars of said adjustment; and (4) that the deviation is in the best interest of the contracting authority.

Such certificate shall be signed under the penalties of perjury and shall be a permanent part of the file record of the work contracted for.

Whoever violates any provision of this section willfully and with intent to defraud shall be punished by a fine of not more than five thousand dollars or by imprisonment for not more than six months, or both.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39J Public construction contracts; effect of decisions of contracting body or administrative board

Section 39J. Notwithstanding any contrary provision of any contract for the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or public works by the commonwealth, or by any county, city, town, district, board, commission or other public body, when the amount of the contract is more than five thousand dollars in the case of the commonwealth and more than two thousand dollars in the case of any county, city, town, district, board, commission or other public body, a decision, by the contracting body or by any administrative board, official or agency, or by any architect or engineer, on a dispute, whether of fact or of law, arising under said contract shall not be final or conclusive if such decision is made in bad faith, fraudulently, capriciously, or arbitrarily is unsupported by substantial evidence, or is based upon error of law.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39L Public construction work by foreign corporations; restrictions and reports

Section 39L. The commonwealth and every county, city, town, district, board, commission or other public body which, as the awarding authority, requests proposals, bids or sub-bids for any work in the construction, reconstruction, alteration, remodeling, repair or demolition of any public building or other public works (1) shall not enter into a contract for the work with, and shall not approve as a subcontractor furnishing labor and materials for a part of the work, a foreign corporation which has not filed with the awarding authority a certificate of the state secretary stating that the corporation has complied with requirements of section 15.03 of subdivision A of Part 15 of chapter 156D and the date of compliance, and further has filed all annual reports required by section 16.22 of subdivision B of Part 16 of said chapter 156D, and (2) shall report to the state secretary and to the department of corporations and taxation any foreign corporation performing work under such contract or subcontract, and any person, other than a corporation, performing work under such contract or subcontract, and residing or having a principal place of business outside the commonwealth.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39M Contracts for construction and materials; manner of awarding

Section 39M. (a) Every contract for the construction, reconstruction, alteration, remodeling or repair of any public work, or for the purchase of any material, as hereinafter defined, by the commonwealth, or political subdivision thereof, or by any county, city, town, district, or housing authority, and estimated by the awarding authority to cost more than ten thousand dollars, and every contract for the construction, reconstruction, installation, demolition, maintenance or repair of any building by a public agency, as defined by subsection one of section forty-four A of chapter one hundred and forty-nine, estimated to cost more than $25,000 but not more than $100,000, shall be awarded to the lowest responsible and eligible bidder on the basis of competitive bids publicly opened and read by such awarding authority forthwith upon expiration of the time for the filing thereof; provided, however, that such awarding authority may reject any and all bids, if it is in the public interest to do so. Every bid for such contract shall be accompanied by a bid deposit in the form of a bid bond, or cash, or a certified check on, or a treasurer's or cashier's check issued by, a responsible bank or trust company, payable to the awarding authority. The amount of such bid deposit shall be five per cent of the value of the bid. Any person submitting a bid under this section shall, on such bid, certify as follows:

The undersigned certifies under penalties of perjury that this bid is in all respects bona fide, fair and made without collusion or fraud with any other person. As used in this paragraph the word "person" shall mean any natural person, joint venture, partnership, corporation or other business or legal entity.

_____
(Name of person signing bid)

_____
(Company)

This paragraph shall not apply to the award of any contract subject to the provisions of sections forty-four A to forty-four J, inclusive, of chapter one hundred and forty-nine and every such contract shall continue to be awarded as provided therein. In cases of extreme emergency caused by enemy attack, sabotage or other such hostile actions or resulting from an imminent security threat explosion, fire, flood, earthquake, hurricane, tornado or other such catastrophe, an awarding authority may, without competitive bids and notwithstanding any general or specific law, award contracts otherwise subject to this paragraph to perform work and to purchase or rent materials and equipment, all as may be necessary for temporary repair and restoration to service of any and all public work in order to preserve the health and safety of persons or property; provided, that this exception shall not apply to any permanent reconstruction, alteration, remodeling or repair of any public work.

(b) Specifications for such contracts, and specifications for contracts awarded pursuant to the provisions of said sections forty-four A to forty-four L of said chapter one hundred and forty-nine, shall be written to provide for full competition for each item of material to be furnished under the contract; except, however, that said specifications may be otherwise written for sound reasons in the public interest stated in writing in the public records of the awarding authority or promptly given in writing by the awarding authority to anyone making a written request therefor, in either instance such writing to be prepared after reasonable investigation. Every such contract shall provide that an item equal to that named or described in the said specifications may be furnished; and an item shall be considered equal to the item so named or described if, in the opinion of the awarding authority: (1) it is at least equal in quality, durability, appearance, strength and design, (2) it will perform at least equally the function imposed by the general design for the public work being contracted for or the material being purchased, and (3) it conforms substantially, even with deviations, to the detailed requirements for the item in the said specifications. For each item of material the specifications shall provide for either a minimum of three named brands of material or a description of material which can be met by a minimum of three manufacturers or producers, and for the equal of any one of said name or described materials.

(c) The term "lowest responsible and eligible bidder" shall mean the bidder: (1) whose bid is the lowest of those bidders possessing the skill, ability and integrity necessary for the faithful performance of the work; (2) who shall certify, that he is able to furnish labor that can work in harmony with all other elements of labor employed or to be employed in the work; (3) who shall certify that all employees to be employed at the worksite will have successfully completed a course in construction safety and health approved by the United States Occupational Safety and Health Administration that is at least 10 hours in duration at the time the employee begins work and who shall furnish documentation of successful completion of said course with the first certified payroll report for each employee; (4) who, where the provisions of section 8B of chapter 29 apply, shall have been determined to be qualified thereunder; and (5) who obtains within 10 days of the notification of contract award the security by bond required under section 29 of chapter 149; provided that for the purposes of this section the term "security by bond" shall mean the bond of a surety company qualified to do business under the laws of the commonwealth and satisfactory to the awarding authority; provided further, that if there is more than 1 surety company, the surety companies shall be jointly and severally liable.

(d) The provisions of this section shall not apply (1) to the extent that they prevent the approval of such specifications by any contributing federal agency, (2) to materials purchased under specifications of the state department of highways at prices established by the said department pursuant to advertisement and bidding in connection with work to be performed under the provisions of chapter eighty-one or chapter ninety, (3) to any transaction between the commonwealth and any of its political subdivisions or between the commonwealth and any public service corporation, and (4) to any contract of not more than twenty-five thousand dollars awarded by a governmental body, as defined by section two of chapter thirty B, in accordance with the provisions of section five of said

chapter thirty B; and (5) to any contract solely for the purchase of material awarded by a governmental body, as defined by section 2 of chapter 30B, in accordance with section 5 of said chapter 30B.

(e) The word "material" as used in this section shall mean and include any article, assembly, system, or any component part thereof.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39N Construction contracts; equitable adjustment in contract price for differing subsurface or latent physical conditions

Section 39N. Every contract subject to section forty-four A of chapter one hundred and forty-nine or subject to section thirty-nine M of chapter thirty shall contain the following paragraph in its entirety and an awarding authority may adopt reasonable rules or regulations in conformity with that paragraph concerning the filing, investigation and settlement of such claims:

If, during the progress of the work, the contractor or the awarding authority discovers that the actual subsurface or latent physical conditions encountered at the site differ substantially or materially from those shown on the plans or indicated in the contract documents either the contractor or the contracting authority may request an equitable adjustment in the contract price of the contract applying to work affected by the differing site conditions. A request for such an adjustment shall be in writing and shall be delivered by the party making such claim to the other party as soon as possible after such conditions are discovered. Upon receipt of such a claim from a contractor, or upon its own initiative, the contracting authority shall make an investigation of such physical conditions, and, if they differ substantially or materially from those shown on the plans or indicated in the contract documents or from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the plans and contract documents and are of such a nature as to cause an increase or decrease in the cost of performance of the work or a change in the construction methods required for the performance of the work which results in an increase or decrease in the cost of the work, the contracting authority shall make an equitable adjustment in the contract price and the contract shall be modified in writing accordingly.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39O Contracts for construction and materials; suspension, delay or interruption due to order of awarding authority; adjustment in contract price; written claim

Section 39O. Every contract subject to the provisions of section thirty-nine M of this chapter or subject to section forty-four A of chapter one hundred forty-nine shall contain the following provisions (a) and (b) in their entirety and, in the event a suspension, delay, interruption or failure to act of the awarding authority increases the cost of performance to any subcontractor, that subcontractor shall have the same rights against the general contractor for payment for an increase in the cost of his performance as provisions (a) and (b) give the general contractor against the awarding authority, but nothing in provisions (a) and (b) shall in any way change, modify or alter any other rights which the general contractor or the subcontractor may have against each other.

(a) The awarding authority may order the general contractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as it may determine to be appropriate for the convenience of the awarding authority; provided however, that if there is a suspension, delay or interruption for fifteen days or more or due to a failure of the awarding authority to act within the time specified in this contract, the awarding authority shall make an adjustment in the contract price for any increase in the cost of performance of this contract but shall not include any profit to the general contractor on such increase; and provided further, that the awarding authority shall not make any adjustment in the contract price under this provision for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this contract provides for an equitable adjustment of the contract price under any other contract provisions.

(b) The general contractor must submit the amount of a claim under provision (a) to the awarding authority in writing as soon as practicable after the end of the suspension, delay, interruption or failure to act and, in any event, not later than the date of final payment under this contract and, except for costs due to a suspension order, the awarding authority shall not approve any costs in the claim incurred more than twenty days before the general contractor notified the awarding authority in writing of the act or failure to act involved in the claim.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39P Contracts for construction and materials; awarding authority's decisions on interpretation of specifications, etc.; time limit; notice

Section 39P. Every contract subject to section thirty-nine M of this chapter or section forty-four A of chapter one hundred forty-nine which requires the awarding authority, any official, its architect or engineer to make a decision on interpretation of the specifications, approval of equipment, material or any other approval, or progress of the work, shall require that the decision be made promptly and, in any event, no later than thirty days after the written submission for decision; but if such decision requires extended investigation and study, the awarding authority, the official, architect or engineer shall, within thirty days after the receipt of the submission, give the party making the submission written notice of the reasons why the decision cannot be made within the thirty day period and the date by which the decision will be made.

CHAPTER 30. GENERAL PROVISIONS RELATIVE TO STATE DEPARTMENTS, COMMISSIONS, OFFICERS AND EMPLOYEES

Chapter 30: Section 39R Definitions; contract provisions; management and financial statements; enforcement

Section 39R. (a) The words defined herein shall have the meaning stated below whenever they appear in this section:

(1) "Contractor" means any person, corporation, partnership, joint venture, sole proprietorship, or other entity awarded a contract pursuant to sections thirty-eight A 1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A to forty-four H, inclusive, of chapter one hundred and forty-nine, which is for an amount or estimated amount greater than one hundred thousand dollars.

(2) "Contract" means any contract awarded or executed pursuant to sections thirty-eight A 1/2 to thirty-eight O, inclusive, of chapter seven and any contract awarded or executed pursuant to section eleven C of chapter twenty-five A, section thirty-nine M of chapter thirty, or sections forty-four A through forty-four H, inclusive, of chapter one hundred and forty-nine, which is for amount or estimated amount greater than one hundred thousand dollars.

(3) "Records" means books of original entry, accounts, checks, bank statements and all other banking documents, correspondence, memoranda, invoices, computer printouts, tapes, discs, papers and other documents or transcribed information of any type, whether expressed in ordinary or machine language.

(4) "Independent Certified Public Accountant" means a person duly registered in good standing and entitled to practice as a certified public accountant under the laws of the place of his residence or principal office and who is in fact independent. In determining whether an accountant is independent with respect to a particular person, appropriate consideration should be given to all relationships between the accountant and that person or any affiliate thereof. Determination of an accountant's independence shall not be confined to the relationships existing in connection with the filing of reports with the awarding authority.

(5) "Audit", when used in regard to financial statements, means an examination of records by an independent certified public accountant in accordance with generally accepted accounting principles and auditing standards for the purpose of expressing a *certified* opinion thereon, or, in the alternative, a qualified opinion or a declination to express an opinion for stated reasons.

(6) "Accountant's Report", when used in regard to financial statements, means a document in which an independent certified public accountant indicates the scope of the audit which he has made and sets forth his opinion regarding the financial statements taken as a whole with a listing of noted exceptions and qualifications, or an assertion to the effect that an overall opinion cannot be expressed. When an overall opinion cannot be expressed the reason therefor shall be stated. An accountant's report shall include as a part thereof a signed statement by the responsible corporate officer attesting that management has fully disclosed all material facts to the independent certified public accountant, and that the audited financial statement is a true and complete statement of the financial condition of the contractor.

(7) "Management", when used herein, means the chief executive officers, partners, principals or other person or persons primarily responsible for the financial and operational policies and practices of the contractor.

(8) Accounting terms, unless otherwise defined herein, shall have a meaning in accordance with generally accepted accounting principles and auditing standards.

(b) Subsection (a)(2) hereof notwithstanding, every agreement or contract awarded or executed pursuant to sections thirty-eight A 1/2 to thirty-eight O, inclusive, of chapter seven, or eleven C of chapter twenty-five A, and pursuant to section thirty-nine M of chapter thirty or to section forty-four A through H, inclusive, of chapter one hundred and forty-nine, shall provide that:

(1) The contractor shall make, and keep for at least six years after final payment, books, records, and accounts which in reasonable detail accurately and fairly reflect the transactions and dispositions of the contractor, and

(2) until the expiration of six years after final payment, the office of inspector general, and the commissioner of capital asset management and maintenance shall have the right to examine any books, documents, papers or records of the contractor or of his subcontractors that directly pertain to, and involve transactions relating to, the contractor or his subcontractors, and

(3) if the agreement is a contract as defined herein, the contractor shall describe any change in the method of maintaining records or recording transactions which materially affect any statements filed with the awarding authority, including in his description the date of the change and reasons therefor, and shall accompany said description with a letter from the contractor's independent certified public accountant approving or otherwise commenting on the changes, and

(4) if the agreement is a contract as defined herein, the contractor has filed a statement of management on internal accounting controls as set forth in paragraph (c) below prior to the execution of the contract, and

(5) if the agreement is a contract as defined herein, the contractor has filed prior to the execution of the contracts and will continue to file annually, an audited financial statement for the most recent completed fiscal year as set forth in paragraph (d) below.

(c) Every contractor awarded a contract shall file with the awarding authority a statement of management as to whether the system of internal accounting controls of the contractor and its subsidiaries reasonably assures that:

(1) transactions are executed in accordance with management's general and specific authorization;

(2) transactions are recorded as necessary

i. to permit preparation of financial statements in conformity with generally accepted accounting principles, and

ii. to maintain accountability for assets;

(3) access to assets is permitted only in accordance with management's general or specific authorization; and

(4) the recorded accountability for assets is compared with the existing assets at reasonable intervals and appropriate action was taken with respect to any difference.

Every contractor awarded a contract shall also file with the awarding authority a statement prepared and signed by an independent certified public accountant, stating that he has examined the statement of management on internal accounting controls, and expressing an opinion as to

(1) whether the representations of management in response to this paragraph and paragraph (b) above are consistent with the result of management's evaluation of the system of internal accounting controls; and

(2) whether such representations of management are, in addition, reasonable with respect to transactions and assets in amounts which would be material when measured in relation to the applicant's financial statements.

(d) Every contractor awarded a contract by the commonwealth or by any political subdivision thereof shall annually file with the commissioner of capital asset management and maintenance during the term of the contract a financial statement prepared by an independent certified public accountant on the basis of an audit by such accountant. The final statement filed shall include the date of final payment. All statements shall be accompanied by an accountant's report. Such statements shall be made available to the awarding authority upon request.

(e) The office of inspector general, the commissioner of capital asset management and maintenance and any other awarding authority shall enforce the provisions of this section. The commissioner of capital asset management and maintenance may after providing an opportunity for the inspector general and other interested parties to comment, promulgate pursuant to the provisions of chapter thirty A such rules, regulations and guidelines as are necessary to effectuate the purposes of this section. Such rules, regulations and guidelines may be applicable to all awarding authorities. A contractor's failure to satisfy any of the requirements of this section may be grounds for debarment pursuant to section forty-four C of chapter one hundred and forty-nine.

(f) Records and statements required to be made, kept or filed under the provisions of this section shall not be public records as defined in section seven of chapter four and shall not be open to public inspection; provided, however, that such records and statements shall be made available pursuant to the provisions of clause (2) of paragraph (b).

SECTION 00900

Fuel, Asphalt, Concrete, Steel Price Adjustment

Pursuant to G.L. c.30, §38A, public works construction contracts for road, bridge, water, and sewer projects procured under the public works construction bid law, G.L. c.30, §39M, must include a price adjustment clause for certain materials. This adjustment provides for either additional compensation to the Contractor or reduction in payment by the City of Cambridge depending on an increase or decrease in the average price of liquid asphalt, Portland Cement contained in cast-in-place concrete, and fuel, both diesel and gasoline.

The Price Adjustments outlined below include liquid asphalt, Portland cement contained in cast-in-place concrete, diesel and gasoline fuel, required by the **Contractor and subcontractors** to perform work under this contract. These Price Adjustments will occur at periodic pay requisition submissions, but not more than once per month.

Price Adjustment Hot Mix Asphalt Mixtures

The following provision applies to all hot mix asphalt mixtures containing liquid asphalt on projects totaling greater than 200 Tons of hot mix asphalt (HMA).

The Base Price of Liquid Asphalt on the project will be a fixed price determined on the date that bids are opened using the same method as for the determination of the Period Price detailed below.

The price adjustment will be based on the actual variance in price for the Liquid Asphalt component only from the established Base Price to the Period Price. It shall not include transportation or other charges.

The Period Price of liquid asphalt for each monthly period will be determined and published by the Massachusetts Department of Transportation (MassDOT) Highway Division (www.massdot.state.ma.us) by using the average selling price per standard ton of PG64-28 paving grade (primary binder classification) asphalt, FOB manufacturer's terminal, as listed under the "East Coast Market - New England, Boston, Massachusetts area" section of the Poten & Partners, Inc. "Asphalt Weekly Monitor". This average selling price is listed in the issue having a publication date of the second Friday of the month and will be posted as the Period Price for that month. MassDOT will post this Period Price on this website within two (2) business days following their receipt of the relevant issue of the "Asphalt Weekly Monitor". Poten and Partners has granted MassDOT the right to publish this specific asphalt price information sourced from the Asphalt Weekly Monitor.

The Contract Price of the Hot Mix Asphalt Mixture (HMA) will be paid under the respective item(s) in the contract. The price adjustment, as herein provided, upward and downward, will be made as work is performed, using the monthly period price for the month during which the work was performed, based on the amount of HMA installed during the period.

The asphalt content for Hot Mix Asphalt Mixtures shall be 5.5% (0.055) by weight regardless of percentages established by the Job Mix Formula as described in Material Section M3.11.03 of the MassDOT Standard Specification.

The Price Adjustment will be a separate payment item. It will be determined by multiplying the number of tons of hot mix asphalt mixtures placed during each monthly period, times the liquid asphalt content percentage (0.055), times the variance in price between Base Price and Period Price of liquid asphalt.

This Price Adjustment will be made only if the variance from the Base Price is greater than 5% for a monthly period. The complete adjustment for that monthly period will be made in all cases with no deduction of the 5% from either upward or downward adjustments.

No price adjustment will be allowed beyond the completion date of the contract, unless there is an approved extension of time by the City of Cambridge.

Price Adjustment Portland Cement Concrete Mixes

The following provision applies to all cast-in-place concrete mixes containing Portland cement on projects using greater than 100 Cubic Yards of Portland cement concrete.

The Base Price of Portland cement on the project will be a fixed price determined on the date that bids are opened using the same method as for the determination of the Period Price detailed below.

The Price Adjustment will be based on the variance in price for the Portland cement component only from the Base Price to the Period Price. It shall not include transportation or other charges.

The Period Price of Portland cement will be determined by using the latest published price, in dollars per ton (U.S.), for Portland cement (Type I) quoted for Boston, U.S.A. in the Construction Economics section of ENR Engineering News-Record magazine or at the ENR website http://www.enr.com under Construction Economics. The Period Price will be posted on Massachusetts Department of Transportation (MassDOT) Highway Division (www.massdot.state.ma.us) website the Wednesday immediately following the publishing of the monthly price in ENR, which is normally the first week of the month.

The Contract Price of the Portland cement concrete mix will be paid under the respective item(s) in the contract. The price adjustment, as herein provided, upward and downward, will be made after the work is performed, using the monthly period price for the month during which the work was performed.

The Price Adjustment applies only to the actual Portland cement content in the mix placed on the Project in accordance with the specifications. No adjustments will be made for any cement replacement materials such as fly ash or ground granulated blast furnace slag.

The Price Adjustment will be a separate payment item. It will be determined by multiplying the number of cubic yards of Portland cement concrete placed during each monthly period times the Portland cement content percentage times the difference between the Base Price and Period Price of Portland cement.

For items that are not paid on a per cubic yard basis, the Price Adjustment will be calculated per cubic yard from the actual volume used based on information submitted to or gathered by the Owner or the Engineer.

This Price Adjustment will be made only if the variance from the Base Price is greater than 5% for a monthly period. The complete adjustment for that monthly period will be made in all cases with no deduction of the 5% from either upward or downward adjustments.

No price adjustment will be allowed beyond the completion date of the contract, unless there is an approved extension of time by the City of Cambridge.

Price Adjustment Diesel and Gasoline Fuels

The Base Price of Diesel and Gasoline Fuels will be the fixed price of Diesel Fuel as posted on Massachusetts Department of Transportation (MassDOT) Highway Division (www.massdot.state.ma.us) website for the month in which the bids are opened.

The Period Price of Diesel and Gasoline will be determined by using the actual prices paid by MassDOT for Diesel fuels. The Period Price is the average of prices charged to the State, including State Tax for the bulk purchases made during each month. The previous month's prices will be posted on Massachusetts Department of Transportation (MassDOT) Highway Division (www.massdot.state.ma.us) website by the end of the second week of each month.

A “Percent of Contract” method will be utilized to calculate the fuel costs for the contract. This method requires that a Diesel and Gasoline Fuel Use Factor, representing the approximate cost of Diesel and Gasoline fuel as a percentage of the total contract sum is established on the bid sheet. The estimated range for the Diesel and Gasoline Fuel Use Factor associated with this project shall be between 0.5% - 2.5% of the total contract sum of this project. Bidders shall indicate on the bid sheet their bid percentage of fuel costs (0.5% - 2.5%), and that percentage amount of the contract price shall be the estimated total dollar value of fuel use for the entire project.

The cost of fuel is calculated periodically using the Diesel and Gasoline Fuel Use Factor applied against the dollar value of work completed for the pay period (with no retainage deducted) including the value of contract change orders to establish the amount (in dollars) of fuel costs expended by the contractor and subcontractors.

The Fuel Price Adjustment will be a separate payment item. It will be determined by multiplying the fuel costs expended by the contractor and subcontractors and the actual variance between the Base Price and Period Price of Diesel Fuel. As the cost for Diesel and Gasoline fuels are highly correlated and it is likely that Diesel Fuel will make up the most significant portion of fuel use, only the posted Diesel Fuel prices will be used in determining the Base and Period Prices for project fuel use.

This Price Adjustment will be made only if the variance from the Base Price is greater than 5% for a monthly period. The complete adjustment for that monthly period will be made in all cases with no deduction of the 5% from either upward or downward adjustments.

*No adjustment will be paid for work done beyond the extended completion date of any contract unless there is an approved extension of time by the City of Cambridg*e.

END OF SECTION 00900

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 01010

SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. The Work to be done under this contract consists of the installation of new sewer pipe and structures, storm drain pipe and structures; the replacement of water main; pedestrian facility improvements; surface improvements including curb, sidewalk and roadway reconstruction; and landscape and streetscape improvements.

B. The Work includes, but is not limited to, the following.

1. Subsurface components including installation of approximately 9,000 linear feet of 6-inch to 48-inch diameter PVC, RCP and DI storm drains, sanitary sewers, storm drain manholes, piping connections, catch basins, and sewer manholes; CIPP structural liner consisting of 6,300 linear feet of 8-inch to 42-inch diameter liner; 4,700 linear feet of 4-inch to 24-inch DI water main, hydrants and replacement of water services, including replacement of all non-copper water services to the building meters; restoration of all disturbed areas; and test pits as shown on the plans, or described in the Specifications, and as directed by the Engineer.

2. Surface restoration components including roadway restoration of approximately 9000 linear feet of roadway and sidewalks conforming to the latest MA AAB and ADA rules and regulations; full depth roadway construction; asphalt excavation by cold planer; pavement overlay; granite curbing; concrete and brick sidewalk reconstruction; existing tree protection and maintenance; tree planting; landscape planting; pavement markings; signage installation; and sidewalk and private property restoration in areas disturbed by the work.

C. A general description of the Work to be performed under this Contract shall include, but will not be limited to the following construction operations:

1. Tree protection, pruning and maintenance.

2. Coordination with public and private utilities for the relocation and adjustment of their facilities as required.

3. Erosion and sediment controls and containment.

4. Installation of temporary water bypass and replacement of existing

water mains.

5. Installation of storm drains, catch basins and storm drain manholes.

6. Installation of sanitary sewers, sanitary sewer manholes, and CIPP rehabilitation of existing sanitary sewers.

7. Demolition, removal and abandonment of existing structures and pipes.

8. Vibration monitoring as indicated or directed.

9. Rodent control.

10. Disposal of excess geotechnically, analytically, and/or logistically unsuitable excavated material.

11. Reuse of geotechnically and analytically suitable excavated material on site as backfill and dispose of excess material from excavation not required for fill or backfill as specified, and to the satisfaction of the Owner.

12. Temporary roadway restoration.

13. Remove and reset or furnish and install new granite curb; installation of new cement concrete sidewalks, brick sidewalks, driveway reconstruction and pedestrian ramps conforming to the latest MA AAB rules and regulations and to the latest ADA standards for accessible design.

14. Raised crosswalk and intersection installation.

15. Roadway reconstruction; cold planing and overlay paving; permanent trench restoration.

16. Installation of pavement markings.

17. Installation of street signs.

18. Installation of hardscape including pavers, landscape curb, and lighting.

19. Installation of specialty soils, irrigation, and tree, shrub and groundcover plantings.

20. Installation of Stormwater infiltration infrastructure

21. Streetlight replacements, Electric Vehicle (EV) charging station installation, and electrical panel replacements and upgrades.

22. Traffic Signal improvements

D. The work shall conform to such additional drawings, specifications and addenda to these Specifications and Drawings as may be published or exhibited prior to the opening of Bid Proposals or as may be furnished by the Engineer from time to time during the construction.

E. Work and materials which are necessary in the construction, but which are not specifically referred to in the Specifications, or shown on the Drawings, but implied by the Contract shall be furnished by the Contractor and included in the Contractor's Unit and Lump Sum Prices Bid. The work and materials shall correspond with the general character of the work as may be determined by the Engineer, whose decisions as to the necessity for and character of such work and materials shall be final and conclusive. It is the intent of these specifications to produce a complete, finished job whether shown in every detail or not.

F. The work shall conform to such additional drawings, specifications and addenda to these Specifications and Drawings as may be published or exhibited prior to the opening of Bid Proposals or as may be furnished by the Engineer from time to time during the construction.

G. For the purposes of this Contract, anywhere the term "Temporary" is used in the Specifications, in the Plans, in Contract Addenda, in any revisions made to the Contract Documents at any time prior to or during construction, verbally, in writing, in change orders or work change directives or at any other time whether listed here or not, it shall be taken to mean "Temporary" only as it relates to the duration of the Contract. All repairs, restoration, and construction shall be considered Final as it relates to this Contract.

1.2 CONSTRUCTION SEQUENCE

Refer to Specification Section 01063 for additional project sequencing requirements.

Inclusion of the following sequencing restrictions does not relieve the Contractor from its responsibility to complete the Work with the specified contract duration, nor does it relieve the Contractor from its responsibility to sequence and carry out the work so as not to cause harm to the existing systems, environment, or community.

A. Establish baseline Rodent Control

B. Pre-construction Survey

C. Establish baseline Geotechnical Instrumentation and Monitoring

D. Establish baseline Sedimentation and Erosion Control and Tree Protection

E. Mobilization

F. Tree pruning and establish tree protection.

G. Establish advance warning Traffic Management

H. Layout of site work and survey control

I. Perform Test Pits: All Test Pits identified in the Contract Drawings, or described in the Specifications, as well as those identified by the Owner and Engineer shall be performed and completed prior to any other work commencing within a particular street segment. Special attention is given to the Test Pit requirements of Section 02604 – Catch Basins.

J. Prior to installation of the Work the Contractor shall verify the relocation of any existing utilities that are scheduled for relocation, coordinate with the responsible utility, and relocate those utilities which are the Contractor's responsibility as per these Contract Documents.

1.3 CONSTRUCTION COORDINATION WITH ADJACENT WORK

A. Refer to section 01040 for additional project coordination requirements.

B. Construction shall be coordinated with adjacent projects, public or private, within the City of Cambridge, including but not limited to:

a. Reconstruction of Clement Morgan Park beginning March 2026 with duration of up to 2 years.

b. Improvements to adjacent streets including Washington Street, Pine Street, Cherry Street, Eaton Street, School Street and Windsor Street under future The Port Infrastructure Phase II Project - Package 2 Contract. Construction is expected to begin in May 2027.

C. Coordination is considered incidental to the project; no additional payment will be authorized.

1.4 UNDERGROUND UTILITIES

A. The underground utilities shown on the plans have been located primarily from information furnished by others and are considered approximate both as to size and location. There are additional utilities to be encountered that are not shown on the plans, and it shall be the Contractor's responsibility to locate all existing utilities and to protect same from damage or harm. All utilities interfered with or damaged shall be properly restored, at the expense of the Contractor, as required by Owner. Unapproved service interruptions will not be allowed. Refer to Specification Section 01200 for additional utility coordination information and requirements.

1.5 SURFACE RESTORATION

A. Any damage to the pavement, curbing, or sidewalks outside of the limits of excavation and excavation support as defined in the Contract Documents, or the limits of work, shall be the responsibility of the Contractor and all costs associated with the repair of the excavation, sub-base, pavement, curbing, and sidewalks shall be fully borne by the Contractor. Repairs shall be immediately made by the Contractor as per the Contract Documents and as required by the Engineer.

1.6 HOURS OF WORK

A. The hours of work shall be Monday through Friday, 7:00am – 4:00pm excluding City of Cambridge and Cambridge Department of Public Works holidays. See other restrictions identified in 01063 – SEQUENCING OF WORK. The City reserves the right to limit construction operations during periods of public voting, adverse weather, or other special events at no additional cost.

B. The Contractor shall be prepared and available to work at night for water and sewer service tie-ins to buildings that require continuity of services, including but not limited to hospitals, care facilities and schools.

C. During non-work hours (4:00pm – 7:00am weekdays; weekends and holidays), the Contractor shall make the following provisions:

1. Access to all properties shall be maintained. Work zones shall be cleaned, protected, and made safe. The Contractor shall minimize the amount of parking restrictions and shall reduce the parking limitations deemed excessive at no additional cost to the Owner.

2. At the end of each work day, the Contractor shall backfill and pave and/or place steel road plates over all excavations so as to maintain automobile/truck traffic, bicycle traffic, and pedestrian traffic access and flow. Under no circumstances will obstructions or open excavations be allowed during non-work hours.

1.7 CONTRACTOR USE OF PROJECT SITE

A. The Contractor’s use of the project site shall be limited to its construction operations and limited on-site storage of materials.

B. The Contractor shall determine the location(s) of the staging area(s) to be used for this project and shall obtain approval of the location(s) from the City of Cambridge prior to any mobilization activities if within the City of Cambridge. Contractor’s equipment and materials shall not block hydrants or emergency vehicle access. Equipment stored after hours shall be at least 25 feet away from intersections so that large emergency response vehicles may access all properties

within the Contract area.

C. The Contractor shall maintain access to street parking and driveway parking and access to all properties and businesses outside the work zone during off work hours.

D. The Contractor shall remove all equipment and materials, provide full sidewalk and street access, and sweep clean the project area during special events being held within or adjacent to the project area.

E. The City of Cambridge does not provide general parking for private vehicles that belong to contractors working in or upon the City of Cambridge. As a condition of construction permits, the Contractor will be required to manage employee parking ensuring personal vehicles are parked off-site. Note that overtime parking at City meters, and/or parking in Residential Permit parking spaces without a permit, will not be tolerated. Repeated violations may result in loss of project permits.

1.8 LIST OF DRAWINGS

A. The location, general characteristics, and principal details of the work are indicated on a set of drawings entitled “The Port Infrastructure Phase II Project – Package 1”.

B. The drawings stated above are the Contract Drawings, sometimes referred to herein as the "Drawings." Additional drawings showing details in accordance with which the work is to be done may be furnished from time to time by the Engineer, if found necessary, and shall then become a part of the Drawings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01010

SECTION 01025

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Payment for the items specified in the Bid Schedule shall include compensation for furnishing all labor, tools, equipment, supplies, manufactured articles, and for all operations, and incidentals appurtenant to the items of work described, to complete the various items of the Work, all in accordance with the requirements of the Contract Documents, Drawings, Specifications, Addendum, and other modifications issued and approved by the Owner and Engineer.

B. Payment for the items specified in the Bid Schedule shall include all costs for permits and compliance with the regulations of public agencies having jurisdiction including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA).

C. The bid prices listed in the Bid Schedule shall include all Work items described or implied in the Contract Documents, Drawings, Specifications, Addendum, and other modifications issued and approved by the Owner and Engineer, and all other Work items necessary to manufacture, furnish, install and test a complete working project.

D. The following items are considered “Incidental” to the completion of the Work included in this Contract. These incidental work items shall be included in the Bid Schedule prices and are not included for separate payment. The incidental work items include, but are not limited to:

a. Abandonment, removal and disposal of existing, abandoned or relocated private utilities and water main not specified for payment elsewhere.

b. Establishing and maintaining Construction Baselines and Profile Grade Lines.

c. Horizontal and vertical layout and staking.

d. Dust control.

e. Attending Owner meetings, neighborhood meetings, and all other Construction meetings.

f. Submitting work plans, shop drawings, and materials samples.

g. Construction of mock-ups and sample panels.

h. Protection of installed materials from damage, and replacement of damaged materials as directed by the Engineer.

i. Warrantees and Guarantees as indicated in the Contract Documents.

j. Maintenance of plant materials as indicated in the Contract Documents.

k. Concrete encasement of impacted utilities.

l. Street sweeping and removing snow from streets and sidewalks where work is ongoing.

m. Transporting trash and recyclables out of the work area where municipal pickup is hindered.

n. Providing certificates of design where required.

o. Submitting weekly and bi-weekly construction schedule projections and updates.

p. Fulfilling all reporting requirements.

q. Clean-up and restoration of all surface features not included for payment elsewhere.

r. Obtain all permits including payment of fees.

s. Cast-in-place concrete collars for pipe-to-pipe connections for pipe smaller than 15-in diameter.

t. Demolition and removal of all vitrified clay and PVC pipe of any size, and all other pipe materials smaller than 15-inch nominal diameter and all lampholes.

u. Permanent masonry plugs, caps and bulkheads for pipe abandonment smaller than 15-in diameter.

v. Furnishing and placing backfill by one of the approved methods listed below:

    i. Reuse excavated material immediately on site at the general area of excavation.

    ii. Furnish and install imported suitable backfill.

    iii. Transport the material to a staging area, stage and protect the material, load the material, transport the material to be used as backfill at the general area of excavation or to another backfill

area of equal or greater contamination, where geotechnically suitable.

w. Remove and reset all signs and sign posts, trash receptacles, meters, or any other site feature or furnishing not specifically listed for separate payment elsewhere.

x. Rodent Control.

y. Protection of private property including walls at the back of sidewalk.

z. Modification, removal, and disposal of existing tree pits.

aa. Preparation, submission, revision, and adherence to a Health and Safety Plan as per Section 01108 of these specifications.

bb. Cleaning of new and existing catch basins and offline manhole sumps within the project limit of work upon reaching substantial completion.

cc. Use of a City controlled third party Construction Management Platform Software – currently "Procore" for project submittals, design, and engineering documentation.

E. No separate payment shall be made for any item that is not specifically specified in the Bid Schedule, and all costs therefore shall be included in the prices named in the Bid Schedule for the various appurtenant items of work.

F. The Contractor and Subcontractors shall not take advantage of any apparent error or omission on the Drawings or in the Specifications. The Contractor and Subcontractors shall make corrections and interpretations as may be deemed necessary for fulfillment of the intent of the Contract Documents at no additional cost to the Owner.

G. Anywhere in these Contract Documents, the term furnish shall mean manufacture; supply; delivery to the Project site including the actual unloading and unpacking; assembly; erection; placing; installation; anchoring; applying; working to dimension; finishing; curing; protecting; cleaning; testing; start-up; and similar operations unless stated otherwise.

1.2 LUMP SUM ITEMS

A. Payment for the lump sums shall be full compensation for all labor, materials and equipment required to furnish, install, construct, startup and test the work covered under that lump sum item, whether listed in the related Compensation subsection for each item or not. All supervision, overhead items including but not limited to bonds, insurance, and labor burden; and profit are also included.

B. Payment shall fully compensate the Contractor for any other work which is not specified or shown, but which is necessary to complete the Work.

1.3 UNIT PRICE ITEMS

A. Unit prices shall be full compensation for all labor, materials and equipment required to furnish, install, construct, startup and test the work covered under that unit price item, whether listed in the related Compensation subsection for each item or not. All supervision, overhead items including but not limited to bonds, insurance, and labor burden; and profit are also included.

B. Payment shall fully compensate the Contractor for any other work which is not specified or shown, but which is necessary to complete the Work

1.4 ALLOWANCE ITEMS

A. The Contractor is allowed up to a 5% markup on any third party, professional services, testing, or subcontractor invoices submitted through allowance pay items unless otherwise indicated.

1.5 MEASUREMENT FOR PAYMENT

A. Work completed to date shall be submitted by the Contractor and substantiated as required by the Engineer.

B. The Owner and Engineer will review the submittal for completeness and verification. Failure to submit any of the below requirements will be grounds for a rejection of the submitted pay request until such time as the submittals are complete, accurate, up to date, and have been approved by the Owner and Engineer.

a. Include a checklist of completed items. Only items signed-off by the Engineer will be considered for payment.

b. Include red-lined “As-built” drawings indicating degree of completion, as described in Section 01400 – QUALITY CONTROL.

c. Include a revised schedule and narrative as required in the Specifications and showing actual record information.

d. Include a copy of all required test results including, but not limited to geotechnical and settlement monitoring results, compaction test results, concrete strength test results, grain size analysis and analytical test results.

e. Certified pay-rolls for general and all sub-contractors.

f. MBE and WBE reporting and certifications.

1.6 PAYMENT ITEMS

Item 900.1 – Fuel Use Cost Adjuster
Item 900.2 – HMA Cost Adjuster
Item 900.3 – Cement Cost Adjuster

METHOD OF MEASUREMENT:
Payment will be made against the Allowance based on the price adjusters calculated as described in Section 00900 - Fuel, Asphalt, Concrete, Steel Price Adjustment on a periodic basis, but not more than once per month.

BASIS OF PAYMENT/INCLUSIONS:
This Allowance item is for cost adjustments only and does not include any overhead or mark-up costs to calculate or track the cost adjustment which shall be considered incidental to the Contract. Refer to Sectio 00900 – Fuel, Asphalt, Concrete, Steel Price Adjustment for specific basis of payment and inclusions.

Item 900.4 – Fuel Use Factor

This bid item will not be used in establishing overall Bid Price. The "Fuel Use Factor" is a Contractor bid item based on the estimated project gasoline and diesel fuel costs expressed as a percentage of the contract value. The Contractor shall estimate the "Fuel Use Factor" within the range established for the Contract. Use of this item will be in accordance with the procedures set forth in Section 00900 – Fuel, Asphalt, Concrete, Steel Price Adjustment.

Item 1060.1 – MBTA License Agreement

METHOD OF MEASUREMENT:
Measurement for payment for the MBTA License Agreement will be on a Lump Sum basis. The Lump Sum amount will be measured as one complete item and will be considered earned upon successful submission, receipt, and compliance with the fully executed MBTA License Agreement.

BASIS OF PAYMENT/INCLUSIONS:
Payment for the MBTA License Agreement shall be based on the bid price for this item. The Lump Sum price shall be full compensation for furnishing all labor, administrative services, coordination, documentation, and any associated fees necessary to obtain a complete and full executed MBTA License Agreement in a form acceptable to the Engineer. This Item also includes the costs associated with compliance with the Terms and Conditions included within the MBTA License Agreement.

Item 1200.1 – Temporary Utility Support and Coordination

METHOD OF MEASUREMENT:

Measurement for payment for Temporary Utility Support and Coordination will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Payment for Temporary Utility Support and Coordination will be based on the bid for this item in the proposal. Under the Lump Sum Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment and incidentals required to maintain continuity of gas, telephone, electric, telecommunications, cable TV, steam, MBTA, and privately owned utilities. The work includes all trunk, supply, transmission, service and main lines impacted by the Work. Under the Lump Sum Price bid for this item, the Contractor shall also furnish all labor, materials, tools, equipment and incidentals to coordinate and/or temporarily support all utilities exposed during the excavation for the installation of the Work; submission of all utility coordination and support work plans and shop drawings, including plan stamped by a Professional Engineer in the Commonwealth of Massachusetts; coordinate the protection of and protect all overhead utilities; and perform all coordination with the utility companies for the relocation, abandonment, protection, support, and other work required to facilitate the completion of the project. This Item further includes utility location (Dig Safe); provide, install, maintain, and disconnect portable generators to maintain electrical service to dwellings; coordination of construction with existing utility owners and operators; providing access for utility owners and operators to their respective utilities; and communicating with affected homeowners and residents.

EXCLUSIONS:
The following items are not included for payment under this item and are included for payment elsewhere; labor, materials, tools, equipment and incidentals required to maintain continuity of water mains; restoration of curbing, sidewalks, and bituminous concrete pavement; providing by-pass pumping of sanitary sewers and storm drains; and temporarily and permanently relocating sanitary sewers, storm drains, water main and services for sanitary sewers, storm drains and water mains.

Item 1200.2 – Survey Construction Layout and Baseline, As-Builts (Minimum Bid is $100,000)

METHOD OF MEASUREMENT:
Measurement for payment for Survey Construction Layout and Baseline, As-Builts will be on a percent of the Lump Sum bid. 40% will be paid for layout of all proposed work, and the remaining 60% will be paid upon completion and turnover of CAD files recording the As-built and utility information as outlined in this Specification and as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Payment for Survey Construction Layout and Baseline, As-Builts will be based on the bid for this item in the proposal. Under the Lump Sum Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to perform the Survey work using a licensed Professional Land Surveyor registered in Massachusetts, including layout of all proposed work, verification of benchmarks, and completion of as-built drawings.

Item 1200.3 – Gas Main Relocation Utility Support – Harvard Street at Columbia Street Intersection

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Invoices shall include a breakdown of hours, labor rates, direct expenses, sub-contractor costs, material costs, and all other costs included in the request. Incomplete or incorrect invoices will not be approved. The General Contractor is allowed up to a 3% mark-up on all subcontractor and 5% markup on all direct costs incurred under this item as supported by invoices. Subcontractor markup shall also be limited to 5%. These markups are considered inclusive of supervision, overhead, profit, insurance, and bond. At the end of the Contract, all remaining funds will be deleted from the Contract by a Change Order.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Gas Main Relocation Utility Support – Harvard Street at Columbia Street Intersection will be based on the Allowance amount provided. The Allowance for this item shall be reimbursed to the Contractor to furnish all labor, equipment, and incidentals for the Contractor to provide excavation, support of excavation, temporary roadway restoration including daily use of roadway plates, and other support as directed by the Engineer in order to support relocation of the gas main in the intersection of Harvard Street and Columbia Street. All work under this Allowance shall be preapproved by the Engineer.

SPECIAL NOTES ON EXCLUSIONS:
This item excludes coordination and scheduling with Eversource Gas in preparation for the work as this is included for payment under the Temporary Utility Support and Coordination item.

Item 1200.4 – MBTA Ductbank Relocation – Harvard Street at Columbia Street Intersection

METHOD OF MEASUREMENT:
Measurement for payment for MBTA Ductbank Relocation – Harvard Street and Columbia Street Intersection will be based on a Lump Sum for the removal of the MBTA ductbank passing through the 36” drain and replacement with new concrete encased conduits over the 36” drain. This ductbank is believed to be abandoned, but the contractor is responsible for confirming with the MBTA that there are no energized conductors in this ductbank. The EMH to the north does contain energized conductors and the contractor is prohibited from entering the Manhole.

BASIS OF PAYMENT / INCLUSIONS:
Payment for the MBTA Ductbank Relocation – Harvard Street and Columbia Street Intersection shall be based on the bid price for this item in the proposal. Payment shall be considered as full compensation for furnishing all labor, equipment, materials, and services for unclassified excavation, excavation by Vac Excavation methods at the MBTA manhole, backfill; furnish and install subbase gravel for roadway, temporary paving; removal of the existing MBTA EDB from the brick drain, reinstalling (4) concrete encased PVC conduits and tying them into ductbank on the south side; disposal of removed piping, clean up; and all else incidental thereto. No separate measurement for electrical conduits, or ductbank will be made for this Lump Sum work. This work is indicated on Contract drawing U-7 near Station 2011+90

SPECIAL NOTES ON EXCLUSIONS:
This item excludes coordination and scheduling with the MBTA in preparation for the work as this is included for payment under the Temporary Utility Support and Coordination item. This item also excludes demolition and reinstallation of the 36" drain as this work is covered elsewhere.

Item 1200.5 – MBTA Electric Manhole Frame and Cover Adjustments

METHOD OF MEASUREMENT:
Measurement for payment for the MBTA Electric Manhole Frame and Cover Adjustments shall be based on the actual number of complete and functional MBTA manhole frame and covers adjusted to match the final grades as shown on the Contract Drawings or as directed by the Owner or Engineer. The Electric Manholes contain energized conductors and the contractor is prohibited from entering the Manholes.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the adjustment of existing manhole frame and covers to the finish grades indicated on the Drawings, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; adjusting manhole frames and covers to the elevations indicated; grade and compact gravel pavement sub-base; compaction testing; installing concrete collars; and all appurtenances and incidental work.

Adjustment of the replaced frame and cover to final grade, and any adjustments to intermediate grades, are included under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
This item excludes coordination and scheduling with the MBTA in preparation for the work as this is included for payment under the Temporary Utility Support and Coordination item.

Item 1390.1 – External Building Inspection – Residential
Item 1390.2 – External Building Inspection – Non-Residential

METHOD OF MEASUREMENT:
Measurement for payment for External Building Inspection will be based on the per Each bid as approved by the Engineer.

BASIS OF PAYMENT/ INCLUSIONS:
Under the Unit Price for External Building Inspection the Contractor shall furnish all labor, materials, instrumentation, tools, equipment, and incidentals required to complete an external building inspection for each building adjacent to the project area as pre-approved by the Engineer. Payment under this Item includes, but is not limited to, obtaining Right of Entry(ies) when conditions require entry onto the property to properly document the building inspection; up to 3 documented attempts to notify the property owner(s) via certified mail in order to obtain a Right of Entry as needed; video inspection and documentation of external conditions; and

delivering report of inspection.

Contractor to provide schedule of values for the completion of external inspection, and documented attempt to obtain a Right of Entry for each unit as needed. In the event property owner is unable to be contacted or unwilling to allow entry, the contractor will receive 30% partial payment for external inspection and documented attempts.

Item 1390.3 – Interior Building Inspection

METHOD OF MEASUREMENT:
Payment for Interior Building Inspection will be made against the Allowance based on invoices submitted by the General Contractor on a monthly basis. Labor, professional services, technician, and other invoices shall include a breakdown of hours, labor rates, direct expenses of all sub-consultant and contractor mark-ups, material costs, shipping, taxes and all other costs included in the request. Incomplete or incorrect invoices will not be approved.

The General Contractor is allowed up to a 5% mark-up on labor, professional service, technician, and other costs related to interior building inspections as approved by the resident engineer.

BASIS OF PAYMENT/ INCLUSIONS:
The allowance for this item shall be reimbursement to the General Contractor to furnish all labor, professional services, technician, equipment, and incidentals for the Contractor to complete Interior Building Inspections as required by the Engineer and not included in other pay items.

EXCLUSIONS AND SPECIAL NOTES:
Payment for External Building Inspection shall be paid for under separate Items.

Item 1400.1 – Quality Control and Testing

METHOD OF MEASUREMENT:
Payment for Quality Control and Testing will be made against the Allowance based on invoices submitted by the General Contractor on a monthly basis. Labor, professional services, technician, and other invoices shall include a breakdown of hours, labor rates, direct expenses all sub-consultant and contractor mark-ups, material costs, shipping, taxes and all other costs included in the request. Incomplete or incorrect invoices will not be approved.

The General Contractor is allowed up to a 5% Mark-up on labor, professional service, technician, and other costs related to testing.

BASIS OF PAYMENT:
The allowance for this item shall be reimbursement to the General Contractor to furnish all labor, professional services, technician, equipment, and incidentals for third party testing requested by the City or Engineer and not included in other pay items. The work includes, but is not limited to, testing for: in-situ soil density,, concrete and hot mix asphalt standard paving compaction testing items.

SPECIAL NOTES/EXCLUSIONS:

Environmental testing of soil, imported soils material gradation and density testing, pipe and manhole testing, water main testing, test pitting, landscape and tree planting soils testing, and all other testing not explicitly called out in this Section will not be paid for under this item and are covered under separate pay items. Testing done for the contractor's convenience or solely at the request of the contractor will not be compensated under this item.

Item 1505.1 – Mobilization (3% Maximum)

METHOD OF MEASUREMENT:
Payment for Mobilization will be at Lump Sum price bid for this item in the proposal and shall be payable by percentage complete per the previous listed items when the Contractor is operational on the site. Operational is defined as the substantial commencement of work on site as described in the following paragraph. The Lump Sum price bid for mobilization shall not exceed three percent (3%) of the Total Amount of Bid.

BASIS OF PAYMENT:
Under the Lump Sum price bid for Mobilization, the Contractor shall move their equipment to the site and prepare to begin construction. Mobilization shall include all costs of initiating the Contract, exclusive of the cost of materials. Mobilization includes securing and constructing a staging area(s) for materials and office trailers and erecting all temporary fencing (0.3%); furnishing office trailers or field offices fully equipped and supplied (0.3%); furnishing and paying for all utilities (0.3%), furnishing and installing pre-construction traffic management signage (0.3%); distributing contact numbers for Contractor's staff to Owner and Engineer; submission and approval of initial shop drawings (0.2%); submission and approval of Traffic Management Plans (0.2%); submission and approval of initial work plans and sequencing plans (0.2%); installing temporary power, lighting and water for construction purposes (0.3%); implementing security features (0.3%); furnishing and installing temporary sanitary facilities (0.3%); transporting all necessary trucks and construction equipment to the site necessary to begin construction (0.3%); and all other work necessary to start Construction.

Item 1520.1 – Field Office

METHOD OF MEASUREMENT:
No measurement shall be made for this item. Owner's Field Office shall be the amount listed in the Base Bid Items table of section 00300 – Form for General Bid to be used at the discretion of the Engineer or Owner. The Allowance may be used for work directed by the Engineer related to Field Office and associated supplies.

BASIS OF PAYMENT:
Payment for work performed under this item will be in accordance with the procedures set forth in Section 01520 of the Specifications. The Contractor is allowed up to a 3% markup on all costs incurred under this item as supported by invoices. At the end of the Contract, all remaining funds will be deleted from the Contract by a Change Order.

Item 1568.1 – Erosion and Sedimentation Control

METHOD OF MEASUREMENT:

Measurement for payment for Sedimentation and Erosion Control will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS
Payment for Sedimentation and Erosion Control will be based on the bid for this item in the proposal. Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment and incidentals required to furnish, install, maintain, relocate, and remove all sedimentation and erosion control measures. Under the Unit Price bid for this item, the Contractor shall also furnish all labor, materials, tools, equipment and incidentals to prepare and submit all work plans and submittals; line all existing and new catch basins with sediment filter devices and remove prior to inclement weather; install, maintain, and remove composting socks; install, maintain and remove temporary vegetation for erosion control; removal and disposal of all silt and sediment collected from sedimentation and erosion control measures; and all other items of work not specifically included herein or elsewhere required to furnish, install, maintain, relocate, and remove sedimentation and erosion control devices as specified and required.

Item 1570.1 – Traffic and Pedestrian Management

METHOD OF MEASUREMENT:
Measurement for payment for Traffic and Pedestrian Management will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the original Contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Traffic and Pedestrian Management shall be based on the lump sum price bid for this item in the proposal. Under the lump sum price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to provide, maintain, relocate, and remove Traffic and Pedestrian Management in areas directly or indirectly influenced by construction within the limits of work or outside the limits of work; along truck routes inside or outside the limits of work; as delineated in the approved Traffic and Pedestrian Management Plan, by the MUTCD, ADA, MA AAB, and MassDOT standards; and as further required by the Owner and Engineer. The work includes but is not limited to fabrication of signage; furnishing and installing signage; mounting and securing signage; maintaining signage; protecting and storing signage not in use; relocating signage; removal of signage; The work further includes, but is not limited to, obtaining permits; coordination with the Department of Public Works and Traffic, Parking and Transportation Department (CAMDOT); coordination with the MBTA for temporary bus stop relocations and all impacts to the MBTA operations; coordination with private property owners within the limits of work; preparing, submitting, reviewing, implementing, and revising traffic management and control plans; work zone layouts; installing and maintaining traffic management devices based on approved traffic management and control plans including precast concrete and/or triplex barriers with fencing and plywood panels, reflectorized drums, lane delineators, portable barricades, temporary crosswalks, and cones; furnish, install and maintain temporary pavement markings including all crosswalks throughout the duration of construction, and repainting faded pavement markings as needed and as directed by the Engineer; removal of temporary and existing pavement markings; furnishing, installing, shimming, pinning, maintaining, and removing steel road plates;

furnishing, installing, and removing cold patch pavement as necessary or as directed by the Engineer; ordering and coordinating police details; furnishing and installing temporary construction fencing; maintaining roadways and sidewalks inside or outside the limits of work; establishing and dismantling detours; covering existing traffic signs; obtaining, posting and maintaining "No Parking" signs; meeting with police details daily; coordinating police detail locations; and all incidental work, whether listed here or not, required to provide maintenance and protection of traffic and pedestrians.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item and are included for payment elsewhere; bituminous hot mix asphalt pavement; remote controlled changeable message boards; and Police Details. Police Details will be paid directly by the Owner. Signage damaged as a result of misuse or improper handling shall be replaced by the Contractor at no additional cost to the Owner.

Item 1570.2 - Remote Controlled Changeable Message Board

METHOD OF MEASUREMENT:
Measurement for Payment for Remote Controlled Changeable Message Board shall be based on the number of weeks each changeable message sign is provided, moved, removed and maintained, complete, as required by the Owner or Engineer. Remote controlled changeable message boards which are on site but not requested or approved by the Owner or Engineer shall be at the Contractor's expense, i.e. changeable message signs which are brought on site earlier than directed, not removed in a timely manner when required, or which are not operational.

BASIS OF PAYMENT:
Payment for Remote Controlled Changeable Message Board will be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to provide, program, move, remove and maintain changeable message signs in approved locations within or adjacent to the project area, complete, as required by the Owner or Engineer. The work further includes, but is not limited to the following; coordinating with the Owner and Engineer for changeable message sign locations; furnishing and setting-up changeable message signs, power supply, programming equipment and appurtenances; maintaining message signs throughout project; relocating message signs to new locations as required by the Owner and Engineer; transportation and handling; cellular telephone and cellular service; and all incidental work required to furnish, place, program, maintain, relocate, and remove the changeable message signs.

Item 2015.1 - Vibration Monitoring

METHOD OF MEASUREMENT:
Measurement for payment for Vibration Monitoring will be on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer.

BASIS OF PAYMENT/ INCLUSIONS:

Under the Lump Sum for Vibration Monitoring, the Contractor shall furnish all labor, materials, instrumentation, tools, equipment, and incidentals required to perform all vibration monitoring as specified in the Contract Specifications and also as required by the Engineer. Payment under this Item includes, but is not limited to; furnishing, installation and maintenance of seismographs; monitoring seismograph data and submission of all data to the Engineer; submission of shop drawings and submittals as required.

Item 2051.1 - Disposal of Construction Debris as Solid Waste

METHOD OF MEASUREMENT:
Measurement for payment for Disposal of Construction Debris as Solid Waste shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip. Solid Waste disposed of for which return manifests or certified weight slips have not been submitted will not be paid for. Calculated weights based on the calculated volume of concrete, reinforced concrete, cobbles, and other debris disposed of will be used to approximately confirm weight slip totals and may be used in lieu of scaled weights by mutual agreement.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Disposal of Construction Debris as Solid Waste shall be based on the per ton price bid for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Dispose of Construction Debris as Solid Waste. The work includes, but is not limited to; handle, load, transport, stockpile, weigh and dispose at an appropriately permitted facility; all cobbles, rail, timber, brick, cement concrete, metals, cast iron, granite blocks, granite curb, edging, inlets and corners, plastic, or other construction debris; and all fees, permits, taxes, sampling, testing and analysis required by the facility.

SPECIAL NOTES ON EXCLUSIONS:
The excavation and removal of the items listed above for disposal are not included herein but are included for payment elsewhere. This is a disposal item only. Soils are not included for payment herein but are included for payment in the appropriate soil disposal item. Soil weight excavated and disposed with Construction Debris due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed. Disposal of bituminous concrete is not paid for herein but is included for payment elsewhere. Bituminous Concrete weight excavated and disposed with Construction Debris due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed. Payment for the disposal of abandoned or relocated existing gas, telephone, electric, cable TV, telecommunications, fire alarm and traffic signal utilities shall NOT be paid herein or separately elsewhere and are considered “incidental” to the Contract, with costs to be carried in the Contractor’s base bid. Disposal of concrete and brick sidewalks, driveways, and pedestrian ramps removed and disposed of is not included herein but is carried under the unit price for the construction of the new sidewalks, driveways, and pedestrian ramps.

Item 2051.2 - Disposal of Bituminous Concrete

METHOD OF MEASUREMENT:

Measurement for payment for Disposal of Bituminous Concrete shall be on the basis of Tons of bituminous concrete actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip. Bituminous Concrete disposed of for which return manifests or certified weight slips have not been submitted will not be paid for. Calculated weights based on the calculated volume of bituminous asphalt disposed of will be used to approximately confirm weight slip totals and may be used in lieu of scaled weights by mutual agreement.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Disposal of Bituminous Concrete shall be based on the per ton price bid for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Dispose of Bituminous Concrete. The work includes, but is not limited to; handle, load, transport, stockpile, weigh and dispose at an appropriately permitted facility all bituminous concrete; and all fees, permits, taxes, sampling, testing, and analysis required by the facility. The disposal of temporary pavement used in the course of the work will also be paid under the per ton price for this item.

SPECIAL NOTES ON EXCLUSIONS:
The excavation and removal of bituminous concrete is not included herein. This is a disposal item only. Soils are not included for payment herein but are included for payment in the appropriate soil disposal item. Soil weight excavated and disposed with Bituminous Concrete Pavement due to poor segregation techniques shall be estimated by the Engineer and deducted from the total weight disposed. Disposal of construction debris as solid waste is not included for payment herein but is included for payment elsewhere.

Item 2051.3 -- Demolition or Removal of Manhole, Catch Basin or Other Structure

METHOD OF MEASUREMENT:
Measurement for payment for Demolition or Removal of Manhole, Catch Basin or Other Structure shall be on the basis of the number of individual manholes, catch basins or other structures demolished or removed complete as measured by the Engineer. Manholes, catch basins or other structures that are partially demolished or removed for the Contractor's convenience, or not fully removed or demolished where indicated in the Contract Documents, will be at the Contractor's expense and at no cost to the Owner.

BASIS OF PAYMENT / INCLUSIONS:
Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Demolition or Removal of Manhole, Catch Basin or Other Structure. The work includes, but is not limited to: saw cutting existing bituminous and cement concrete; excavation; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction and compaction testing; temporary excavation support furnished and installed complete; construction dewatering; disconnecting existing pipe, services and other connections; removal or demolition of the manhole, catch basin or other structure; masonry plugs in the disconnected pipe not specified for payment elsewhere; remove and stack or remove and dispose existing castings as required; salvage of materials specified; stockpile of salvaged materials and delivery of materials identified as to be salvaged to a location designated by

the Owner.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere: disposal of construction debris as solid waste; demolition and removal of pipes and lampholes; abandonment of manholes, catch basins or other structures.

The demolition of existing, abandoned or relocated gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.4 -- Abandon-In-Place Manhole, Catch Basin or Other Structure

METHOD OF MEASUREMENT:
Measurement for payment for Abandon in Place Manhole, Catch Basin or Other Structure shall be on the basis of the number of individual manholes, catch basins or other structures abandoned in place as specified herein and as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Abandon in Place a Manhole, Catch Basin or Other Structure. The work includes, but is not limited to; saw cutting existing bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; compaction and compaction testing; temporary excavation support furnished and installed complete; construction dewatering; disconnecting existing pipe, services and other connections; remove and stack or remove and dispose existing castings as directed; cutting and demolition of the manhole, catch basin or other structure sections a minimum of 4-ft below finished grade or to a greater extent to facilitate installation of adjacent work; masonry plugs in the disconnected pipe not specified for payment elsewhere; stockpile of salvaged materials and delivery of materials identified as to be salvaged to a location designated by the Owner; drill a minimum of four 2-in holes in invert of structure and furnish, install control density fill or compacted sand; and incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere; disposal of construction debris as solid waste; demolition and removal of pipes, lamp holes, manholes, catch basins or other structures.

The abandonment-in-place of existing, abandoned or relocated gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.5 – Abandon-In-Place with Cellular Concrete – Pipe 15-Inch or Larger

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the Cubic Yard of material placed within existing sewer, drain or water main abandoned in place that is 15-inch or larger as measured by the Engineer from beginning to end of abandonment.

BASIS OF PAYMENT / INCLUSIONS:
Under the per unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required. The work includes, but is not limited to; saw cutting; excavation; furnish and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction and compaction testing; temporary excavation support furnished and installed complete; furnish and installation of masonry plugs or caps; coordination with water department for abandonment of existing water main; construction dewatering; disconnecting existing pipe, services and other connections; identification and verification of all unknown active connections through surface inspection, CCTV inspection, dye testing, test pit, or other method approved by the Engineer for transfer to an active and functioning pipe; installation of cellular concrete as directed by the Engineer; and incidental work not indicated for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere; disposal of construction debris as solid waste; demolition and removal of manholes, catch basins or other structures.

Abandonment of pipe less than 15-inch diameter is incidental work.

The demolition of existing, abandoned or relocated gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.6 – Demolition or Removal of Concrete or Brick Pipe 15-Inch to 24-Inch Diameter
Item 2051.7 – Demolition or Removal of Concrete or Brick Pipe 27-Inch to 42-Inch Diameter
Item 2051.8 – Demolition or Removal of Concrete or Brick Pipe 48-Inch Diameter and Larger

METHOD OF MEASUREMENT:
Measurement for payment for Demolition or Removal of Concrete or Brick Pipe shall be based on the per Linear Feet of individual pipes of a given size, demolished or removed complete as measured by the Engineer from inside wall of structure or beginning of demolition to inside wall of structure or end of demolition.

BASIS OF PAYMENT / INCLUSIONS:

Under the per unit price for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to Demolish or Remove Concrete or Brick Pipe. The work includes, but is not limited to; saw cutting; excavation; furnish and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction and compaction testing; temporary excavation support furnished and installed complete; furnish and installation of masonry plugs or caps; construction dewatering; disconnecting existing pipe, services and other connections; identification and verification of all unknown active connections through surface inspection, CCTV inspection, dye testing, test pit, or other method approved by the Engineer for transfer to an active and functioning pipe; demolition and removal of the pipe; salvage of materials specified; stockpile of salvaged materials and delivery of materials identified as to be salvaged to a location designated by the Owner; and incidental work not indicated for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere: disposal of construction debris as solid waste.

Pipe demolished or removed for the Contractor's convenience, not indicated to be removed or demolished in the Contract, will be at the Contractor's expense and at no cost to the Owner.

The demolition of existing, abandoned or relocated gas, electric, telephone, cable TV, fire alarm, traffic signal, or telecommunications structures and utilities are not included for payment herein or elsewhere but are considered incidental to the Contract and the Contractor shall carry costs in the base bid as necessary.

Item 2051.9 – Removal of Abandoned Intruding Utility from Gravity Pipe and Repair

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of intruding utility removal with pipe repair completed as measured by the Engineer. Pipes not fully removed from the existing gravity pipe will be at the Contractor's expense and at no additional cost to the Owner.

BASIS OF PAYMENT / INCLUSIONS:
Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove the deactivated utility and perform hole repairs. The work includes, but is not limited to: coordination with the intruding utility owner until deactivation is confirmed; saw cutting existing bituminous and cement concrete; excavation of bituminous concrete roadway; excavation; transporting material to/from staging areas; temporary excavation support furnished, installed, and removed; construction dewatering; flow handling; furnishing and placing backfill and gravel pavement sub-base per one of the approved methods including filter fabric as required; compaction and compaction testing; sawcutting, disconnecting, and removing the deactivated utility from the drain; capping the open ends of the remaining deactivated

utility; and patching the resulting holes in the gravity pipe with masonry, reinforcement, anchorage, doweling, waterproofing, bonding, formwork and concrete as directed by the Engineer so that the inside face of the drain is smooth and suitable for future CIPP lining.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item but are included for separate payment elsewhere; test pits, disposal of construction debris as solid waste; and temporary paving. Should the removal of the deactivated utility create such an impact to the gravity drain that segmental replacement of the drain is required in the opinion of the Engineer, pipeline replacement and field closures will be required and are covered elsewhere.

Item 2080.1 – OHM - Soil and Waste Management

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the following breakdown; a maximum of 3 percent of the Lump Sum will be paid upon the finished construction of the completed soil/fill staging area as specified and accepted by the Engineer. A maximum of 4 percent of the lump sum will be paid upon the submittal and acceptance of all related submittals, plans and shop drawings. A minimum of 3 percent of the lump sum will be paid at the complete removal and restoration of the staging area, as approved by the Engineer. The balance of the Lump Sum measurement for payment for will be on a percent of the Lump Sum bid remaining, calculated by dividing the elapsed time to date by the contractual construction time limit as approved by the Engineer. Deducts for work not performed as specified shall be applied.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Soil and Waste Management shall be based on the Lump Sum price complete for this item in the proposal. The Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Soil and Waste Management. This item includes the contractor locating and obtaining the rights and any necessary permits for a suitable soil/fill staging area. The work includes, but is not limited to; Environmental Professional; dewatering Professional; soil/fill sampling; analytical services; development and implementation of all submittals and plans specified including, but not limited to: Health and Safety Plan; Equipment and Personnel Decontamination Plan; Soil and Waste Management Plan; Dust, Vapor, and Odor Plan; Air Quality Control Plan; and a Spill and Discharge Control Plan; submittal of all required certifications; coordination with all parties affected and maintaining proper documentation necessary; disposal of wastes, such as construction-related waste and by-products, and Contractor-generated waste material, such as personal protective equipment, excess materials, debris, wash water, and any other waste materials not specifically addressed in other payment items; waste characterization sampling and analysis costs for the waste referenced above; construct and maintain a secure (enclosed with 8 foot high fencing and gate) soil/fill staging area for soil/fill stockpiling pending analytical testing, reuse, or disposal; all permits and administration fees; collecting and testing surface soil samples pre- and post- use of staging area; placement of polyethylene liner under piles; additional placement of bituminous or cement concrete as may be needed at the staging area; construction of segregated soil/fill bays; signage and lighting at the staging area; installation of sedimentation and erosion control at the staging area; construction of a truck wash down area; construction of a decontamination

area with wheel wash; maintenance including placement of daily polyethylene covers over existing stockpiles; performing dust control; street sweeping; vehicle wheel-washing in the staging areas as needed to control airborne dust and sediment from spreading beyond the staging area or presenting a health risk to the workers or public; day to day security measures; maintenance of the soil/fill stockpiles to avoid migration; and maintenance of the sedimentation and erosion control measures; and removal, hauling, and disposal of all items of which the staging area was constructed as well as the restoration of the site to pre-construction conditions.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material; re-use of soil and fill material on site as backfill; handling unknown materials; sedimentation and erosion control for other uses besides soil management (at the staging area); and all work associated with a staging area for other uses beyond soil and waste management.

02095 – Transportation and Disposal of Soil and Fill

GENERAL:
Measurement and Payment for Transportation and Disposal of Soil and Fill items shall be as listed below. Payment for lump sum items and unit price items shall constitute full payment for all fees, labor, materials and equipment required to perform the work; all supervision; all overhead items including but not limited to bonds, insurance, labor burden, profit, protections and cautions are also included. Payment for unit price items shall be as detailed below and as measured by the Engineer. The Contractor shall be made aware that for Transportation and Disposal of Soil and Fill unit price items, the actual quantities encountered may vary significantly from the estimated quantities presented in the Bid Schedule. The estimated quantities presented have been established for bid comparison purposes only and do not represent a warranty of work. In the event of quantity changes, the unit bid price shall be the basis for compensation or credit.

The following unit price payment items are for transporting and disposing excess soils and fill material encountered during the course of this contract. Management of soil/fill shall be in accordance with applicable regulations and technical specifications. The costs associated with disposing excess soil and fill other than allowed for in the following payment items shall be incorporated into the Contractor's lump sum bid price for soil and fill management. A minimum unit bid cost may be established for each unit price bid item. The Contractor is required to review the minimum unit bid price and increase it within the bid table as the Contractor sees fit. The Contractor is not obligated to accept the minimum unit price indicated but shall not be able to reduce it. The minimum unit price established may be below actual market cost and is provided to avoid unbalanced bidding. The Contractor is required to review the minimum unit price presented and develop a competitive unit price for inclusion in the bid table. Any bids received which do not present a unit price entered by the Contractor within the bid table or present a unit price below the minimum unit price established, shall be rejected as non-responsive.

The quantity of any pay item expressed as tons shall be subject to verification by the Engineer by calculation of the in-place weight using the horizontal and vertical trench pay limits defined

in the Contract Drawings, a bulking factor applicable to the soil type, and in place density tests supplied from a certified soil testing lab, hired by the Contractor. Should the quantity presented by the Contractor on the certified weight slips be significantly more (i.e. greater than 10%) than that as determined through the Engineer's calculations, the Contractor shall be compensated for the lesser tonnage. The Contractor shall receive no additional compensation for material removed outside of the approved pay limits. The Owner, and/or their representative, shall have the right to perform independent weighing of trucks. No payments will be made in cases of incomplete documentation of disposal. Payment will be at the unit price established set in the FORMS FOR GENERAL BID.

The quantity of any pay item expressed as cubic yards shall be as measured by the Engineer, per the horizontal and vertical trench pay widths established in the Drawings and confirmed through field engineering surveys performed by the Contractor. The Contractor shall receive no additional compensation for material removed outside of the approved pay limits. Payment will be at the unit price established set in the FORMS FOR GENERAL BID.

Preference is to be given to the most cost-effective option of either reusing excavated material on-site as fill or disposal off-site.

Item 2095.1 – OHM - Disposal of Soil – Less than RCS-1 (Class A)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Less than RCS-1 (Class A) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP MSR. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a reuse location that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Less than RCS-1 (Class A) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Less than RCS-1 (Class A). The work includes, but is not limited to; handle, load, transport, and dispose at a facility in accordance with the facility's acceptance criteria, all soil/fill which is unsuitable for on-site reuse and is defined as less than RCS-1; placing, grading and compacting the material at the disposal site as specified; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.2 – OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Daily Cover Unlined Landfill (Class B-1). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill which is unsuitable for on-site reuse and is defined as a non-hazardous solid waste suitable for reuse as daily cover at an unlined Massachusetts Landfill (as defined in MassDEP Policy #COMM-97-001); placing, grading and compacting the material at the disposal site as specified; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A level; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.3 – OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2)

METHOD OF MEASUREMENT:

Measurement for Payment for OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Daily Cover Lined Landfill (Class B-2). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill which is unsuitable for on-site reuse or disposal at one of the lesser unit price options and is defined as a non-hazardous solid waste suitable for reuse as daily cover at a lined Massachusetts Landfill (as defined in MassDEP Policy #COMM-97-001); placing, grading and compacting the material at the disposal facility as specified; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A or B-1 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.4 – OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching or Thermal Treatment (Class B-3/B-4)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching or Thermal Treatment (Class B-3/B-4) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required

by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching or Thermal Treatment (Class B-3/B-4) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Non-Hazardous Solid Waste Asphalt Batching or Thermal Treatment (Class B-3/B-4). For Class B-3, the work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, asphalt batching plant, all soil/fill which is suitable for recycling at an asphalt batching plant (as defined in MassDEP Policy WSC-94-400) and which is unsuitable for on-site reuse or off-site reuse or as daily cover at a Massachusetts Landfill; and all fees, permits, and taxes. For Class B-4, the work includes, but is not limited to; handle, load, transport, and dispose soil/fill which is unsuitable for in-state recycling, on-site reuse, off-site reuse as daily cover at a Massachusetts Landfill, or at an appropriately permitted asphalt batching plant; and all fees, permits, and taxes.

EXCLUSIONS:
For Class B-3, the following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, or B-2 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

For Class B-4, the following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, or B-3 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.5 – OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further

described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

It is the intent, that if the analytical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Non-Hazardous Solid Waste (Class B-5). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill (including embedded debris or foreign objects), which is not hazardous waste but is unsuitable for other non-hazardous recycling and disposal options listed above; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, or B-4 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.6 – OHM - Disposal of Soil with Debris – Non-Hazardous Solid Waste (Class B-6)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil Debris – Non-Hazardous Solid Waste (Class B-6) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

It is the intent, that if the analytical and physical characteristics of the material meet the criteria for this classification, but not that of lower levels of contamination, that the disposal be paid for at the unit price bid for this item. The Contractor shall use due diligence to identify a disposal facility that meets the criteria identified in Section 02080 (Item 1.4 Definitions). Payment for disposal of the material at a higher unit price

item shall be made only if the Contractor provides written certification that a reuse location that meets the criteria is not available; and only if approved in writing by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil with Debris– Non-Hazardous Solid Waste (Class B-6) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil with Debris– Non-Hazardous Solid Waste (Class B-6). The work includes, but is not limited to; handle, load, transport, and dispose at an appropriately permitted, solid waste facility, all soil/fill (including embedded debris or foreign objects), which is not hazardous waste but is unsuitable for other non-hazardous recycling and disposal options listed above; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, or B-4 or B-5 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.7 – OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Disposal of Soil as Non-Hazardous Waste (Class C-1)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Dispose of as Non-Hazardous (Class C-1) shall be on the basis of Tons of waste actually treated and disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP BWSC Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Dispose of as Non-Hazardous (Class C-1) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil – Treatment of RCRA Characteristically Hazardous Soil to De-Characterize and Dispose of as Non-Hazardous (Class C-1). The work includes, but is not limited to: treat on-site all soil/fill determined through testing to be characteristically hazardous waste to render the material characteristically non-hazardous; handle, load, transport, and dispose at an appropriately permitted facility, all soil/fill determined through testing to be hazardous

waste which has been treated on-site and subsequently determined through laboratory testing to be characteristically non-hazardous; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, B-4, B-5 or B-6 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.8 – OHM - Disposal of Soil - RCRA Hazardous Waste (Class C-2)

METHOD OF MEASUREMENT:
Measurement for Payment for OHM – Disposal of Soil - RCRA Hazardous Waste (Class C-2) shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate Uniform Hazardous Waste Manifest. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM – Disposal of Soil - RCRA Hazardous Waste (Class C-2) shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Soil - RCRA Hazardous Waste (Class C-2). The work includes, but is not limited to; handle, load, transport and dispose at an approved RCRA-permitted hazardous waste facility all soil and fill determined through testing to be hazardous waste; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which can be disposed of at the A, B-1, B-2, B-3, B-4, B-5, B-6 or C-1 levels; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; and disposal of construction debris.

Item 2095.9 - OHM - Disposal of Special Waste

METHOD OF MEASUREMENT:
Measurement for Payment for OHM - Disposal of Special Waste shall be on the basis of Tons of waste actually disposed, as measured at the disposal facility by certified scale, and documented on the return manifest or certified weight slip and accompanied by the appropriate MassDEP BWSC Bill of Lading form. Measurement shall be verified as described above and the lesser tonnage, as further described above, paid for. Material excavated outside of the pay limits indicated elsewhere in the Contract

Documents or as required by the Engineer shall be done at the Contractor's expense, at no additional cost to the Owner.

BASIS OF PAYMENT / INCLUSIONS:
Payment for OHM - Disposal of Special Waste shall be based on the per ton price complete for this item in the proposal. Under the per ton price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for OHM - Disposal of Special Waste. The work includes, but is not limited to; handle, load, haul, and dispose all soil and fill material defined as asbestos-containing waste; procuring all health and safety items; compliance with local ordinances and preparing appropriate waste manifests; and all fees, permits, and taxes.

EXCLUSIONS:
The following items are not included for payment under this item; transportation and disposal of soil and fill material which does not meet the definition of soil of this classification; reuse of soil and fill material on site as backfill; furnishing and installing replacement imported backfill; staging; disposal of bituminous concrete; disposal of construction debris; segregate, handle, stage, test, and characterize all soil and fill material suspected of containing asbestos-containing materials; protecting the excavation from accidental entry; and controlling windblown litter and the spread of airborne contaminants.

Item 2100.1 -- Pre-Construction Tree Pruning

METHOD OF MEASUREMENT:
Measurement for payment for Pre-Construction Tree Pruning will be based on the Lump Sum bid and shall be paid following full completion of pre-construction tree pruning as approved by the Owner's Representative.

BASIS OF PAYMENT:
Payment for work under Pre-Construction Tree Pruning will be based on the Lump Sum price bid for this item in the proposal and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to tree maintenance; and root and branch pruning before construction begins as specified or as otherwise required by the Owner's Representative or City Arborist.

EXCLUSIONS AND SPECIAL NOTES:
Payment for tree pruning during construction and post-construction shall not be paid for under this item and shall be paid for under the Tree Protection and Maintenance item.

Item 2100.2 -- Tree Protection and Maintenance

METHOD OF MEASUREMENT:
Measurement for payment for Tree Protection and Maintenance will be based on a percent of the Lump Sum bid calculated by dividing the elapsed time to date by the original Contractual construction time limit as approved by the Owner's Representative.

BASIS OF PAYMENT:
Payment for work under Tree Protection and Maintenance will be based on the Lump Sum price bid for this item in the proposal and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to protecting trees, including tree box at Special Mature Trees; tree maintenance; root and branch pruning during and after construction; furnishing, installing, maintaining, and removing drip line or tree pit fencing and/or tree wrap; covering exposed roots with moist burlap, mulch, or soil; watering trees; injecting fertilizer into trees; air spading of roots at trees; and removing, storing, maintaining and re-planting of targeted shrubs and plantings as specified or as otherwise required by the Owner's Representative or City arborist.

EXCLUSIONS AND SPECIAL NOTES:
Payment for pre-construction tree pruning shall not be paid for under this item and is paid for elsewhere.

Item 2100.3 -- Stump Removal

METHOD OF MEASUREMENT:
Measurement for payment for Stump Removal will be based on Each stump removed and approved by the Owner's Representative and City Arborist.

BASIS OF PAYMENT:
Payment for work under Stump Removal will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to; protection of water and gas services or other utility infrastructure that may exist within the root zone; removal and disposal of stump and roots and any other work incidental to the removal of the stump.

Item 2100.4 -- Tree Removal – Diameter Under 14"
Item 2100.5 -- Tree Removal – Diameter 14" – 36"

METHOD OF MEASUREMENT:
Measurement for payment for Tree Removal – Diameter Under 14" and Tree Removal – Diameter 14" – 36" shall be based on each tree removed as required by the City Arborist or as indicated on the contract documents. The tree size shall be the diameter of the tree as measured at 4.5-feet above the nearby ground surface.

BASIS OF PAYMENT:
Payment for work under Tree Removal will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, disposal, equipment, tools, and any other incidentals necessary for the completion of this work as specified, including but not limited to removal and disposal of tree, removal and disposal of tree stump and roots, protection of people, buildings, betterments, water and gas services or other utility infrastructure that may exist within the root zone,; coordination with overhead electric and other utilities for the removal of the tree; and any other work incidental to the removal of the tree.

EXCLUSIONS:
Stump and root removals are excluded from this item as it is covered under the Stump Removal Item.

2140.1 -- Treatment of Construction Dewatering

METHOD OF MEASUREMENT:
Measurement for payment for Treatment of Construction Dewatering will be on a per calendar day basis for treatment of dewatering, as measured by the Engineer. The Contractor shall be paid per calendar day that the dewatering treatment system(s) is onsite and operational, as defined by this Section, as required by the applicable dewatering permits, and as required by the Owner or Engineer. The Contractor shall not be compensated when the dewatering treatment system is onsite when not required by the Engineer or not required by the applicable dewatering permits. A dewatering treatment system shall include a settling tank, granular activated carbon (GAC) unit, filters, meters, hose connections, hoses and other treatment apparatus.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Treatment of Construction Dewatering will be based on the unit price bid for this item in the proposal. Under the unit price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, analytical testing, permit preparation and filing, and incidentals required for treatment of construction dewatering complete, as required and as required by the Engineer. The work includes but is not limited to mobilization and demobilization of the complete system(s); design of the system(s); furnishing and installing treatment system(s); maintenance of the treatment system(s); "breakdown", transportation and set-up of the treatment system(s) between on-site areas requiring treatment; sampling; reporting; maintenance of all logs and other documentation required; laboratory testing; coordination with permitting agencies and the Owner and Engineer; compliance with all permit requirements; removal, transportation, and stockpiling testing and disposal of all collected sediment; Dewatering Professional services; Dewatering Specialist services and all incidental work not included for payment elsewhere.

EXCLUSIONS
The Contractor shall not be compensated for construction dewatering under this item; including but not limited to de-siltation of construction dewatering, re-infiltrated construction dewatering; providing, installing and maintaining pumps and hoses; installation and maintenance of well points, deep wells and pump filters and screens; temporary power sources and all incidental work. Construction dewatering shall be covered in the Contractor's base bid, at no additional cost to the Owner. This is a Treatment Item only.

Item 2210.1 -- Test Pits

METHOD OF MEASUREMENT:
Measurement for payment for Test Pits will be based on the computed volume in Cubic Yards of material displaced during test pit excavation where required by the design drawings or as directed and measured by the Engineer. Depth of excavation will be measured to the average depth of the excavation. Irregularly deep parts of the exaction will not be used as the

excavation depth. The width of the excavation for this computation will be measured to an average width across the excavation. Irregularly wide parts of the excavation will not be considered the width of the excavation.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Test Pit shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Test Pits. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavate and backfill such materials as necessary to locate pipe, utilities and other possible obstructions as indicated on the Drawings, as required by the Owner or Engineer, or as approved by the Owner or Engineer prior to performing the test pit; temporary excavation support; furnishing and placing backfill per one of the approved methods; compaction and compaction testing; coordination with utility companies/owners; survey of existing conditions including horizontal and vertical utility alignments and reflecting the actual conditions on the Project's As-built Drawings; and construction dewatering and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS:
Test Pits completed for the Contractor's convenience and not indicated on the design drawings or directed or approved by the Engineer, or expressly paid for elsewhere, will be at the Contractor's expense and at no additional cost to the Owner. This exclusion includes advance test pitting at proposed catch basin locations, and exploratory excavations made during utility installation.

Test Pits completed for the purpose of locating existing utilities in proximity to catch basins and related structures shall not be paid for under this item. Test Pits completed for the purpose of soil characterization shall not be paid for under this item.

Test Pits completed for purposes of locating water services for making temporary water bypass or permanent water main connections shall not be paid for under this item.

Pre-trenching prior to the installation of temporary support of excavation or for any other purpose shall not be paid for herein unless approved by the Owner and Engineer in advance. Temporary paving of the test pit areas is not paid for here and are paid for elsewhere.

Item 2210.2 -- Test Pits for Drain Lateral Investigations

METHOD OF MEASUREMENT:
Measurement for payment for Test Pits for Drain Lateral Investigations will be based on the computed volume in Cubic Yards of material displaced during test pit excavation where required by the design drawings or as directed and measured by the Engineer. Depth of excavation for this computation will be measured to the average depth of the excavation. Irregularly deep parts of the excavation will not be used as the excavation depth. The width of the excavation for this computation will be measured to an average width across the excavation. Irregularly wide parts of the excavation will not be considered the width of the excavation.

BASIS OF PAYMENT / INCLUSIONS:

Test Pits completed for the purpose of locating existing utilities potentially in conflict with catch basins, drain manholes, and related storm drain system structures and piping shall be paid for under this item. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Test Pits for Drain Lateral Investigations. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavate and backfill such materials as necessary to locate pipe, utilities and other possible obstructions as indicated on the Drawings, as required by the Owner or Engineer, or as approved by the Owner or Engineer prior to performing the test pit; temporary excavation support; furnishing and placing backfill per one of the approved methods; compaction and compaction testing; coordination with utility companies/owners; survey and turnover of existing conditions information including horizontal and vertical utility alignments, and reflecting the actual conditions on the Project's As-built Drawings; and construction dewatering and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS:
Test Pits completed for the Contractor's convenience and not indicated on the design drawings or directed or approved by the Engineer, or expressly paid for elsewhere, will be at the Contractor's expense and at no additional cost to the Owner. This exclusion includes exploratory excavations made during utility installation.

Test Pits completed for purposes of locating water services for making temporary water bypass or permanent water main connections shall not be paid for under this item. Test Pits completed for the purpose of soil characterization shall not be paid for under this item.

Pre-trenching prior to the installation of temporary support of excavation or for any other purpose shall not be paid for herein unless approved by the Owner and Engineer in advance. Temporary paving of the test pit areas is not paid for here and are paid for elsewhere.

Item 2210.3 -- Controlled Density Fill for Backfill

METHOD OF MEASUREMENT:
Measurement for payment for Controlled Density Fill for Backfill shall be made on the basis of Cubic Yards placed within the trench width pay limits shown or indicated elsewhere in the Construction Documents or as otherwise directed or approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Controlled Density Fill for Backfill shall be based on the cubic yards installed complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Controlled Density Fill for Backfill. The work includes but is not limited to; furnish and install controlled density fill for backfill under existing utilities, in areas of difficult compaction, and where required by the Engineer; temporary bulkheads and forms; furnishing and installing filter fabric; and material testing.

SPECIAL NOTES/EXCLUSIONS:
Controlled Density Fill used for the abandonment of pipes and structures will not be paid for under this item.

Item 2210.4 -- Unclassified Excavation

METHOD OF MEASUREMENT:
Measurement for payment for Unclassified Excavation shall be made on the basis of Cubic Yards of bituminous pavement, reinforced concrete subbase, concrete and cobblestones excavated in the roadway as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer. The cubic yard volume will be calculated based on the thickness and area of the roadway sections removed.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Unclassified Excavation shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of bituminous pavement, reinforced concrete subbase, concrete and cobblestones excavated in the roadway. The work includes but is not limited to; saw cutting; excavating bituminous pavement, reinforced concrete subbase, concrete and cobblestones; relocation and stockpiling excavated materials; and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS OR SPECIAL NOTES:
This item does not include payment for removal of temporary asphalt as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of existing sidewalks (all types) as it is paid for elsewhere in the Contract Documents. This item does not include transportation and disposal of bituminous concrete or concrete debris, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of soil or gravel, as it is paid for elsewhere in the Contract Documents.

Item 2210.5 -- Roadway Earth Excavation

METHOD OF MEASUREMENT:
Measurement for payment for Roadway Earth Excavation shall be made on the basis of Cubic Yards of gravel and soil, excavated to final roadway subbase grade as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Roadway Earth Excavation shall be based on the cubic yards excavated complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the removal of gravel and other soils excavated to final subbase grade within limits of full depth construction. The work includes, but is not limited to; excavating gravel and soil; transporting material to/from soil staging area; reuse of existing gravel or soil when suitable; and all work incidental thereto and all work not specifically included for payment under other items.

EXCLUSIONS OR SPECIAL NOTES:
This item does not include payment for removal of asphalt, temporary asphalt, gravel and/or soil within the trench limits of structures, manholes, pipe, or other subsurface work within the roadway as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of existing sidewalks (all types) as it is paid for elsewhere in the Contract

Documents. This item does not include transportation and disposal of Roadway Earth Excavation, as it is paid for elsewhere in the Contract Documents. This item does not include payment for removal of concrete, asphalt, and cobbles, as it is paid for elsewhere in the Contract Documents. This item does not include final grading of subbase and work related to cold planing, as it is paid for elsewhere in the Contract Documents. Excess or unsuitable Roadway Earth Excavation shall be disposed of under soil management and disposal items.

Item 2210.6 -- Dense Graded Crushed Stone

METHOD OF MEASUREMENT:
Measurement for payment for Dense Graded Crushed Stone shall be made on the basis of Cubic Yards placed during full depth construction between limits of proposed curbing as indicated elsewhere in the Construction Documents or as otherwise approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Dense Graded Crushed Stone shall be based on the cubic yards installed complete for this item in the proposal. Under the per cubic yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for placement of Dense Graded Crushed Stone. The work includes, but is not limited to; furnish and install Dense Graded Crushed Stone where indicated, where there is insufficient existing roadway base material, and where required by the Engineer; material testing; compaction; and compaction testing.

SPECIAL NOTES/EXCLUSIONS:
Dense Graded Crushed Stone used as trench backfill and for sidewalk construction will not be paid for under this item and are covered under separate pay items. Dense Graded Crushed Stone shall only be paid for work related to full depth roadway construction, or as otherwise directed by the Engineer.

Item 2210.7 -- 3/4-Inch Crushed Stone

METHOD OF MEASUREMENT:
Measurement for payment for 3/4-inch Crushed Stone will be on the basis of cubic yards of material placed and compacted to the designated thickness as directed by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 3/4-inch Crushed Stone shall be based on the Cubic Yards installed complete under the unit price bid for this item in the proposal. Under the unit price bid, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installation of crushed stone, as directed and approved by the Engineer and as may be indicated in the Contract Documents. This item may be used at the discretion of the Engineer to replace unsuitable soils below proposed infrastructure. The work includes, but is not limited to; furnish and place crushed stone, furnish and install filter fabric if required, and all work incidental thereto.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not include for payment under this item: installation of crushed stone and filter fabric for pipe or structure bedding, curb bedding, fire hydrant backfill, stop and

waste curb stop backfill, raised intersection and crosswalk backfill, bollard backfill, porous concrete screeding and reservoir course, or biobasin backfill, as they are included for payment elsewhere in the Contract Documents.

Item 2210.8 -- Clean Washed 3/4-Inch Crushed Stone

METHOD OF MEASUREMENT:
Measurement for payment for Clean Washed 3/4-inch Crushed Stone will be on the basis of Cubic Yards of material placed and compacted to the designated thickness as specified or directed by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Clean Washed 3/4-inch Crushed Stone shall be based on the Cubic Yards installed complete under the unit price bid for this item in the proposal. Under the unit price bid, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installation of crushed stone at biocell locations, as directed and approved by the Engineer and as may be indicated in the Contract Documents. The work includes, but is not limited to; excavation; furnish and place clean washed crushed stone and all work incidental thereto.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item: ¾-Inch Crushed Stone, installation of crushed stone for pipe or structure bedding, curb bedding, fire hydrant backfill, stop and waste curb stop backfill, raised intersection and crosswalk backfill, bollard backfill, or porous concrete screeding and reservoir course, as they are included for payment elsewhere in the Contract Documents.

Item 2210.9 -- CCTV of Sewer/Drain Laterals on Washington Street

METHOD OF MEASUREMENT:
Measurement for payment for CCTV of Sewer/Drain Laterals on Washington Street shall be based on the number of CCTV of Sewer/Drain Laterals on Washington Street, completed, and as measured by the Engineer and where indicated on the Contract Drawings.

BASIS OF PAYMENT / INCLUSIONS:
Payment for CCTV of Sewer/Drain Laterals on Washington Street shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to perform mainline CCTV inspection to locate the laterals, CCTV inspection of the service laterals as indicated on the Drawings and as directed. The work includes, but is not limited to: providing all CCTV equipment and operators; cleaning and flushing the pipe to obtain clear and usable video; locating and accessing each pipe lateral from the upstream or downstream manhole, accessing the lateral pipe by removing and repairing a short section; recording the inspection in digital format and per contract standards; providing CCTV logs of the inspected pipes; and identifying all defects and locations of repairs.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item: test pits only as directed by the Owner or Engineer should conditions require that the lateral be excavated to create access

for lateral CCTV inspection, as they are included for payment elsewhere in the Contract Documents.

Item 2252.1 -- Type-1 Manhole – Precast 3-Foot and 4-Foot Diameter
Item 2252.2 -- Type-1 Manhole – Precast 5-Foot Diameter
Item 2252.3 -- Type-1 Manhole – Precast 6-Foot Diameter
Item 2252.4 – Type-1 Manhole – Precast 8-Foot Diameter
Item 2252.5 – Type-4 Sump Manhole – Precast 3-Foot and 4-Foot Diameter
Item 2252.6 – Type-6 Manhole Over Existing Utility – Precast 4-Foot Diameter
Item 2252.7 – Type-6 Manhole Over Existing Utility – Precast 6-Foot Diameter
Item 2252.8 – Type-7 Manhole – Precast (3-Foot x 4-Foot Rectangular)

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the Vertical Feet of complete and functional manholes of a given type and size as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be from the interior floor of the structure to finished grade.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of manholes complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: saw cutting bituminous and reinforced concrete; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; construction dewatering; filter fabric as required; placement of bedding, including compaction; precast manhole sections with frames, covers, masonry chimney, hoods (if applicable), appurtenances, bench, and casing sleeve and carrier pipe for existing utility (if applicable); bituminous damp proofing (if applicable); furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included under this pay item.

Manholes installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of

groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 2252.9 -- Manhole – Remove and Replace Existing Frame and Cover

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of complete and functional manhole frame and covers removed and replaced as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and inspection of removal and replacement of existing manhole frame and grate complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; manhole frames, covers, adjusting the masonry chimney, appurtenances;; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

Adjustment of the replaced frame and cover to final grade, and any adjustments to intermediate grades, are included under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; procurement of off-site common fill; procurement, installation, compaction of CDF; and removal of frames and covers that are part of a manhole demolition or abandonment.

Item 2252.10 – Modify Top of Existing Drain or Sewer Structure

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of existing drain or sewer structure top modified as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete modification of the top of an existing sewer or drain structure as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; protection of existing manhole; rotating the top pre-cast section into a new position; re-building the masonry chimney; bituminous damp proofing (if applicable); furnishing, placing and

compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

Adjustment of the existing frame and cover or grate to final grade, and any adjustments to intermediate grades, are included in under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; procurement, installation, and compaction of CDF; adjustments to proposed manholes; adjusting castings of unmodified existing structures for paving.

Item 2252.11 – Modify Interior of Existing Drain or Sewer Structure

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of existing drain or sewer structure interiors modified as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete modification of the interior of an existing sewer or drain structure as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: selective demolition of formed concrete and brick work; patching and grouting; bonding adhesives; rebuilding inverts and benches; protection of existing manhole; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: flow bypass, disposal of bituminous concrete and construction debris.

Item 2500.1 – Temporary Hot Mix Asphalt – (Trench Width and Temporary Ramps/Sidewalk)

METHOD OF MEASUREMENT:
Measurement for Payment for Temporary Hot Mix Asphalt – (Trench Width and Temporary Ramps/Sidewalks) shall be based on the Tons of temporary asphalt placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and trench widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench width) x L' (trench length) x D' (trench depth) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is greater than 10% lower than the tonnage on the pavement slips, the lesser tonnage shall be paid to the

Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Payment for Temporary Hot Mix Asphalt – (Trench Width and Temporary Ramps/Sidewalks) shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix temporary paving within the limits of the trenches to depth and width indicated within the payment limits as shown in the Contract Documents, temporary ramps, sidewalks, bypass piping installation and removals, or other temporary paving requested or authorized by the Engineer. The work includes but is not limited to the following: raising and resetting existing structures, castings and boxes if needed; installation and compaction of hot mix temporary asphalt to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; and all incidental work not included for payment elsewhere. The Temporary paving item includes all costs associated with the removal, but not disposal, of the Temporary Paving ahead of final restorations.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; furnish and install gravel subgrade; hot mix asphalt for final paving; back-of-sidewalk restoration; disposal of all temporary paving; and pavement installed to replace asphalt damaged by the Contractor.

Item 2500.2 --- Hot Mix Asphalt Intermediate Course – Full Width (19.0 MM Superpave SIC-19.0)

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Intermediate Course shall be based on the Tons of intermediate course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench width) x L' (trench length) x D' (trench depth) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is greater than 10% lower than the tonnage on the pavement slips, the lesser tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Intermediate Course shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt intermediate course full roadway width to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; locating, raising and resetting castings and boxes installed under this contract or otherwise owned by the City; installation and compaction of hot mix

asphalt intermediate course to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for Shared Streets, and pavement installed to replace asphalt damaged by the Contractor.

Item 2500.3 --- Hot Mix Asphalt Intermediate Course – Full Width – Shared Street (19.0 MM Superpave SIC-19.0)

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Intermediate Course for Shared Streets (Worcester Street, Suffolk Street, Pine Street) shall be based on the Tons of intermediate course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench width) x L' (trench length) x D' (trench depth) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is greater than 10% lower than the tonnage on the pavement slips, the lesser tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Intermediate Course for Shared Streets shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt intermediate course full roadway width on shared streets to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; locating, raising and resetting castings and boxes installed under this contract or otherwise owned by the City; installation and compaction of hot mix asphalt intermediate course to the depth and width and in the area specified; any alternative installation methods required to meet the accessible slopes and grades shown on the Contract Drawings; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere. Special attention shall be paid to meeting the slopes and grades shown on the Contract Drawings which are designed to meet accessible design standards for pedestrians within the roadway while maintaining positive drainage. This Item is to be used on Shared Streets to reflect the greater placement accuracy required by the tighter tolerances necessary for Shared Street construction. The contractor should consider whether additional survey, reduced production rates, revised equipment or methods, greater oversight, and/or additional support will be needed to meet the more restrictive tolerances.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for intermediate course on non-shared streets; and pavement installed to replace asphalt damaged by the Contractor.

Item 2500.4 --- Hot Mix Asphalt Surface Course – Full Width (12.5 MM Superpave SSC-12.5)

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Surface Course shall be based on the Tons of surface course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench width) x L' (trench length) x D' (trench depth) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is greater than 10% lower than the tonnage on the pavement slips, the lesser tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Surface Course shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt surface course full roadway width to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; locating, raising and resetting castings and boxes installed under this contract or otherwise owned by the City; coordination with private utilities to raise castings prior to final paving; furnish and install tack coat; installation and compaction of hot mix asphalt surface course to the depth and width and in the area specified; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere. This Item also includes furnishing and installing a shim course of ½-inch or ¾-inch intermediate course paving where necessary to meet the grades indicated in the areas of Cold Plane to Concrete Slab on Harvard Street.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for surface course on Shared Streets; and pavement installed to replace asphalt damaged by the Contractor.

Item 2500.5 --- Hot Mix Asphalt Surface Course – Full Width – Shared Street (12.5 MM Superpave SSC-12.5)

METHOD OF MEASUREMENT:
Measurement for Payment for Hot Mix Asphalt Surface Course for Shared Streets (Worcester Street, Suffolk Street, Pine Street) shall be based on the Tons of surface course placed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. Tonnage of pavement placed will be verified through calculation based on the actual thickness and roadway widths and lengths or the pavement thicknesses, widths, and lengths defined in the Contract, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench width) x L' (trench length) x D' (trench depth) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is greater than 10% lower than the tonnage on the pavement slips, the lesser tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Payment for Hot Mix Asphalt Surface Course for Shared Streets shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hot mix asphalt surface course full roadway width on shared streets to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; locating, raising and resetting castings and boxes installed under this contract or otherwise owned by the City; coordination with private utilities to raise castings prior to final paving; furnish and install tack coat; installation and compaction of hot mix asphalt surface course to the depth and width and in the area specified; any alternative installation methods required to meet the accessible slopes and grades shown on the Contract Drawings; hand placement and compaction of hot mix asphalt around structures, aprons, driveways and as required; power sweeping; keyways and other jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere. Special attention shall be paid to meeting the slopes and grades shown on the Contract Drawings which are designed to meet accessible design standards for pedestrian pathways within the roadway while maintaining positive drainage. This Item is to be used on Shared Streets to reflect the greater placement accuracy required by the tighter tolerances necessary for Shared Street construction. The contractor should consider whether additional survey, reduced production rates, revised equipment or methods, greater oversight, and/or additional support will be needed to meet the more restrictive tolerances.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for surface course on non-shared streets; and pavement installed to replace asphalt damaged by the Contractor.

Item 2500.6 -- Hand Placed Hot Mix Asphalt

METHOD OF MEASUREMENT:
Measurement for Payment for Hand Placed Hot Mix Asphalt shall be based on the Tons of hand placed hot mix asphalt placed complete, to limits as required by the Engineer or Owner and as measured by the Engineer. Tonnage of pavement paid will be calculated based on the actual thickness measured, width of placement measured and length of placement measured or the

pavement thicknesses, widths, and lengths defined in the Contract, if appropriate, whichever is less. The formula for calculating the tonnage of pavement shall be W' (trench width) x L' (trench length) x D' (trench depth) x 0.075 ton/cf = tons. Calculated tonnage will be compared to the actual tonnage placed as submitted on pavement tonnage slips. If the tonnage calculated is greater than 10% lower than the tonnage on the pavement slips, the lesser tonnage shall be paid to the Contractor. Placement of pavement to excess thicknesses and outside the limits defined in the Contract Documents or as required shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Payment for Hand Placed Hot Mix Asphalt shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install hand placed hot mix asphalt to depths, widths, and lengths required by the Owner or Engineer. The work includes, but is not limited to the following; hand placement and compaction of hot mix asphalt intermediate or surface course for raised crosswalk ramps, raised crosswalks, and raised intersections and to the depth, width and length and in the area required by the Owner or Engineer; jointing between new and existing asphalt; furnish and place tack coat on all edges; and all incidental work not included for payment elsewhere.

All locations of hand placement of hot mix asphalt shall be approved by the Engineer prior to installation and payment.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for brick sidewalk; hot mix asphalt for aprons around castings or other transitions after cold planning and before final paving; hot mix asphalt at the back of sidewalk.

Item 2500.7 – Cold Plane 2-Inch - Full Width

METHOD OF MEASUREMENT:
Measurement for the Cold Plane 2-Inch, Full Width will be based on the Square Yards of hot mix asphalt pavement cold planned to a depth of 2-inches, as measured by the Engineer to the payment limits described in the Contract Drawings and Specifications.

BASIS OF PAYMENT:
Payment for Cold Plane 2-Inch, Full Width shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to cold plane 2-inches to the pay limits indicated on the Drawings and as specified. The work includes removing, hauling, stockpiling, and disposing or reusing of cold planned asphalt material; sweeping after the cold planning operation; removal of asphalt from around existing structures and castings; replacement of castings damaged by the contractor's operations with new castings; providing transitions at the limits of the cold planning; providing and maintaining temporary asphalt aprons at transitions and castings until final paving; maintaining the cold planed surface until final paving; providing temporary pavement markings, as required, until final paving; and all incidental work not included for payment elsewhere.

Item 2500.8 – Cold Plane to Concrete Slab

METHOD OF MEASUREMENT:
Measurement for the Cold Plane to Concrete Slab will be based on the Square Yards of hot mix asphalt cold planed over existing concrete slab to the concrete slab surface in the areas indicated on the Contract Drawings, as measured by the Engineer to the payment limits described in the Contract Drawings and Specifications.

BASIS OF PAYMENT:
Payment for Cold Plane to Concrete Slab shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, additional teeth for the milling machines, and incidentals required to cold plane to the concrete slab surface indicated on the Contract Drawings and to the pay limits indicated on the Drawings and as specified. The work includes removing, hauling, stockpiling, and disposing or reusing of cold planned asphalt and concrete material; sweeping after the cold planning operation; removal of asphalt and concrete from around existing structures and castings; replacement of castings damaged by the contractor's operations with new castings; providing transitions at the limits of the cold planning; providing and maintaining temporary asphalt aprons at transitions and castings until final paving; maintaining the cold planed surface until final paving; providing temporary pavement markings, as required, until final paving; and all incidental work not included for payment elsewhere. This item also includes; removing all loose material from the concrete surface, cleaning to the concrete slab surface, and providing tack coat prior to shim or final paving, This Item is to be used for the north side of Harvard Street in areas where the existing concrete slab is scheduled to remain and is generally about 3.5" to 4" below the roadway surface. The contractor shall assume an increased quantity of teeth to be replaced for the milling equipment within these areas.

Item 2500.9 – Fine Grading and Compacting Subbase Under Roadways

METHOD OF MEASUREMENT:
Measurement for the Fine Grading and Compacting Subbase Under Roadways will be based on the Square Yards of roadway sub-base graded to its final elevations, as measured by the Engineer to the payment limits described in the Contract Drawings and Specifications.

BASIS OF PAYMENT:
Payment for the Fine Grading and Compacting Subbase Under Roadways shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to fine grade the roadway sub-base, to the pay limits indicated on the Drawings and as specified. The work includes providing, removing, hauling, stockpiling, and disposing or reusing of excess road sub-base; final grading; layout by a professional land surveyor registered in the Commonwealth of Massachusetts of final grades, elevations and alignments; maintaining the graded sub-base until final paving; and all incidental work not included for payment elsewhere.

Item 2500.10 – Fine Grading and Compacting Subbase Under Roadways – Shared Streets

METHOD OF MEASUREMENT:

Measurement for Fine Grading and Compacting Subbase Under Roadways – Shared Streets (Worcester Street, Suffolk Street, Pine Street and Ashburton Street) will be based on the Square Yards of roadway sub-base graded to its final elevations, as measured by the Engineer to the payment limits described in the Contract Drawings and Specifications. This Item is for Shared Streets only and will be measured from the centerline of the raised crossings or if there are no raised crossings, actual Shared Street limits will be used.

BASIS OF PAYMENT:
Payment for the Fine Grading and Compacting Subbase Under Roadways – Shared Streets shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to fine grade the roadway sub-base, to the pay limits indicated on the Drawings and as specified. The work includes removing, hauling, stockpiling, and disposing or reusing of excess road sub-base; final grading to a tolerance that is stricter than required for typical roadway grading; layout by a professional land surveyor registered in the Commonwealth of Massachusetts of final grades, elevations and alignments; maintaining the graded sub-base until final paving; and all incidental work not included for payment elsewhere. This Item is to be used on Shared Streets to reflect the greater grading accuracy required by the tighter tolerances necessary for Shared Street construction. The contractor should consider whether additional survey, reduced production rates, greater oversight, and/or additional support will be needed to meet the more restrictive tolerances.

Item 2500.11 -- Hot Poured Rubberized Asphalt Sealing

METHOD OF MEASUREMENT:
Measurement for Hot Poured Rubberized Asphalt Sealer will be based on the Linear Foot of Hot Poured Rubberized Asphalt Sealer placed, as measured by the Engineer and where indicated on the Contract Drawings.

BASIS OF PAYMENT:
Payment for Hot Poured Rubberized Asphalt Sealer shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to place Hot Poured Rubberized Asphalt Sealer where indicated on the Drawings and as specified or directed. The work includes cleaning the surface prior to placing the sealer; prep all surfaces prior to placing the sealer; furnishing and placing the hot poured rubberized asphalt sealer; protecting areas where the sealer was installed; and all incidental work not included for payment elsewhere.

Item 2500.12 -- Shared Streets Pavement Remediation – Spot Repairs

METHOD OF MEASUREMENT:
Measurement for Shared Streets Pavement Remediation – Spot Repairs will be based on the number of spot repairs completed, as measured by the Engineer. Spot Repairs will not be paid until the roadway is determined to meet accessibility requirements for a pedestrian pathway and is sloped to maintain positive drainage.

BASIS OF PAYMENT:

Payment for Shared Streets Pavement Remediation – Spot Repairs shall be based on the unit price bid for this item in the proposal. Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to replace or remediate the final hot mix asphalt pavement on shared streets (Worcester Street, Suffolk Street, Pine Street) in order to create an accessible pedestrian roadway and while maintaining positive slopes for drainage. Each spot repair may include remediation by full depth replacement, cold planning and overlay, infrared shaping, or other methods to alter the final roadway grades. Each spot repair may include a single continuous repair with area up to 500 square feet as directed and approved by the Engineer. This Item is not intended for use due to contractor's failure to meet final grades as indicated, but will be used when conditions beyond the contractor's control make rework of final paving surface necessary as determined by the Engineer.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; hot mix asphalt for temporary paving; hot mix asphalt for intermediate and/or surface course on shared streets; cold planning; hot poured rubberized asphalt sealer; and spot repairs completed to address roadways damaged by the Contractor.

Item 2500.13 -- Full Depth Construction Above MWRA Water Main

METHOD OF MEASUREMENT:
Measurement for Payment for Full Depth Reconstruction Above MWRA Water Main shall be based on the Square Yards of roadway and sidewalk impacted by MWRA permit limitations as required by the MWRA and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for Full Depth Reconstruction Above MWRA Water Main shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, specialized equipment, and incidentals required to install 4" dense grade crushed stone and two 3" lifts of hot mix asphalt intermediate course to depth and width indicated above the MWRA Water Main, complete, as shown in the Contract Documents. The work includes, but is not limited to the following; coordination with MWRA to comply with all requirements of the 8(m) Permit – expected requirements are outlined in Section 01060, including the development and submission of pipeline loading calculations (prepared by a professional engineer licensed in the state of Massachusetts) for MWRA approval; all MWRA required specialized compaction methods; installation and compaction of subbase and hot mix asphalt courses to the depth and width and in the area specified; and all incidental work not included for payment elsewhere. In order to comply with MWRA loading limitations, the work may include alternative methods for pavement and subgrade soil removal, dense graded crushed stone installation and compaction, special paving sequencing, truck and equipment access restrictions, and off-hours access restrictions.

SPECIAL NOTES ON EXCLUSIONS:
This item is intended to cover additional costs for the Contractor to comply with all MWRA requirements for paving above the existing MWRA water main and excludes all other pay items associated with full depth reconstruction which shall also be measured and paid under the respective items.

Item 2500.14 -- 8-Inch and 10-Inch Cement Concrete Roadway

METHOD OF MEASUREMENT:
Measurement for Payment for 8-Inch and 10-Inch Cement Concrete Roadway shall be based on the square yards of reinforced concrete roadway installed complete, to a maximum width defined by the payment limits shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer. This item is for installation of the roadway on Ashburton Place and on Shared Street concrete roadway ramps and raised crossings where indicated..

BASIS OF PAYMENT:
Payment for 8-Inch and 10-Inch Cement Concrete Roadway shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install cement concrete roadway on Ashburton Place and on Shared Street concrete roadway ramps and raised crossings where indicated to depth and width indicated within the payment limits, complete, as shown in the Contract Documents or at the requirements of the Engineer. The work includes, but is not limited to the following; locating, raising and resetting castings and boxes installed under this contract or otherwise owned by the City; coordination with private utilities to raise castings prior to final paving; forming and placing cement concrete roadway to the depth and width and in the area specified; installing wire mesh reinforcement; installing expansion joints; power sweeping; keyways and other jointing between new and existing roadways; furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the concrete; furnish and place the curing compound; protect and cure the concrete after placement; furnish and place alkaline resistant protective penetrating concrete sealer; and all incidental work not included for payment elsewhere. Special attention shall be paid to meeting the slopes and grades shown on the Contract Drawings which are designed to meet accessible design standards for pedestrian pathways within the roadway while maintaining positive drainage.

SPECIAL NOTES ON EXCLUSIONS:
Items not included for payment herein include but are not limited to; cement concrete sidewalks, driveways, and pedestrian ramps; cement concrete base for raised crosswalks and intersections; and cement concrete roadway installed to replace roadway damaged by the Contractor.

Item 2520.1 – Flexible Porous Paving

METHOD OF MEASUREMENT:
Measurement for Flexible Porous Paving shall be based on the actual number of Square Yards of Flexible Porous Paving placed, complete within the limits shown on the Drawings or as directed by the Owner's Representative and as measured by the Owner's Representative. Placement of Flexible Porous Paving outside the limits defined in the Drawings, without approval by the Engineer, shall be at no additional cost to the Owner.

BASIS OF PAYMENT:
Under the Unit Price for Flexible Porous Paving, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals, including 5-year warranty, excavation of existing sidewalk, disposal of existing removed sidewalk, temporary asphalt, and crushed stone subbase required to install Flexible Porous Paving to the depth and width indicated, complete, as shown in the Drawings or at the direction of the Owner's Representative. Contractor shall note that limits of Flexible Porous Paving may be adjusted by the Engineer during construction based on the location and elevation of existing root systems located after removing the existing sidewalk.

Item 2524.1 – 4-Inch Cement Concrete Sidewalks

METHOD OF MEASUREMENT:
Measurement for 4-inch Cement Concrete Sidewalks shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 4-inch Cement Concrete Sidewalks shall be based on the square yard of 4-in Cement Concrete Sidewalks installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 4-in Cement Concrete Sidewalks as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs, or other items obstructing the construction of the sidewalk; excavate, removal and disposal of existing sidewalks and subbase as required; install, grade, compact, and test compaction of gravel sub-base and sub-grade; raise and adjust water and gas service boxes, gate boxes, frames and covers, and other castings; furnish, furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place alkaline resistant protective penetrating concrete sealer; remove and dispose of formwork; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; and 6-in sidewalks at driveways, pedestrian ramps, intersections and shared streets.

Item 2524.2 – 6-Inch Cement Concrete Sidewalks at Driveways
Item 2524.3 – 6-Inch Cement Concrete Sidewalks at Pedestrian Ramps and Intersections

METHOD OF MEASUREMENT:
Measurement for 6-inch Cement Concrete Sidewalks at Driveways, Pedestrian Ramps and Intersections shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 6-inch Cement Concrete Sidewalks at Driveways, Pedestrian Ramps and Intersections shall be based on the square yard of 6-inch Cement Concrete Sidewalks installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 6-inch Cement Concrete Sidewalks as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the sidewalk and driveway; excavate, removal and disposal of existing sidewalks and subbase as required; furnish, install, grade, compact and test compaction of gravel subbase and sub-grade; raise and adjust water and gas service boxes, gate boxes, frames and covers and other castings; furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place alkaline resistant protective penetrating concrete sealer; remove and dispose of formwork; reinforcing; backfilling; furnish and install loam and seed, mulch, or other backing and/or adjacent material specified including tree pits and grass areas; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; 4-in sidewalks; and 6-in sidewalks on shared streets.

Item 2524.4 – 6-Inch Cement Concrete Sidewalks and Driveways – Shared Streets

METHOD OF MEASUREMENT:
Measurement for 6-inch Cement Concrete Sidewalks and Driveways – Shared Streets shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for 6-inch Cement Concrete Sidewalks and Driveways – Shared Streets (Suffolk, Worcester, and Pine Streets) shall be based on the square yard of 6-inch Cement Concrete Sidewalks and Driveways installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of 6-inch Cement Concrete Sidewalks as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the sidewalk and driveway; excavate, removal and disposal of existing sidewalks and subbase as required; furnish, install, grade, compact and test compaction of gravel subbase and sub-grade; raise and adjust water and gas service boxes, gate boxes, frames and covers and other castings; furnish and install Cement Concrete complete with micro-fiber, expansion joints, and formwork; finish the Concrete; furnish and place the curing compound; protect the concrete after placement; furnish and place alkaline resistant protective penetrating concrete sealer; remove and dispose of formwork; reinforcing; backfilling; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:

The following items are not included for payment under this item; sidewalks installed to replace sidewalks damaged by the Contractor during construction; 4-in sidewalks; and 6-in sidewalks at pedestrian ramps and intersections.

Item 2524.5 – Wire Cut Bricks on 4-Inch Bituminous Concrete Base

METHOD OF MEASUREMENT:
Measurement for Wire Cut Bricks on 4-inch Bituminous Concrete Base shall be based on the square yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Wire Cut Bricks on 4-inch Bituminous Concrete Base shall be based on the square yard of brick sidewalk and feature strips installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of Brick as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; remove, transport, stack, protect, and reset all parking meters, signs or other items obstructing the construction of the wire cut brick; removal and disposing existing concrete, bricks, and subbase as required furnish, install, grade, compact, and test compaction of gravel subbase and sub-grade; raise and adjust water and gas service boxes, gate boxes, frames and covers, and other castings;; furnish and install hot mix asphalt base; compaction of the hot mix asphalt base; protect the asphalt after placement; furnish and install wire cut bricks; furnish and install iron edge with spiral galvanized steel spikes; furnish and install ¾" asphalt modified sand setting bed; applying asphalt tack coat and neoprene modified asphalt tack coat; sweeping with dry sand/ cement mix; compaction of bricks; backfilling; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

Item 2524.6 – Cement Concrete Base for Raised Crosswalks and Intersections

METHOD OF MEASUREMENT:
Measurement for Cement Concrete Base for Raised Crosswalks and Intersections shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Cement Concrete Base for Raised Crosswalks and Intersections shall be based on the square yard of concrete as detailed in the Contract Drawings installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of cement concrete base as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; remove, transport, stack, protect parking meters, signs, or other items obstructing the construction of the crosswalk or intersection; removal of existing pavement; excavate, removal, and disposal of existing sidewalks within limits of crosswalk or intersection; grade, compact, and test compaction of sub-base and sub-grade; furnish and install cement concrete base; raise and adjust water and gas service boxes, gate boxes, frames and covers, and other castings; and all other work not included for payment elsewhere.

Item 2524.7 -- Remove and Reset/Relocate Granite Curb (Straight, Transition, and Curved)

METHOD OF MEASUREMENT:
Measurement for Remove and Reset/Relocate Granite Curb (Straight, Transition, and Curved) shall be based on the Linear Foot of granite curb removed and reset installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer. Payment will be made only after the curb has been reset.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Remove and Reset/Relocate Granite Curb (Straight, Transition, and Curved) shall be based on the linear foot of granite curb removed and reset or relocate complete for this item in the proposal. Under the linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and reset and/or relocate existing granite curb as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cut; excavate, maintenance and protection of roots; remove, transport, stack, protect, and reset straight, transition, and curved granite curb; furnish, install, grade, compact and test compaction of sub-base and sub-grade; modify the existing granite curb; furnish and install cement concrete; point the granite curb; backfilling;; and all other work not included for payment elsewhere. This Item includes Removed and Reset Curb on Shared Streets.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; and new granite curb; and Shared Street Landscaping Curb.

Item 2524.8 -- Remove and Discard Granite Curb (Straight, Transition, and Curved)

METHOD OF MEASUREMENT:
Measurement for Remove and Discard Granite Curb (Straight, Transition, and Curved) shall be based on the Linear Foot of granite curb removed and discarded, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer. Payment will be made only after the curb has been discarded.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Remove and Discard Granite Curb (Straight, Transition, and Curved) shall be based on the linear foot of Granite Curb removed from an existing alignment and discarded. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and dispose of existing granite curb as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cut; excavate, maintenance and protection of roots; remove and transport existing damaged or unsalvageable straight, transition, and curved granite curb; dispose; and backfilling; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and discarded to accommodate the Contractor's means and methods.

Item 2524.9 – New Granite Curb Type VA 4 (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for New Granite Curb Type VA4 (Straight and Curved) shall be based on the Linear Foot of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb Type VA 4 (Straight and Curved) shall be based on the linear foot of Granite Curb (straight and curved) installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite curb as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; maintenance and protection of roots; furnish, install, grade, compact and test compaction of sub-base and sub-grade; furnish and install new granite curb (straight and curved); install curbing at shallow depths as required; furnish and install cement concrete; point the granite curb; backfilling;; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite transition curb at pedestrian ramps, driveways, and curb corners; and removing and resetting granite curb.

Item 2524.10 – New Granite Curb Type VA 4 Transition Curb at Pedestrian Ramps and Driveways (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for New Granite Curb Type VA 4 Transition Curb at Pedestrian Ramps and Driveways (Straight and Curved) shall be based on the Linear Foot of granite transition curb installed at pedestrian ramps and driveways, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb Type VA 4 Transition Curb at Pedestrian Ramps and Driveways (Straight and Curved) shall be based on the linear foot of Granite Transition Curb at Pedestrian Ramps and Driveways (straight and curved) installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite transition curb at pedestrian ramps and driveways as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; maintenance and protection of roots; furnish, install, grade, compact, and test compaction of sub-base and sub-grade; furnish and install new granite transition curb at pedestrian ramps and driveways (straight and curved); furnish and install cement concrete; point the granite curb; install curbing at shallow depth as required; backfilling; ; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite curb corners; and removing and resetting granite curb.

Item 2524.11 – New Granite Curb Type VA 4 for Raised Crosswalks and Intersections

METHOD OF MEASUREMENT:
Measurement for New Granite Curb Type VA 4 for Raised Crosswalks and Intersections shall be based on the Linear Foot of flush granite curb for raised crosswalks and intersections installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb Type VA 4 for Raised Crosswalks and Intersections shall be based on the linear foot of flush granite curb for raised crosswalks and intersections installed complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new flush granite curb at raised crosswalks and intersections as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; maintenance and protection of roots; furnish, install, grade, compact and test compaction of sub-base and sub-grade; furnish and install new flush granite curb; furnish and install cement concrete; point the granite curb; backfilling; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; and removing and resetting granite curb.

Item 2524.12 – New Granite Curb at Back of Sidewalk – 4-Inch and 6-Inch (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for New Granite Curb at Back of Sidewalk (Straight and Curved) shall be based on the Linear Foot of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb at Back of Sidewalk (Straight and Curved) shall be based on the linear foot of granite curb installed at back of sidewalk complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite curb at back of sidewalk as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; maintenance and protection of roots; furnish, install, grade, compact and test compaction of sub-base and sub-grade; furnish and install new granite curb; furnish and install cement concrete; point the granite back curb; backfilling; protection

and restoration of property outside the right-of-way; furnish and install loam and seed, mulch, or other backing material specified; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; new granite roadway curb; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new curb; and removing and resetting granite curb.

Item 2524.13 – New Granite Curb 6"X24" for BMPs (Straight and Curved)

METHOD OF MEASUREMENT:
Measurement for New Granite Curb 6"X24" for BMPs (Straight and Curved) shall be based on the Linear Foot of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb 6"X24" for BMPs (Straight and Curved) shall be based on the linear foot of granite curb installed at biocells complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install new granite curb at biocells as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of sub-base and sub-grade; furnish and install new granite curb; furnish and install cement concrete; point the granite back curb; cut notches in the granite curb as detailed; backfilling; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; and removing and resetting granite curb.

Item 2524.14 – New Granite Curb Type VA 4 (Straight and Curved) – Shared Street Landscaping

METHOD OF MEASUREMENT:
Measurement for New Granite Curb Type VA4 (Straight and Curved) – Shared Street Landscaping shall be based on the Linear Foot of granite curb installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer. The Contractor shall coordinate with the City Arborist regarding the placement and installation of curb over existing tree root systems. No additional payment shall be made for this coordination or any modifications required to accommodate existing tree root systems.

BASIS OF PAYMENT / INCLUSIONS:
Payment for New Granite Curb Type VA 4 (Straight and Curved) shall be based on the linear foot of granite curb (straight and curved) installed on shared streets (Worcester Street, Suffolk Street, Pine Street and Ashburton Place) at landscape areas complete for this item in the proposal. Under the per linear foot price for this item, the Contractor shall furnish all labor,

materials, tools, equipment, and incidentals required to install new granite curb on shared streets as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of sub-base and sub-grade; furnish and install new granite curb (straight and curved); install curbing at shallow depths as required; furnish and install cement concrete; point the granite curb; backfilling;; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; new curb on non-shared streets; granite curb removed and reset to accommodate the Contractor's means and methods; new curb to replace curb damaged by the Contractor; new granite transition curb at pedestrian ramps, driveways, and curb corners; and removing and resetting granite curb.

Item 2524.15 – Granite Curb Corner Type A – 2 FT
Item 2524.16 – Granite Curb Corner Type B – 3 FT

METHOD OF MEASUREMENT:
Measurement for Granite Curb Corner Type A – 2 FT and Granite Curb Corner Type B – 3 FT shall be based on Each of granite curb corners installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Granite Curb Corner Type A – 2 FT and Granite Curb Corner Type B – 3 FT shall be based on Each granite curb corner installed complete for this item in the proposal. Under the Each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install granite curb corners as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish, install, grade, compact and test compaction of sub-base and sub-grade; furnish and install new granite curb corner; furnish and install cement concrete; point the granite curb corner; backfilling; and all other work not included for payment elsewhere. Reused curb corners can be used in R&R areas and new curb corners shall be used in new curb areas.

Item 2524. 17 – Cast-in-Place Detectable Warning Panel

METHOD OF MEASUREMENT:
Measurement for Cast-in-place Detectable Warning Panel shall be based on Square Foot of detectable warning panel installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Cast-in-place Detectable Warning Panel shall be based on Square Foot of Cast-in-place Detectable Warning Panel installed complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install detectable warning panels as detailed and where indicated or required by the Owner or Engineer. The work includes but is not limited to; furnish and install cast iron detectible warning panels; cut or pre-order cast iron detectible warning panels to match radii shown on the Contract Drawings; set cast iron detectible warning panels in concrete; and all other work not included for payment elsewhere.

Item 2524.18 – Concrete Pavers at Raised Intersections

METHOD OF MEASUREMENT:
Measurement for Concrete Pavers at Raised Intersections shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Concrete Pavers at Raised Intersections shall be based on the square yard of concrete pavers installed at raised intersections as detailed in the Contract Drawings installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the installation of concrete pavers on concrete base as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; furnish and install concrete pavers; leveling course and setting bed; tack coats as required; sweeping joints with polymeric sand; raise and adjust water and gas valve boxes, gate boxes, frames and covers, and other castings; and all other work not included for payment elsewhere.

Item 2535.1 – Illicit Connection Survey (Entire Project Area)

METHOD OF MEASUREMENT:
Measurement for Illicit Connection Survey (Entire Project Area) shall be based on the Lump Sum Price bid in the proposal. Measurement for payment shall be based on the Schedule of values for complete and certified confirmation of all illicit connections removed and select private inflow sources redirected to the storm drain system.

BASIS OF PAYMENT/INCLUSIONS:
Under the Lump Sum Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to identify illicit connections (laterals and cross connections), private inflow sources, and the function of unknown service laterals complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer, during the course of construction and at completion of collection system improvements. This work shall include furnishing, installing, and/or performing the following: dry weather sampling and subsequent visual inspection of each drain manhole listed in the Contractor's Work Plan in order to visually identify illicit sanitary connections to the storm drain within the Project Limit; transportation and processing fees for testing of samples; coordinating with homeowners and residents; introducing dye into plumbing fixture connected to potential illicit connections, potential private inflow sources, and unknown service laterals; introducing dye into upstream manhole of suspected cross connection; concurrent CCTV inspection during dye testing; and all appurtenances and incidental work. This work also includes providing the Owner and Engineer with sufficient documentation to confirm the work has been successfully completed.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: CCTV for purposes of cleaning, Cured-in-Place Pipelining, or post

construction inspection; redirection of illicit services and private inflow sources or elimination of cross connections.

Item 2555.1 -- Manhole Lining

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of manholes lined as shown on the Contract Drawings, or as directed by the Owner or Engineer. Assume the existing manholes have an average interior surface area equivalent to a 5-foot inner diameter manhole with invert 12 feet below grade.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage inspection of Manhole Lining complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. This work shall include furnishing, installing, and/or performing the following: transporting material to/from staging area; removal and reinstallation of existing frame and cover; infiltration control grouting; cleaning, repair and preparatory work; characterization, removal and disposal of grit, debris and wash water; spraying and troweling GLS; visual testing and all appurtenances and incidental work.

Manhole Lining installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere; flow bypass, removal and replacement of existing frame and cover.

2577.1 – 4-Inch to 8-Inch Reflectorized Pavement Markings – Yellow and White (Thermoplastic)

METHOD OF MEASUREMENT:
Measurement for payment for Reflectorized Pavement Markings shall be per Linear Foot of 4-inch to 8-inch wide lines applied with thermoplastic. Broken lines shall be paid by deducting ¼ of the total linear foot of roadway painted with full deductions for breaks greater than 10-feet.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Reflectorized Pavement Markings shall be based on the linear foot price complete for this item in the proposal. Under the linear foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Reflectorized Pavement Markings. The work includes, but is not limited to: sweeping, furnish, apply, and protect all thermoplastic pavement lines; grinding and removing pavement markings and lines no longer required.

EXCLUSIONS:
The following items are not included for payment under this item: Painted lines for temporary or traffic management lines and crosswalks will not be paid for under this item but are considered incidental to other items.

2577.2 - Pavement Arrows & Legends Reflectorized White (Thermoplastic)

METHOD OF MEASUREMENT:
Measurement for payment for Pavement Arrows and Legends Reflectorized (Thermoplastic) markings shall be per Square Foot of arrows and legends applied with thermoplastic as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Pavement Arrows and Legends Reflectorized (Thermoplastic) markings shall be based on the square foot price complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Pavement Arrows and Legends Reflectorized (Thermoplastic) markings. The work includes, but is not limited to: sweeping, furnish, apply, and protect all surface applied thermoplastic pavement markings; grinding and removing pavement markings and lines no longer required.

EXCLUSIONS:
The following items are not included for payment under this item: Painted lines for temporary or traffic management will not be paid for under this item but are considered incidental to other items.

2577.3 – Crosswalks and Stop Lines Reflectorized White (Thermoplastic)

METHOD OF MEASUREMENT:
Measurement for payment for Crosswalks and Stop Lines Reflectorized shall be per Square Foot of lines applied with thermoplastic as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Crosswalks and Stop Lines Reflectorized shall be per square foot of lines applied with thermoplastic complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing Crosswalks and Stop Lines Reflectorized. The work includes, but is not limited to: sweeping, furnish, apply, and protect all thermoplastic pavement lines; grinding and removing pavement markings and lines no longer required.

2577.4 – High Friction Green Paint

METHOD OF MEASUREMENT:
Measurement for pavement for High Friction Surface Treatment shall be per Square Foot of surface treatment installed as specified.

BASIS OF PAYMENT / INCLUSIONS:

Payment for High Friction Surface Treatment shall be based on the square foot price complete for this item in the proposal. Under the square foot price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing High Friction Green Paint. The work includes, but is not limited to: sweeping, furnish, apply, and protect all high friction surface treatment pavement markings; grinding and removing pavement markings and lines no longer required.

2577.5 - High SRI Pavement Coating

METHOD OF MEASUREMENT:
Measurement for payment for High SRI Pavement Coating shall be per Square Yard of pavement coating installed as specified.

BASIS OF PAYMENT / INCLUSIONS:
Payment for High SRI Pavement Coating shall be based on the square yard price complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for installing the surface paint. The work includes, but is not limited to: cleaning, sweeping, furnishing, taping off, applying, and protecting all surface paint; grinding and removing pavement markings and lines no longer required.

Item 2590.1 -- Masonry Plug or Bulkhead for Pipe 15-Inch Diameter and Larger

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the number of masonry plugs and bulkheads installed on pipes in service that are 15-inch diameter and larger, as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for each in this Proposal. Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install masonry plugs or bulkheads. The work includes, but is not limited to: saw cutting; excavation; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction and compaction testing; temporary excavation support furnished and installed complete; construction dewatering; disconnecting existing pipe, services and other connections; identification and verification of all unknown active connections through surface inspection, CCTV inspection, dye testing, test pit, or other method as necessary for transfer to an active and functioning pipe; the design and installation of masonry plugs or bulkheads in the disconnected pipe including but not limited to brick, concrete masonry units, other masonry, cement, mortar, grout, concrete, miscellaneous metals, and fasteners; and all incidental work not indicated elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: plugs or bulkheads for abandonment of pipe smaller than 15-inch diameter; temporary plugs or bulkheads for flow bypassing.

Masonry plugs or bulkheads installed for the Contractor's convenience, not indicated in the Contract to be installed, will be at the Contractor's expense and at no additional cost to the Owner.

Item 2604.1 -- Catch Basin – Type 1 Single Grate (4-Foot Diameter)
Item 2604.2 -- Catch Basin – Type 2 Double Grate (5-Foot Diameter)
Item 2604.3 -- Catch Basin – Type 3 Single Grate (3-Foot x 4-Foot Rectangular)
Item 2604.4 -- Catch Basin – Type 4 Double Grate (3-Foot x 4-Foot Rectangular)

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the Vertical Feet of complete and functional catch basins of a given type and size as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be from the interior floor of the structure to finished grade.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation and cleaning of catch basin complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting including removal; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; stone bedding, including compaction; precast concrete catch basin sections with frames, grates, hoods, masonry chimney, appurtenances, pipe sleeve (if applicable); alternate grate patterns (if applicable); furnishing, placing and compacting suitable backfill soil; compaction testing; and all appurtenances and incidental work.

Adjustment of the frame and grate to final grade, and any adjustments to intermediate grades, are included under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; furnish and install roadway gravel sub-base; temporary paving; flow bypass; procurement of off-site common fill; procurement and installation of CDF.

Item 2604.5 -- Catch Basin – Type 5 Direct Inlet

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of complete and functional direct inlets of a given type as shown on the Contract Drawings or as directed by the Owner

or Engineer. Assume direct inlet catch basins to have an average vertical depth of 4 feet as measured from inside floor of base section to finished grade. Double grate direct inlets shall be measured as two items.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation and cleaning of direct inlets complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting – including removal; construction dewatering; filter fabric as required; stone bedding, including compaction; precast boxes with frames, grates, masonry chimney, hoods, appurtenances; alternate grate patterns (if applicable); pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill soil; compaction testing; and all appurtenances and incidental work.

Adjustment of the frame and grate to final grade, and any adjustments to intermediate grades, are included under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: Type 4 Sump Manholes serving as offline sumps; excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; furnish and install roadway gravel sub-base; temporary paving; flow bypass; procurement of off-site common fill; procurement and installation of CDF.

Item 2604.6 -- Direct Inlet – Custom

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of complete and functional custom direct inlets as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation and cleaning of custom direct inlets complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting – including removal; construction dewatering; filter fabric as required; stone bedding, including compaction; steel road plate; rebar; cast-in-place concrete work; alternate materials such as pre-cast boxes and manhole block (if applicable); frames, grates, masonry chimney, hoods, appurtenances; alternate grate patterns (if

applicable); pipe sleeve (if applicable); furnishing, placing and compacting suitable backfill soil; compaction testing; and all appurtenances and incidental work.

Adjustment of the frame and grate to final grade, and any adjustments to intermediate grades, are included under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: Type 4 Sump Manholes serving as offline sumps; excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; furnish and install roadway gravel sub-base; temporary paving; flow bypass; procurement of off-site common fill; procurement and installation of CDF.

Item 2604.7 -- Catch Basin – Leaching Riser

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of complete and functional leaching risers as shown on the Contract Drawings or as directed by the Owner or Engineer. This item applies to leaching risers incorporated into deep sump catch basins and offline sump manholes.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation and cleaning of leaching risers complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting including removal; construction dewatering; precast concrete perforated riser section; filter fabric; infiltration stone and suitable backfill; compaction testing; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; furnish and install roadway gravel sub-base; temporary paving; flow bypass; procurement of off-site common fill; procurement and installation of CDF.

Item 2604.8 -- Catch Basin – Remove and Replace Existing Frame and Grate

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of complete and functional catch basin frames and grates removed and replace as shown on the Contract Drawings or as

directed by the Owner or Engineer. Double frames and grates shall be measured as a quantity of two items.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and inspection of removal and replacement of existing catch basin frame and grate complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; catch basin frames, grates, masonry chimney, appurtenances; furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

Adjustment of the frame and grate to final grade, and any adjustments to intermediate grades, are included under this pay item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; procurement of off-site common fill; procurement, installation, compaction of CDF; and removal of existing manholes or catch basins included elsewhere.

Item 2604.9 -- Catch Basin – Remove and Replace Existing Hood

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of complete and functional catch basin hoods removed and replaced as shown on the Contract Drawings or as directed by the Owner or Engineer. Hoods installed within existing catch basins lacking a hood, or within manhole repurposed as catch basin or offline sump, shall also be measured under this item.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of replacement catch basin hoods as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. This work shall include furnishing, installing, and/or performing the following: selective demolition of existing hood; cutting and patching of brick and concrete; repair of pipe ends; hood; and all appurtenances and incidental work.

Item 2609.1 -- Pipe – RCP (Gravity) 30-Inch
Item 2609.2 -- Pipe – RCP (Gravity) 36-Inch
Item 2609.3 -- Pipe – RCP (Gravity) 48-Inch

METHOD OF MEASUREMENT:

Measurement for payment shall be based on the actual Linear Feet of complete and functional pipe of a given size as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures, or to the points of connection with existing pipes.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of precast concrete pipe complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting – including removal; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; reinforced concrete pipe, fittings, couplings, and appurtenances; connecting existing and new laterals; connections to structures; furnishing, placing and compacting suitable backfill soil; compaction testing; and all appurtenances and incidental work.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete, and construction debris; treatment of groundwater discharged under a Dewatering Permit; furnish and install roadway gravel sub-base; temporary paving; flow bypass; procurement and installation of CDF.

Item 2615.1 --- Pipe – DI (Gravity) 12-Inch
Item 2615.2 --- Pipe – DI (Gravity) 16-Inch
Item 2615.3 --- Pipe – DI (Gravity) 18-Inch
Item 2615.4 --- Pipe – DI (Gravity) 30-Inch

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual Linear Feet of complete and functional ductile iron pipe of a given size as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures, or to the points of connection with existing pipes.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon

receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of ductile iron pipe of a given size complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of looped detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; construction dewatering; filter fabric as required; bedding, including compaction; ductile iron pipe of the required wall thickness, fittings, and couplings; connections to structures; furnishing, placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement, installation, and compaction of CDF; ductile iron pipe used for water pipe. Drain Lateral piping with greater than three-feet of cover should be PVC pipe unless otherwise indicated or directed.

Item 2615.5 -- Fitting – Inserta Tee

METHOD OF MEASUREMENT:
Measurement for payment shall be based on Each Inserta Tee installed as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of Inserta-Tees. The work includes, but is not limited to: coring of mainline pipe; Inserta-Tee fittings; connection of Inserta-Tee to mainline and lateral piping, and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: trenching associated with pipes connecting to the Inserta-Tee, test pitting and alignment determination for storm drain system Inserta-Tees.

Item 2615.6 - Field Core for Storm Drain Lateral Structures

METHOD OF MEASUREMENT:

Measurement for payment shall be based on Each Field Core for Storm Drain Lateral Structure performed as accepted or directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete field core performed at a storm drain lateral structure and includes providing equipment capable of coring from inside the structure should field conditions require. The work includes but is not limited to; coring of precast storm drain lateral structures; furnishing and installation of pipe boot and hardware and fittings; providing brick and mortar seal around core annular space if needed, and all appurtenances and incidental work. The contractor shall also confirm with the precast concrete supplier that the structures are built in a way that will accept a future core of required diameter.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: Test pitting and alignment determination for storm drain system; and Inserta-Tees. This item shall not be used for coring mainline structures at the mainline inverts.

Item 2622.1 -- Pipe – PVC (Gravity) 6-Inch
Item 2622.2 -- Pipe – PVC (Gravity) 8-Inch
Item 2622.3 -- Pipe – PVC (Gravity) 10-Inch
Item 2622.4 -- Pipe – PVC (Gravity) 12-Inch
Item 2622.5 -- Pipe – PVC (Gravity) 15-Inch
Item 2622.6 -- Pipe – PVC (Gravity) 18-Inch
Item 2622.7 -- Pipe – PVC (Gravity) 24-Inch

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual Linear Feet of complete and functional PVC pipe of a given size as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be taken horizontally along the centerline of the pipe from the inside face of structures to inside face of structures, or to the points of connection with existing pipes. Vertical lengths of pipe for chimneys and cleanouts shall be measured vertically.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of PVC pipe complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not

limited to: pavement or sidewalk sawcutting; removal of looped detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; construction dewatering; filter fabric as required; bedding, including compaction; PVC pipe, fittings, couplings, and appurtenances; chimney and cleanout assemblies (if required); connections to structures; placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement, installation, and compaction of CDF; lengths of PVC pipe defined for reconnect/redirect laterals to mainline pipe; Inserta tee fittings; PVC large full-body tees or wyes.

Item 2622.8 -- Pipe – PVC (Gravity) Spot Repair < 24-Inch

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual number of PVC spot repairs of gravity pipe less than 24-inch diameter as shown on the Contract Drawings, determined as necessary based on CCTV review, or as directed by the Owner or Engineer. Each measurement shall constitute up to 20 linear feet of pipe replacement.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for these items, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection of piping spot repairs complete as indicated on the Drawings and Specifications, determined necessary by CCTV inspection, or as directed by the Owner or Engineer. The work includes, but is not limited to: pavement or sidewalk sawcutting; removal of looped detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; construction dewatering; filter fabric as required; bedding, including compaction; PVC pipe, fittings, couplings, and appurtenances; connections to structures; placing and compacting suitable backfill soil; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:

The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement, installation, and compaction of CDF; chimney and cleanout assemblies; lengths of PVC pipe defined for reconnect/redirect laterals to mainline pipe; Inserta tee fittings; PVC large full-body tees or wyes.

Item 2622.9 -- Fitting – PVC Large Full-Body Tee or Wye

METHOD OF MEASUREMENT:
Measurement for payment shall be based on Each PVC large full-body tee or wye installed on PVC mainline gravity pipe 18-inch diameter and larger for branch connections of any size.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of PVC large full-body tee or wye. The work includes, but is not limited to: PVC wye or tee fittings and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: trenching associated with pipes connecting to the PVC large full-body tee or wye; full-body tee or wye installed on PVC mainline gravity pipe 15-inch diameter and smaller for branch connections of any size

Item 2622.10 -- Reconnect/Redirect PVC (Gravity) Lateral to Mainline Pipe

METHOD OF MEASUREMENT:
Measurement for payment shall be based on Each PVC lateral reconnect/redirect to mainline pipe as required by the Contract Documents or as directed by the Owner or Engineer. This item applies to the length of 6-inch to 12-inch PVC laterals connected to and laid within a distance of three (3) feet from the edge of proposed mainline pipe.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement and installation of PVC laterals reconnected/directed to mainline pipe. The work includes, but is not limited to: filter fabric as required; bedding, including compaction; PVC pipe, fittings and couplings; connecting laterals to mainline pipe including full-body fittings; chimney and cleanout assemblies (if required within the defined distance from mainline pipe); compaction testing; and all appurtenances and incidental work.

This item also applies to the removal of intruding taps where located at the point of connection between new and existing gravity mains.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: Inserta tee fittings; trenching associated with the mainline pipe at the point of connection; flow bypass; procurement, installation, and compaction of CDF.

2622.11 – Drain Lateral through Sewer Main and Tie-in to Main Drain

METHOD OF MEASUREMENT:
Measurement for payment for Drain Lateral through Sewer Main and Tie-in to Main Drain shall be based on Each drain lateral tie-in installation through the brick sewer completed as approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Drain Lateral through Sewer Main and Tie-in to Main Drain shall be based on each drain lateral through the brick sewer installation completed. Under the each price for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each pipe complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous concrete; concrete; reinforced concrete; cobbles; excavation; dewatering; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, and removed; transporting material to/from soil staging area; removal and proper abandonment of existing pipe in the new pipe trenches; furnish, install, and compact bedding; determination of the vertical drain lateral alignment; careful removal of the brick and CIPP crown of the sewer; careful opening of the existing drain main; furnish and install drain lateral pipe, fittings, furnish and install formwork including luan as needed, bentonite swell strips, rebar, cement concrete encasement and closure;; connections to existing and proposed pipes and structures;; and all work incidental to the installation of drain lateral pipe through the brick sewer crown , not specifically included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of HMA and roadway concrete, Inserta-tee fittings if used, dense graded crushed stone, temporary paving, and all test pitting and alignment determinations.

2622.12 – Drain Spot Replacements at Utility Intrusions (Up to 48”)

METHOD OF MEASUREMENT:
Measurement for payment for Drain Spot Replacements at Utility Intrusions (Up to 48”) shall be based on Each complete drain spot replacement performed at a utility intrusion, up to a maximum pipe diameter of 48” and as performed in accordance with the Contract Documents and approved by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Drain Spot Replacements at Utility Intrusions (Up to 48”) shall be based on each drain spot replacement completed at utility intrusions for up to 48” diameter pipe. The

Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each complete each pipe replacement as shown on the Contract Drawings or as required by the Engineer. The work includes, but is not limited to; saw cutting bituminous concrete; concrete; reinforced concrete; cobbles; excavation; dewatering; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, and removed; transporting material to/from soil staging area; removal of existing pipe; furnish, install, and compact bedding; furnish and install drain pipe, fittings,; connections to existing and proposed pipes using concrete field closures as shown in the details;; and all work incidental to the installation of pipe, not specifically included for payment elsewhere. This item shall be used when an intruding utility can not be relocated from the existing drain. The work will then include removal of the existing pipe around the intruding utility and then replacement of that pipe with a smaller diameter pipe or pipes such that the intruding utility no longer presents an obstruction to the pipeline flow. The replacement pipe(s) will be PVC, DI, or RCP based on the configuration that best serves flow maintenance at the direction of the Engineer.

SPECIAL NOTES ON EXCLUSIONS:
This item excludes situations where the intruding utility does get relocated and the demolition, replacement pipe matching the existing size, and field closures are covered under those items elsewhere. This item also excludes coordination and scheduling with the private utility owners; disposal of HMA and concrete construction debris; test pits for locating the utility intrusions; dense graded crushed stone gravel sub-base; and temporary and permanent paving.

Item 2630.1 - Pipe – DI (Water) 4-Inch
Item 2630.2 - Pipe – DI (Water) 6-Inch
Item 2630.3 - Pipe – DI (Water) 8-Inch
Item 2630.4 - Pipe – DI (Water) 12-Inch
Item 2630.5 - Pipe – DI (Water) 16-Inch
Item 2630.6 - Pipe – DI (Water) 24-Inch

METHOD OF MEASUREMENT*:*
Measurement for payment for items 2630.1 through 2630.6 will be based on the actual Linear Feet of pipe installed, tested, and accepted, completed as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer along the centerline of the pipe with no reduction for fittings, valves, or hydrants.

Pipe installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

BASIS OF PAYMENT:
Payment for items 2630.1 through 2630.6 will be based on the unit price bid for this item in the proposal. Under the linear foot price for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each pipe complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous concrete; concrete; reinforced concrete; cobbles; excavation; dewatering; furnishing and placing backfill per one of the approved methods;

furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, and removed; transporting material to/from soil staging area; removal and proper abandonment of existing abandoned pipe in the new pipe trenches; furnish, install, and compact bedding; furnish and install ductile iron pipe, gaskets and appurtenances; connections to existing and proposed pipes and structures; corporation stops for chlorination, testing, and flushing; chlorination, flushing and testing; disposal of testing materials; furnish and install pipe insulation as necessary; protective coating; and all work incidental to the installation of Ductile Iron Water Pipe, not specifically included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; removal of train tracks and ties; new water service connections from the new main to existing service lines; furnish and install roadway gravel sub-base; temporary paving; sewer and drain flow bypass; sidewalk restoration; back-of-sidewalk restoration. The Contractor designed and installed bypass system in conformance with the requirements of Specification Section 02685.

Item 2630.7 – Fittings, Couplings, and Restraints

METHOD OF MEASUREMENT:
Measurement for payment for Fittings, Couplings, and Restraints will be based on Fittings, the total weight in pounds installed in the completed project and accepted by the Engineer. Weight shall be based upon manufacturer catalog data and shipping weight slips furnished from the supplier to the Contractor. No payment will be allowed for standard mechanical joint glands and accessories that are not used due to installation of restrained joints.

BASIS OF PAYMENT:
Payment for Fittings, Couplings, and Restraints shall be considered full compensation for furnishing all labor, equipment, materials, and all else incidental thereto for the satisfactory completion of the work. Restraints installed for Contractor convenience shall not be paid for under this item.

2640.1 -- 4-Inch Gate Valve and Gate Box
2640.2 -- 6-Inch Gate Valve and Gate Box
2640.3 -- 8-Inch Gate Valve and Gate Box
2640.4 -- 12-Inch Gate Valve and Gate Box
2640.5 -- 16-Inch Butterfly Valve and Gate Box
2640.6 -- 24-Inch Insertion Valve and Gate Box

METHOD OF MEASUREMENT*:*
Measurement for payment for Valves and Boxes will be based on the actual number of valves and boxes installed, including valves outside the limits of the water main construction to support the installation of the new water main, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:

Payment for Valves and Boxes will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each valve and box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous asphalt and reinforced concrete; excavation; furnish and install gate valve; furnishing and placing backfill by one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete and removed; transporting material to/from soil staging area; furnishing, installing and compacting bedding; furnish and install valve and box, mechanical joint restraints, gaskets and appurtenances; connections to existing and proposed pipes and structures; chlorination, flushing and testing; disposal of testing materials; concrete setting bed for the box; furnish and install insulation as necessary; protective coating; support of valve during installation; and all incidental work required for the installation of valves and boxes not specifically included for payment elsewhere.

2640.7 -- Replace Existing Water Valve Box Structure

METHOD OF MEASUREMENT*:*
Measurement for payment for Replace Existing Water Valve Box Structure will be based on the actual number of water valve boxes replaced complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for Replace Water Valve Box Structure will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to replace each valve box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous asphalt and reinforced concrete; excavation; furnishing and placing backfill by one of the approved methods; furnishing and installing filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete and removed; transporting material to/from soil staging area; furnishing, installing and compacting bedding; removal of the existing water valve boxes; furnishing and installing gate valve boxes, concrete setting bed for the gate valve boxes; and all incidental work required for the replacement of valve boxes not specifically included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
This item excludes payment for installation or replacement of valve box structure at new water valves or at curb stops relocated to the roadway as this is paid for elsewhere.

2640.8 -- Blow-Off

METHOD OF MEASUREMENT*:*
Measurement for payment for Blow-Offs will be based on the actual number of Blow-Offs installed complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:

Payment for Blow-Offs will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each blow-off complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous asphalt and reinforced concrete; excavation; furnishing and placing backfill by one of the approved methods; furnishing and installing filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete and removed; transporting material to/from soil staging area; furnishing, installing and compacting bedding; furnishing and installing copper piping, fittings, corporation stop, curb stop, valve boxes, restrained tapped cap; connections to existing and proposed pipes; chlorination, flushing and testing; disposal of testing materials; furnishing and installing insulation as necessary; protective coating; support of water main during installation; and all incidental work required for the installation of blow-offs not specifically included for payment elsewhere.

Item 2645.1 – New Hydrant

METHOD OF MEASUREMENT:
Measurement for payment for New Hydrant will be based on the actual number of new hydrants furnished and installed, as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for New Hydrant will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to furnish and install each new hydrant as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to; saw cutting bituminous and cement concrete; excavation; transporting material to/from soil staging area; furnish and install backfill per one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; coordination with Cambridge Fire Department and Cambridge Water Department; temporary excavation support furnished and installed complete, and removed; furnish, transport and install the hydrant; furnish and install all fittings and mechanical or other joint restraints; flow testing; painting; all permits and fees; and all incidental work required for the providing and the installation of a new hydrant not included for payment elsewhere.

Item 2645.2 – Remove and Dispose of Existing Hydrant

METHOD OF MEASUREMENT:
Measurement for payment for Remove and Dispose Existing Hydrant will be based on the actual number of hydrants removed and delivered or disposed, as shown on the Contract Drawings or as directed by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for Remove and Dispose Existing Hydrant will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove and dispose each hydrant as shown on the Contract Drawings or at the direction of the Engineer. The work includes, but is not limited to; saw cutting; excavation; furnish and install backfill; transporting

material to/from soil staging area; compaction; compaction testing; resetting the curb; coordination with Cambridge Fire Department and Cambridge Water Department; temporary excavation support furnished and installed complete, removal of the hydrant; disposal of the hydrant or transport to CWD; capping of existing hydrant lateral and removal of valve box; all permits and fees; and all incidental work required for the removal and disposal of an existing hydrant not included for payment elsewhere.

Item 2645.3 – Hydrant Relocation at Harvard and Windsor Street Intersection

METHOD OF MEASUREMENT:
Measurement for payment for Hydrant Relocation at Harvard and Windsor Street Intersection will be based on a Lump Sum for the removal of the existing hydrant and associated valves, fittings, and piping after the new nearby hydrant on Windsor Street is placed into service.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Hydrant Relocation at Harvard and Windsor Street Intersection will be based on the Lump Sum price bid for this item in the proposal. Payment shall be considered as full compensation for furnishing all labor, equipment, materials, and services for unclassified excavation, excavation, backfill; furnish and install subbase gravel for roadway, temporary paving; removal of the existing valves, fittings, piping and hydrant, replacement of 12" watermain including (2) solid sleeves, and turnover of valves, and hydrant to CWD at their Alewife Brook facility; coordination of all work with CWD, CFD; disposal of removed piping, clean up; and all else incidental thereto. No separate measurement for 12" piping or fittings will be made for this Lump Sum work. This work is indicated on Contract drawing U-7 near Station 2018+60

Item 2660.1A – 1-Inch Water Service Replacement
Item 2660.1B – 1.5-Inch Water Service Replacement
Item 2660.1C – 2-Inch Water Service Replacement
Item 2660.1D – 3-Inch Water Service Replacement

METHOD OF MEASUREMENT:
Measurement for payment for Water Service Replacement will be based on the actual Linear Feet of pipe installed, tested, and accepted, from 1-inch to 3-inch diameter, at all depths, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer along the centerline of the pipe from the centerline of the mainline to the connection with the existing service, curb stop, meter, or final point of connection.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Water Service Replacement will be based on the unit price bid for this item in the proposal. Under the unit price for each pipe item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to replace existing water services between 1-inch and 3-inch in diameter. The work includes; saw cutting bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, left in place, and cut off below grade where required or directed; furnishing, placing and compacting bedding; removal of existing curb stops and boxes as required; furnish and install type K water service pipe, corporation stops, fittings, saddles, curb stops and boxes,

couplings, appurtenances and joints; connections to existing and proposed pipes; flushing/cleaning and testing; and all incidental work not specifically included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Excludes unclassified excavation, disposal of asphalt and reinforced concrete; furnish and install subbase gravel for roadway; temporary paving, and final surface paving; and sidewalk and back-of-sidewalk restoration as these items are paid for elsewhere. This item also excludes the first six (6) feet of replacement for 1-inch to 3-inch water service replacement covered under the Reconnect Existing Water Service bid item..

Item 2660.2A – Reconnect Existing Water Service – 1-Inch
Item 2660.2B – Reconnect Existing Water Service – 1.5-Inch
Item 2660.2C – Reconnect Existing Water Service – 2-Inch
Item 2660.2D – Reconnect Existing Water Service – 3-Inch

METHOD OF MEASUREMENT:
Measurement for payment for Reconnect Existing Water Service 1-Inch through 3-Inch shall be based on Each water service reconnected to existing copper service piping and as measured by the Engineer for each water service reconnect complete. This item will cover up to six (6) feet of copper service replacement for each service reconnected to an existing copper service 1" or larger.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Reconnect Water Service to Existing Water Main will be based on the unit price bid for this item in the proposal. The Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to; reconnect water services for 1-in to 3-in in diameter, from the new water main to an existing 1-inch to 3-inch copper service, or replace a non-copper or undersized water service; at all depths, complete as shown on the Contract Drawings or as required by the Engineer. Payment under this item is considered to cover up to the first six (6) feet of 1-inch to 3-inch copper service replacement. The work includes; saw cutting bituminous or reinforced concrete; transporting material to/from soil staging area; coordinating with property owner to locate water service; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, and removed; furnishing, placing and compacting bedding; furnish and install type k water service pipe, fittings, couplings, appurtenances and joints; connections to existing and proposed pipes; flushing and cleaning; and all incidental work not specifically included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
Excludes unclassified excavation, disposal of asphalt and reinforced concrete; furnish and install subbase gravel for roadway; temporary paving, and final surface paving; and sidewalk and back-of-sidewalk restoration as these items are paid for elsewhere.

Item 2660.3 – Foundation Wall Core and Seal

METHOD OF MEASUREMENT:

Measurement for payment for Foundation Wall Core and Seal will be based on the actual number of foundation walls cored and sealed, installed and accepted, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Foundation Wall Core and Seal will be based on the unit price bid for this item in the proposal. This item shall be used when existing foundation wall/slab service penetration is determined to be inaccessible for service replacement by the Engineer. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to core the existing foundation wall or slab and seal the penetration complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes but is not limited to; core existing foundation wall or slab; seal penetration after new service installation by use of non-shrink hydraulic cement; furnish and install concrete for existing slab restoration; and all incidental work required for the coring and sealing of the foundation wall or slab not specifically included for payment elsewhere.

Item 2660.4 – Connection to Meter

METHOD OF MEASUREMENT:
Measurement for payment for Connection to meter will be based on the actual number of connections to existing water service meters completed and accepted, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Connection to Meter, will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to connect a new copper water service to an existing meter, complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes but is not limited to; installing all fittings and couplings required; removal and resetting of the existing meter if required; furnish and install meter couplings, ball valves, and meter stop; furnish and install temporary lock for street-side ball valve; and all incidental work required for the connection to service meter not specifically included for payment elsewhere. All work inside of the foundation work shall be performed by a plumber licensed in the state of Massachusetts. This work will require a plumbing permit obtained and signed off by Cambridge Inspectional Services which is considered incidental to this bid item.

Item 2660.5 – Curb Stop Replacement

METHOD OF MEASUREMENT:
Measurement for payment for Curb Stop Replacement will be based on the actual number of existing curb stops removed and replaced as determined by curb stop confirmation or as directed by CWD completed and accepted, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Curb Stop Replacement will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove a “full turn” style curb stop and

replace it with a "1/4 turn" style curb stop, complete as shown on the Contract Drawings, as determined through curb stop turn testing, or at the requirements of the Engineer. The work includes; saw cutting bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; install, grade, and compact gravel sidewalk; compaction; compaction testing; temporary excavation support furnished and installed complete, left in place, and cut off below grade where required or directed; furnishing, placing and compacting bedding; furnish and install curb stops, fittings, couplings, appurtenances and joints; furnish and install service boxes; and connections to existing water services. This item is for replacement of "full turn" style curb stops with "1/4 turn" style curb stops and service boxes only and shall not be used when replacing non-copper water services that requires installation of a new curb stop or as otherwise shown on the Contract Drawings or directed by the Engineer.

SPECIAL NOTES ON EXCLUSIONS:
Excludes unclassified excavation, disposal of asphalt and reinforced concrete; furnish and install subbase gravel for roadway; temporary paving, and final surface paving; sidewalk and back-of-sidewalk restoration; and replacement of existing curb stops and service boxes that are within the limits of water service replacement covered under the 1-inch to 3-inch Water Service Replacement item as these items are paid for elsewhere.

Item 2660.6 – Curb Stop with Valve Box

METHOD OF MEASUREMENT:
Measurement for payment for Curb Stop with Valve Box will be based on the actual number of existing curb stops located in proposed landscape areas removed and replaced to a location within the roadway complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Curb Stop Replacement will be based on the unit price bid for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to remove the existing curb stop box and install a new curb stop with valve box complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes; saw cutting bituminous or cement concrete; excavation; furnishing and placing backfill per one of the approved methods; furnish and install filter fabric as required; compaction; compaction testing; temporary excavation support furnished and installed complete, left in place, and cut off below grade where required or directed; furnishing, placing and compacting bedding; furnish and install curb stop, water service piping, fittings, couplings, appurtenances and joints; remove existing curb stop box; and furnish and install valve box.

Item 2660.7 – Interior Restoration for Non-Copper Service Replacement

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Invoices shall include a breakdown of hours, labor rates, direct expenses, sub-contractor costs, material costs, and all other costs included in the request. Incomplete or incorrect invoices will not be approved. The General Contractor is allowed up to

a 5% mark-up on all costs incurred under this item as supported by invoices. At the end of the Contract, all remaining funds will be deleted from the Contract by a Change Order.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Interior Restoration for Non-Copper Service Replacement will be based on the Allowance amount provided. The Allowance for this item shall be reimbursed to the Contractor to furnish all labor, professional services, equipment, and incidentals for the Contractor to restore building interior impacted by the installation of water service replacement as directed by the Engineer. This work includes, but is not limited to, drywalling; finish carpentry; interior painting; and other interior restoration work required to restore interior finishes to the existing condition prior to water service replacement. The Contractor shall take care to limit impacts to interior finishes when replacing and reconnecting water services. All work paid for under this item shall be pre-identified by the Contractor and confirmed by the Engineer and building owner by a signed Right-of-Entry prior to commencement of water service replacement and reconnect. Any work required beyond the scope of work defined in the Right-of-Entry shall only be paid if approved by the Engineer.

SPECIAL NOTES ON EXCLUSIONS:
Excludes all work included in 1-Inch to 3-Inch Water Service Replacement, Foundation Wall Core and Seal, and Connection to Meter. Any damage to the interior caused by the Contractor's lack of care during service replacement, or otherwise not pre-identified, will be repaired at the Contractor's expense and is not eligible for compensation under this item.

Item 2660.8 – Concrete Sewer Encasement

BASIS OF PAYMENT / INCLUSIONS:
Payment for Sewer Encasement will be based on the unit price for this item in the proposal. Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to perform sewer encasement as indicated in the "Concrete Encasement Details" of the contract drawings. This encasement may be on the sewer main and/or sewer service. Any line that serves both sewer and storm water shall be considered a "sewer" line. Costs for providing restrained joint fittings in these areas is covered under the "fittings" unit price bid item and is not covered here.

METHOD OF MEASUREMENT:
Measurement for payment for Sewer Encasement will be based on the actual number of Sewer Encasements completed and accepted, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

Item 2685.1 – Temporary Bypass Piping for Water Mains – Columbia Street

METHOD OF MEASUREMENT:
Measurement for payment for Temporary Bypass Piping for Main Wains – Columbia Street will be based on a Lump Sum for temporary water main on Columbia Street as designed, furnished, installed, and removed by the Contractor as outlined in this Specification Section.

BASIS OF PAYMENT / INCLUSIONS:

Payment for Temporary Bypass Piping for Water Mains – Columbia Street will be based on the Lump Sum price bid for this item in the proposal. Payment shall be considered as full compensation for designing and furnishing all labor, equipment, materials, and services for installing temporary water lines for individual services, for installing temporary bypass valves, for locating, excavating, where required and connecting to the temporary service lines to all users whose water service will be disrupted for more than 4-hours, for providing temporary fire protection at all hydrants which will be out of service for more than 4-hours, for constructing necessary ramps and trenches across streets and driveways to protect temporary water lines, temporary signage for temporary bicycle and pedestrian access routes, connections to existing hydrants where required; pressure testing; flushing; disinfection and dechlorination as specified; sampling; laboratory analyses; emergency repairs and maintenance, removal of all temporary water lines, and for restoring all property damaged or altered in the course of providing temporary water services; coordination of all work with CWD, CFD, and property owners; clean up; and all else incidental thereto, for which separate payment is not provided under other items in the Bid Proposal. This item is for temporary bypass piping for water main installation on Columbia Street and shall include temporary service for all properties impacted by water main installation between Bishop Allen Drive and Harvard Street including Columbia Terrace, Renz Way, and Marvin Place.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; new water service connections from the new main to existing service lines; furnish and install roadway gravel sub-base; temporary paving; sewer and drain flow bypass; sidewalk restoration; back-of-sidewalk restoration.

Item 2685.2 – Temporary Bypass Piping for Water Mains – Washington Street

METHOD OF MEASUREMENT:
Measurement for payment for Temporary Bypass Piping for Water Mains – Washington Street will be based on a Lump Sum for temporary water main on Washington Street as designed, furnished, installed, and removed by the Contractor as outlined in this Specification Section.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Temporary Bypass Piping for Water Mains – Washington Street will be based on the Lump Sum price bid for this item in the proposal. Payment shall be considered as full compensation for designing and furnishing all labor, equipment, materials, and services for installing temporary water lines for individual services, for installing temporary bypass valves, for locating, excavating, where required and connecting to the temporary service lines to all users whose water service will be disrupted for more than 4-hours, for providing temporary fire protection at all hydrants which will be out of service for more than 4-hours, for constructing necessary ramps and trenches across streets and driveways to protect temporary water lines, temporary signage for temporary bicycle and pedestrian access routes, connections to existing hydrants where required; pressure testing; flushing; disinfection and dechlorination as specified; sampling; laboratory analyses; emergency repairs and maintenance, removal of all temporary water lines, and for restoring all property damaged or altered in the course of providing temporary water services; coordination of all work with CWD, CFD, and property owners; clean up; and all else incidental thereto, for which separate payment is not provided under other items in the

Bid Proposal. This item is for temporary bypass piping for water main installation on Washington Street and shall include temporary service for all properties impacted by water main installation between Norfolk Street and Pine Street including Fiske Place.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; new water service connections from the new main to existing service lines; furnish and install roadway gravel sub-base; temporary paving; sewer and drain flow bypass; sidewalk restoration; back-of-sidewalk restoration.

Item 2685.3 – Temporary Bypass Piping for Water Mains – Ashburton Place

METHOD OF MEASUREMENT:
Measurement for payment for Temporary Bypass Piping for Water Mains – Ashburton Place will be based on a Lump Sum for temporary water main on Ashburton Place as designed, furnished, installed, and removed by the Contractor as outlined in this Specification Section.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Temporary Bypass Piping for Water Mains – Ashburton Place will be based on the Lump Sum price bid for this item in the proposal. Payment shall be considered as full compensation for designing and furnishing all labor, equipment, materials, and services for installing temporary water lines for individual services, for installing temporary bypass valves, for locating, excavating, where required and connecting to the temporary service lines to all users whose water service will be disrupted for more than 4-hours, for providing temporary fire protection at all hydrants which will be out of service for more than 4-hours, for constructing necessary ramps and trenches across streets and driveways to protect temporary water lines, temporary signage for temporary bicycle and pedestrian access routes, connections to existing hydrants where required; pressure testing; flushing; disinfection and dechlorination as specified; sampling; laboratory analyses; emergency repairs and maintenance, removal of all temporary water lines, and for restoring all property damaged or altered in the course of providing temporary water services; coordination of all work with CWD, CFD, and property owners; clean up; and all else incidental thereto, for which separate payment is not provided under other items in the Bid Proposal. This item is for temporary bypass piping for water main installation on Ashburton Place and shall include temporary service for all properties impacted by water main installation from Essex Street to the end of Ashburton Place.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete and construction debris; new water service connections from the new main to existing service lines; furnish and install roadway gravel sub-base; temporary paving; sewer and drain flow bypass; sidewalk restoration; back-of-sidewalk restoration.

Item 2710.1 --- Internal Grinding of Protruding Laterals

METHOD OF MEASUREMENT:

Measurement for payment shall be based on the actual number of complete and functional trimmed services as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSION:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to grind existing service laterals protruding into sewer or drain complete as indicated on the Drawings and Specifications. This work shall include furnishing, installing, and/or performing the following: flow handling; making arrangements for a water source; cutting and grinding protruding pipe; removal of cut fragments and grinded material; concurrent CCTV inspection; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: CCTV for purposes of cleaning, Cured-in-Place Pipelining, or post-construction inspection.

Item 2760.1 -- Heavy Cleaning of Collection System

METHOD OF MEASUREMENT:
Measurement for Heavy Cleaning of Collection System shall be based on the Hours needed by the cleaning crew beyond any light cleaning as approved by the Engineer. Heavy cleaning is defined as any jetting of gravity pipe beyond the initial Light Cleaning. Light Cleaning of the gravity pipe is defined as 2 or fewer passes with a standard jetter nozzle.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for Heavy Cleaning of Sanitary Sewer complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. This work shall include furnishing, installing, and/or performing the following: required submittals and work plans; securing a temporary dump site; storm and sewer flow handling including sand bagging, temporary plugs and bulkheads, dewatering and flow bypassing; making arrangements for a water source; loosening, cleaning, and extracting deposits throughout the pipeline; transporting material to/from dump site; end-of-day surface cleaning around access manhole; repair of any damage caused by the Contractor; restoration of surface; and incidental work not indicated for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item: Light Cleaning; cleaning of the Work at substantial completion.

Item 2761.1 -- Flow Bypass of Gravity Pipe

METHOD OF MEASUREMENT:
Measurement for payment for Flow Bypass will be based on a percent complete of the Lump Sum item as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Lump Sum price for Flow Bypass, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to furnish, install, move, maintain and remove gravity or pumped flow bypasses complete as required to handle existing flows while completing the required elements of the Work at all locations. The work includes, but is not limited to; design and submittal of the bypass systems; pumps; suction hoses; discharge hoses; generators; install and remove temporary bulkheads; gravity bypasses including furnishing and installing pipe of all sizes at all depths; excavation for buried hoses or pipe; furnish and placing backfill around buried hoses and pipe; preparation of subgrade; temporary pavement over buried hoses or pipe; ramps; protection of bypass measures; emergency service during non-work hours; manning pumps or other bypasses as may be required; fittings, couplings and appurtenances; connections to existing and proposed pipes and structures; protection of discharge locations; and all incidental work not specifically included for payment elsewhere required to bypass existing flows in all storm drain, combined sewer or sanitary sewer.

SPECIAL NOTES ON EXCEPTIONS:
Items not included for payment herein include, but are not limited to: water main bypasses.

2767.1 -- CIPP – 8-Inch Gravity Main
2767.2 -- CIPP – 10-Inch Gravity Main
2767.3 -- CIPP – 12-Inch Gravity Main
2767.4 -- CIPP – 15-Inch Gravity Main
2767.5 -- CIPP – 18-Inch Gravity Main
2767.6 -- CIPP – 25-Inch x 32-Inch Gravity Main

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual linear feet of complete cured-in-place pipe liner as shown on the Contract Drawings or as directed by the Owner or Engineer. Measurement shall be taken along the centerline of the pipe from the inside face of structures to inside face of structures.

Cured-In-Place Pipeliner installed but not successfully tested and accepted shall be paid for at a maximum of 95 percent of the unit prices bid under this item. The remaining 5 percent shall be paid upon receipt of successful test results by the Engineer. All reductions in payment due to unsuccessful testing shall be made prior to normal retainage.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and inspection of Cured-in-Place Pipeliner in existing pipes complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: all homeowner notification and coordination; repair of defects; minor root removal; pipe liner as described in the Contract Specifications; reinstating building service laterals; pipeline cleaning; transportation of the material removed during cleaning

operations to a temporary stockpile area; temporary storage and control of stockpiling; pre- and post-installation inspection by closed circuit television; providing inspection photos and logs; sealing around manhole connections; and testing of liner samples. The work also includes temporary removal of the top of manhole where necessary to insert the CIPP liner, consisting of: sawcutting pavement and concrete; excavate bituminous concrete; excavation; transporting material to and from soil staging area; remove and reset frame and cover; remove and replace the top section of brick manhole; placing and compacting suitable backfill material; grade and compact gravel pavement sub-base; compaction testing; raising frames and covers to grade; and all incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; procurement of off-site common fill; procurement, installation, and compaction of CDF; adjusting castings for paving; flow handling and bypass pumping.

Item 2890.1 – Traffic Signal Reconstruction - Harvard Street at Prospect Street
Item 2890.2 – Traffic Signal Reconstruction - Harvard Street at Columbia Street
Item 2890.3 – Traffic Signal Reconstruction - Harvard Street at Windsor Street

METHOD OF MEASUREMENT:
Measurement for payment of Items 2890.1 through 2890.3 will be based on full completion as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
The lump sum prices bid for Items 2890.1 through 2890.3 shall constitute full compensation for all labor, materials and equipment necessary or incidental to the installation of a complete intersection traffic control signal system functioning as specified and as shown, including local traffic controller, controller cabinet, electrical conduit and wiring, electric handholes, frames and covers, vehicle signal heads, loop detectors and amplifiers, mast arms/bases, signal posts/bases, signal wiring and electrical connections, phasing and timing adjustments, removal and stacking of existing equipment, foundations, excavation and backfill, service connections, and all charges therefore.

EXCLUSIONS:
No separate payment shall be made for sand bedding, marking tape, controlled density fill, temporary top course hot mix asphalt pavement, or any incidental materials, but all costs in connection therewith shall be included in the Contract unit price for Items 2890.1 through 2890.3.

Item 2890.4 – 3 Inch Electrical Conduit Type NM – Plastic (UL)

METHOD OF MEASUREMENT:
Payment for 3 Inch Electrical Conduit Type NM - Plastic (UL) shall be paid at the Contract unit price per Linear Foot of complete and functional conduit installed as shown on the Contract Drawings or as directed by the City or Engineer. Measurement shall be taken along

the centerline of the pipe from the inside face of structures to inside face of structures, to the points of connection with existing pipes.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and cleaning as indicated on the Drawings and Specifications, or as directed by the City or Engineer. This work shall include furnishing, installing, and/or performing the following: gravel pavement subbase; pavement or sidewalk sawcutting; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; removal of groundwater from the trench; handling groundwater recharged back to the soil; filter fabric as required; bedding, including compaction; 3 inch electrical conduit pipe, fittings, couplings, and appurtenances; concrete encasement; connections to structures; cleanout assemblies (if required); placing and compacting suitable backfill soil and controlled density fill and marker tape; grade and compact gravel pavement sub-base; and all appurtenances and incidental work.

Item 2890.5 – Pull Box 12" X 12"

METHOD OF MEASUREMENT:
Measurement for payment of Items 2890.5 will be based on the number of installed pull boxes as specified herein and as measured by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Payment for Pull Box 12" X 12" shall be paid at the Contract unit price per each pull box installed under Items 2890.5, which shall include all labor, material, equipment and incidental costs required to complete the work.

Item 2890.6 – Service Connection Eversource Approved Handhole

METHOD OF MEASUREMENT:
Measurement for payment of Item 2890.6 will be based on the number of completed Service Connections to Eversource Approved Handholes as specified herein and as measured by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Payment for Item 2890.6 shall be based on the per number of individual Service Connections made to Eversource Approved Handholes for the traffic signal system. Under the per each price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required complete the service connection. The work includes, but is not limited to; saw cutting existing bituminous or cement concrete; excavation; furnishing and placing concrete encased conduit as necessary; furnishing and placing backfill per one of the approved methods; installing marker tape and pull ropes if required; coordination with Eversource including obtaining an Eversource Work Order; payment for any fees associated with the Eversource Work Order; and incidental work not included for payment elsewhere.

Item 2900.1 – Shrub Planting
Item 2900.2 – Perennial Planting

METHOD OF MEASUREMENT:
Measurement for Payment for shrubs and perennial planting materials shall be based on the actual number plants dug, stored, installed, complete in place and accepted.

BASIS OF PAYMENT:
Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete installation of shrubs and perennial planting as shown on the Contract Documents. The work involved will be paid for at the contract unit prices for the kind and size of plant and the method of planting, as the case may be, completed and accepted in place for these items. No additional payment will be made for hole excavations for planting, backfilling, staking, fertilizing, mychorrizal inoculations or for the 2-year Guarantee.

EXCLUSIONS AND SPECIAL NOTES:
Payment for mulch shall not be paid for under this item and is paid for elsewhere.

Item 2900.3 – Mulch

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the Cubic Yards of Mulch installed by the Contractor as shown on the Contract Drawings and as directed by the Engineer, complete and in place.

BASIS OF PAYMENT:
Payment for Mulch shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete installation of mulch including excavation, placement, compaction, testing and grading, as shown on the Contract Drawings or at the direction of the Engineer.

EXCLUSIONS AND SPECIAL NOTES:
Payment for plantings shall not be paid for under this item and are paid for elsewhere.

Item 2901.1 – Planting Soil

METHOD OF MEASUREMENT:
The unit price bid for Planting Soil will be measured in units of Cubic Yards, complete in place, required to establish finish grades for the planting areas and tree pits, in accordance with the Contract Drawings, and as directed by the Engineer.

BASIS OF PAYMENT:
The unit price for Planting Soil shall be full compensation for all labor, tools, equipment, materials, transport, testing and all incidental labor and materials necessary to complete the work including excavation, placement, compaction, testing and grading, as specified herein, at

the direction of the Engineer, and as shown and detailed on the Contract Drawings.

Item 2901.2 – Bioretention Soil

METHOD OF MEASUREMENT:
The unit price bid for Bioretention Soil will be measured in units of Cubic Yards, complete in place, required to establish finish grades for the biocells, in accordance with the Contract Drawings, and as directed by the Engineer.

BASIS OF PAYMENT:
The unit price for Bioretention Soil shall be full compensation for all labor, tools, equipment, materials, transport, testing and all incidental labor and materials necessary to complete the work including excavation, placement, compaction, testing and grading, as specified herein, at the direction of the Engineer, and as shown and detailed on the Contract Drawings.

Item 2902.1 – Structural Planting Medium

METHOD OF MEASUREMENT*:*
Measurement for Payment shall be based on the Cubic Yards of Structural Planting Medium installed by the Contractor as shown on the Contract Drawings and as directed by the Engineer, complete and in place. Structural Planting Medium shall have a standard section as shown on the Contract Drawings.

BASIS OF PAYMENT:
Payment for Structural Planting Medium shall be based on the unit price bid for this item in the proposal. Under the unit price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete installation of Structural Planting Medium as shown on the Contract Drawings or at the direction of the Engineer. The work includes, but is not limited to the following; testing, excavation, furnishing and installing Structural Planting Medium, compaction; and all incidental work not included for payment elsewhere required to furnish and install Structural Planting Medium whether included here or not.

Item 2903.1 – Trench Drain Inlet – 24-Inch Wide

METHOD OF MEASUREMENT:
Measurement for payment for Trench Drain Inlet – 24-Inch Wide shall be based on the actual number of units installed, as indicated on the Contract Drawings, or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for this item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, and construction methods to furnish and install Trench Drain Inlet – 24-Inch Wide. The work includes, but is not limited to; excavation; installation of gravel subbase; reinforced cement concrete trench drain and curb; rebar; expansion joint; hand placed asphalt at roadway inlet; cast iron angle frame; cast iron grate; and all work not specifically included for payment elsewhere.

Item 2903.2 – PVC Drain Basin – 24-Inch Diameter

METHOD OF MEASUREMENT:
Measurement for payment for Drain Basin – 24-Inch Diameter shall be based on the actual number of units installed, as indicated on the Contract Drawings, or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for this item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, and construction methods to furnish and install Drain Basin – 24-Inch Diameter. The work includes, but is not limited to; excavation; installation of crushed stone bedding; PVC drain basin; inlet/outlet adapters; ductile iron frame and dome grate; and all work not specifically included for payment elsewhere.

Item 2903.3 – Non-Woven Geotextile

METHOD OF MEASUREMENT:
Measurement for payment for Non-Woven Geotextile shall be based on the actual Square Yards of fabric placed during construction, as indicated on the Contract Drawings, or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for this item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, and construction methods to furnish and place Non-woven Geotextile for use surrounding crushed stone and bioretention soil backfill at biocells.

SPECIAL NOTES ON EXCLUSIONS:
This item is intended to include non-woven geotextile for biocell applications only. All other geotextile installed as required by the Contract Documents is incidental to the Contract or paid for as part of a separate Pay Item.

Item 2903.4 – Pipe – Perforated HDPE 8-Inch
Item 2903.5 – Pipe – Perforated HDPE 12-Inch
Item 2903.6 – Pipe – Solid Wall HDPE 12-inch

METHOD OF MEASUREMENT:
Measurement for payment for Pipe – Perforated and Solid Wall HDPE Pipe shall be based on the actual Linear Feet of pipe placed during construction, as indicated on the Contract Drawings, or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for this item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, and construction methods to furnish and place Pipe – Perforated and Solid Wall HDPE Pipe. The work includes, but is not limited to; excavation; placing bedding and backfill; compaction; compaction testing; transporting material to/from soil staging area; furnish and install HDPE pipe, fittings and other appurtenances; connections to

existing and proposed pipes and structures; and all work not specifically included for payment elsewhere.

Item 2903.7 – Energy Dissipator – Type A
Item 2903.8 – Energy Dissipator – Type B

METHOD OF MEASUREMENT:
Measurement for payment for Energy Dissipator shall be based on the actual number of units installed, as indicated on the Contract Drawings, or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, and construction methods to furnish and install each Energy Dissipator. The work includes, but is not limited to; excavation; installation of gravel subbase; reinforced cement concrete dissipator slab; rebar; hand placed asphalt at roadway inlet; granite pavers mortared in place; and all work not specifically included for payment elsewhere.

Item 2903.9 – GSI Improvement – Parking Lot 5
Item 2903.10 – GSI Improvement – Greene-Rose Heritage Park
Item 2903.11 – GSI Improvement – Private Parking Lot Infiltration Systems

METHOD OF MEASUREMENT:
Payment will be made against the allowance based on invoices submitted by the General Contractor on a monthly basis. Invoices shall include a breakdown of hours, labor rates, direct expenses, sub-contractor costs, material costs, and all other costs included in the request. Incomplete or incorrect invoices will not be approved. The General Contractor is allowed up to a 5% mark-up on all subcontractor and 15% markup on all direct costs incurred under this item as supported by invoices. These markups are considered inclusive of supervision, overhead, profit, insurance, and bond. Should the contractor and the City mutually agree on a lump sum for any of these items, the Allowance will be modified to a Lump Sum Item by written agreement. At the end of the Contract, all remaining funds will be deleted from the Contract by a Change Order.

BASIS OF PAYMENT / INCLUSIONS:
The City is considering various storm water infiltration strategies and designs to potentially be implemented; in the City owned Parking Lot # 5 (PL 5) on the corner of Bishop Allen Drive and Norfolk Street, within the City owned Greene-Rose Heritage Park off of Harvard Street by Moore Street, and in privately owned parking lots in the project area. When and if implemented, a design for the infiltration work will be provided to the contractor for installation. Payment for installation of these designs will be made under these Allowance Items.. Only work done for implementation of these designs will be compensated under these items. The contractor will obtain an executed “Right-of-Entry” from the property Owner, and this will be considered incidental for the GSI-related improvements at the noted locations (Parking Lot 5, Greene-Rose Heritage Park, and Private Parking Lots). Should the City decide not to move forward with any or all of the GSI improvements, the Allowance Items will not be used, and the contractor will make no claim for loss of profit or any other impacts.

Item 2904.1 – Precast Porous Concrete Panel

METHOD OF MEASUREMENT:
Measurement for Precast Porous Concrete Panel shall be based on the Square Yards of Precast Porous Concrete Panels placed, complete within the limits shown on the Drawings or as directed by the Owner's Representative and as measured by the Owner's Representative. Placement of Precast Porous Concrete Panel outside the limits defined in the Drawings shall be at no additional cost to the Owner.

BASIS OF PAYMENT / INCLUSIONS:
Payment shall be based on the unit price bid for this item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, and construction method to furnish and install Precast Porous Concrete Panel. The work includes, but is not limited to; excavation; preparation of subgrade; placing crushed stone reservoir course and screeding course; compaction; compaction testing; transporting material to/from soil staging area; installing precast porous concrete panels; PVC liner; expansion joint; joint filler and backer rod; chip stone; biaxial geogrid; protection and cleaning of porous concrete panels before and after installation; and all work not specifically included for payment elsewhere.

Item 2910.1 – Street Tree Pit Preparation

METHOD OF MEASUREMENT:
Measurement for payment will be for the number of street tree pits prepared for planting by the Contractor and accepted in accordance with these Specifications and accepted by the City Arborist and Engineer.

BASIS OF PAYMENT / INCLUSIONS:
The unit price for Street Tree Pit Preparation shall be full compensation for all labor, tools, equipment, materials, and all incidental labor and materials necessary to complete the work, including sidewalk formwork, excavation of soil within the limits of the tree pit, installation of planting soil and mulch as specified herein in order to prepare the tree pit for future tree planting, as directed by the Engineer, and as shown and detailed on the Contract Drawings.

Item 2910.2 – Shade Tree
Item 2910.3 – Ornamental Tree

METHOD OF MEASUREMENT:
Measurement for payment will be for the number of trees of the specified kind and size, as selected by the City Arborist, furnished and planted by the Contractor and accepted in accordance with these Specifications. Measurement for payment will be for the number of trees of the specified kind and size furnished and planted by the Contractor and accepted in accordance with these Specifications. Payment for these items will not occur until the tree is planted and accepted.

BASIS OF PAYMENT / INCLUSIONS:
The unit price per tree planted shall be full compensation for purchasing and delivering, offloading, receiving, handling and caring for all trees in the laydown area and work sites,

transportation between the laydown area and work sites, furnishing and delivering prepared planting soil, mulch, and fertilizer packets, removal of excess surface material at tree pit location, digging of pits, removal of excavated materials, planting of trees, pruning, staking, guying, wrapping, mulching, weeding, watering, cleanup, tree planting establishment work and care, maintenance replacement, and for all labor, equipment, tools and incidentals necessary to complete the work, and for the Contractor's costs of selecting and tagging the trees, and for the two (2) year guarantee and replacement if required.

Item 2910.4 – Weekly Watering and Maintenance During 2-Year Guarantee Period

METHOD OF MEASUREMENT:
Measurement for payment for Weekly Watering and Maintenance During the 2-year Guarantee Period will be on a per Each basis and shall be paid per tree watered and maintained on a weekly basis and as approved by the Engineer and City Arborist. In order to confirm tree watering has occurred, the Contractor will be required to update the work order established with the City's asset management system, at the time each tree is watered. The Contractor shall not be compensated if the watering has not been updated in the asset management system. All payment and quantification of work performed will be based on the Contractor's use of the City's asset management system.

BASIS OF PAYMENT / INCLUSIONS:
The unit price for Weekly Watering and Maintenance During 2-Year Guarantee Period shall be full compensation for all labor tools, equipment, materials, transport and all incidental labor and materials necessary to complete the work, including furnishing and delivering water, watering approximately once a week or as directed by the City Arborist for the 2-year guarantee period, all tree care as described in this specification, meeting with the City Arborist to review watering and maintenance procedures and status, correction of defective work, pruning at the end of the guarantee period, managing watering and maintenance operations utilizing the City's Asset Management System, utilizing the City supplied tablet computer to record all tree watering operations as specified herein and as directed by the Engineer.

Item 2950.1 – Hardscape Back of Sidewalk Restoration

METHOD OF MEASUREMENT:
Measurement for Hardscape Back of Sidewalk Restoration shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer. This item is for work outside of the public right-of way.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Hardscape Back of Sidewalk Restoration shall be based on the square yard of Hardscape Back of Sidewalk installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the Restoration of all Hardscape Back of Sidewalk areas as detailed and where indicated or required by the Owner or Engineer. The work includes, but is not limited to; obtain executed "Right-of-Entry" from the property Owner; sawcutting as necessary; the furnishing of all labor, equipment, appliances, and materials, and in performing all operations in connection with restoration and reconstruction of private property site features to their original condition and location including matching the original patterns of walkways

and driveways such as herringbone, basket weave, running bond, etc. Back of Sidewalk material may consist of, but not limited to, brick, flagstone, cobble stone, concrete, wood, limestone, and gravel walkways and driveways, removing and resetting curbing, walls, stairs, as directed by the engineer and all other work not included for payment elsewhere.

SPECIAL NOTES ON INCLUSIONS/EXCLUSIONS:
The following items are not included for payment under this item; sidewalks, walkways, driveways and all other back of sidewalk areas installed to replace areas damaged by the Contractor during construction. Cement concrete and hot mix asphalt driveways and walkways are not included for payment under this item and are paid for elsewhere. This item includes private property restoration related to adjacent sidewalk and driveway restoration work within the right of way.

Item 2950.2 – Asphalt Back of Sidewalk Restoration

METHOD OF MEASUREMENT:
Measurement for Asphalt Back of Sidewalk Restoration shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer. This item is for work outside of the public right-of way.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Asphalt Back of Sidewalk Restoration shall be based on the square yard of Asphalt Back of Sidewalk installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the Restoration of all Asphalt Back of Sidewalk areas as detailed and where indicated or required by the Owner or Engineer. The work includes but is not limited to; obtain executed “Right-of-Entry” from the property Owner; the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of hot mix asphalt walkways and driveways located on private property; sawcutting for cut-backs in previously disturbed areas; prep, grading, and compaction of all areas to be repaired or replaced; furnish, install, and compact 4” minimum (or match existing thickness) of hot mix asphalt; and all other necessary appurtenant work to reconstruct back of sidewalk areas to their original condition, as directed by the engineer and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not included for payment under this item; sidewalks, walkways, driveways and all other back of sidewalk areas installed to replace areas damaged by the Contractor during construction. Cement concrete and hot mix asphalt driveways and walkways are not included for payment under this item and are paid for elsewhere. This item includes private property restoration related to adjacent sidewalk and driveway restoration work within the right of way.

Item 2950.3 – Landscape Back of Sidewalk Restoration

METHOD OF MEASUREMENT:

Measurement for Landscape Back of Sidewalk Restoration shall be based on the Square Yard installed, complete, within the payment limits, as shown on the Contract Drawings or as required by the Engineer.

BASIS OF PAYMENT / INCLUSIONS:
Payment for Landscape Back of Sidewalk Restoration shall be based on the square yard of landscape Back of Sidewalk installed complete for this item in the proposal. Under the square yard price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the Restoration of all Landscape Back of Sidewalk areas as detailed and where indicated or required by the Owner or Engineer. The work includes but is not limited to; obtain executed "Right-of-Entry" from the property Owner; the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of grass, mulched, and planting areas located on private property, and all other necessary appurtenant work to reconstruct back of sidewalk areas to their original condition, as directed by the engineer and all other work not included for payment elsewhere.

SPECIAL NOTES ON INCLUSIONS/EXCLUSIONS:
The following items are not included for payment under this item; landscape, grass, and mulch areas located within the right of way and locations installed to replace areas damaged by the Contractor during construction. This item includes restoration related to private property restoration related to adjacent sidewalk and driveway restoration work within the right of way.

Item 2950.4 – Carpentry Work at Stairs Restoration

METHOD OF MEASUREMENT:
Payment will be made against the Allowance based on invoices submitted by the General Contractor on a monthly basis. Invoices shall include a breakdown of hours, labor rates, direct expenses, sub-contractor costs, material costs, and all other costs included in the request. Incomplete or incorrect invoices will not be approved.

The General Contractor is allowed up to a 5% mark-up on all costs incurred under this item as supported by the invoices and as approved by the Engineer. At the end of the Contract, all remaining funds will be deleted from the Contract by a Change Order.

BASIS OF PAYMENT / INCLUSIONS:
The allowance for this item shall be reimbursement to the General Contractor to furnish all labor, professional services, technician, equipment, and incidentals for the Contractor to complete Carpentry Work at Stairs Restoration as required by the Engineer and not included in other pay items. Work includes, but may not be limited to; obtaining a building permit and complying with permit and inspection requirements, removing stairways, installing new stairways, modifying existing stairs, and restoration of landscape and hardscape impacted by the work. All work shall be coordinated with the home owner, including obtaining a signed Right-of-Entry.

Item 2980.1 – Warning, Regulatory and Route Marker – Aluminum Panel (Type A)

METHOD OF MEASUREMENT:

Measurement for Payment shall be based on the area (in Square Feet) of each sign installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install warning, regulatory, and route marker signs on existing and new sign posts.

Item 2980.2 – Street Name Sign
Item 2980.3 – Steel Sign Post
Item 2980.4 – Bicycle Ring and Post (City Standard)

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of each street name, sign post, and bicycle ring and post (City Standard) installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install street name signs, sign posts and bicycle ring and posts. Final lay out of proposed signage and bicycle ring and posts for Engineer and City approval is incidental to this item.

Item 2980.5 – Remove, Protect, and Reinstall Existing Memorial Sign

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of each memorial sign and post removed, protected and reinstalled as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to remove, protect, and reinstall existing memorial signs and sign posts. The Contractor is responsible for protection of existing memorial signs and shall replace in-kind any memorial sign or memorial sign post damaged by the Contractor during construction, removal, stacking, or reinstallation at no additional cost to the Owner. Final lay out of memorial sign reinstallation location for Engineer and City approval is incidental to this item.

Item 2980.6 -- Parking Meter Post

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of each parking meter post installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install parking meter posts. The Owner will furnish and install parking meter heads following installation of parking meter posts. The Contractor is responsible for protection of existing parking meter heads and newly installed parking meter heads and shall replace in-kind any parking meter heads damaged by the Contractor during construction at no additional cost to the Owner. Final lay out of proposed parking meter posts for Engineer and City approval is incidental to this item.

Item 2980.7 -- Solar Trash/Recycling Combination

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of each solar trash/recycling receptacle installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install solar trash/recycling receptacles. Final lay out of proposed solar trash/recycling receptacle for Engineer and City approval is incidental to this item.

Item 2980.8 – 4" Bollard

METHOD OF MEASUREMENT:
Measurement for Payment shall be based on the actual number of each 4" bollard installed as indicated in the Contract Documents or as required by the Engineer.

BASIS OF PAYMENT:
Payment shall be based on the unit price bid for each item. The unit price shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work and construction methods to furnish and install 4" bollards.

Item 3300.1 -- Concrete Field Closure - 12-Inch through 30-Inch Diameter
Item 3300.2 -- Concrete Field Closure - 36-Inch Diameter or Greater

METHOD OF MEASUREMENT:
Measurement for payment shall be based on the actual numbers of Concrete Field Closures installed complete and functional as shown on the Contract Drawings or as directed by the Owner or Engineer.

BASIS OF PAYMENT/INCLUSIONS:
Under the Unit Price bid for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and leakage

testing/inspection, complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: exposure and protection of existing underground infrastructure; waterseal/waterstop; reinforcement and doweling; formwork (with removal); Class A and B concrete, and admixtures; brick masonry; dampproofing; concrete testing; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: trenching (paid under installed pipe item); proposed pipe to be connected; disposal of material.

Item 3300.3 -- Tank Access Hatch Replacement

METHOD OF MEASUREMENT:
Measurement for payment of Tank Access Hatch Replacement will be based on a percent complete of the Lump Sum item as approved by the Engineer.

BASIS OF PAYMENT/INCLUSIONS:
The Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, and testing, complete as indicated on the Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not limited to: saw cutting bituminous and reinforced concrete;; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support; construction dewatering; selective concrete demolition; access hatch fabrications; miscellaneous PVC piping; waterstop; epoxy bonding adhesive; reinforcement and doweling; formwork (with removal); Class A and B concrete, and admixtures; concrete testing; filter fabric as required; placement of bedding, including compaction; furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of material.

Item 3410.1 -- Plant Precast Vault – Washington Street Drain
Item 3410.2 -- Plant Precast Vault – Bishop Allen Drive Drain
Item 3410.3 -- Plant Precast Vault – Washington Street Sewer

METHOD OF MEASUREMENT:
Plant Precast Vault at the location indicated shall be paid per each installed complete.

BASIS OF PAYMENT / INCLUSIONS:
Under the Unit Price for this item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required for the complete procurement, installation, cleaning, and leakage testing/inspection complete as indicated on the Contract Drawings and Specifications, or as directed by the Owner or Engineer. The work includes, but is not

limited to: saw cutting bituminous and reinforced concrete; removal of loop detectors; removal of brick, concrete, or bituminous sidewalk; excavation of bituminous concrete roadway; excavation; transporting material to/from soil staging area; temporary excavation support consisting of trench boxes, or timber or steel sheeting left in place and cut off below grade as per the Contract Specifications; sanitary sewer and storm drain flow handling; construction dewatering; filter fabric as required; placement of bedding, including compaction; precast vault sections with frames, covers, masonry chimney, hoods (if applicable), appurtenances, bench, and bituminous damp proofing (if applicable); furnishing, placing and compacting suitable backfill; grade and compact gravel pavement sub-base; compaction testing; and all appurtenances and incidental work.

Adjustment of the frame and cover to final grade, and any adjustments to intermediate grades, are included under this pay item.

EXCLUSIONS
The following item(s) are not included for payment under this item and are included for payment elsewhere: disposal of bituminous concrete and construction debris; treatment of groundwater discharged under a Dewatering Permit; procurement of off-site common fill; procurement, installation, and compaction of CDF.

Item 15252.1 -- Flap Gate – 8-Inch
Item 15252.2 -- Flap Gate – 18-Inch
Item 15252.3 -- Flap Gate – 30-Inch
Item 15252.4 -- Flap Gate – 48-Inch

METHOD OF MEASUREMENT:
Measurement for payment will be based on the actual number of flap gates installed for a given size, complete as shown on the Contract Drawings or as required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Under the per each unit price bid for the item, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals required to install each gate complete as shown on the Contract Drawings or at the requirements of the Engineer. The work includes, but is not limited to: flap gate with wall thimble or other specified mounting, gaskets and appurtenances; protective coatings; connections to existing and proposed pipes and structures; inspection and testing; supports; and all incidental work required for the installation of gates not specifically included for payment elsewhere.

Item 16050.1 – Electrical Cabinet with Panel and Associated Components

METHOD OF MEASUREMENT:
Measurement for payment for Item 16050.1 will be based on the actual number of Electrical Cabinets with Panel and Associated Components installed, as shown on the Contract Drawings or as otherwise required by the Engineer and as measured by the Engineer. This item is for the

electrical cabinet proposed in Greene-Rose Heritage Park related to the installation of EV charging stations on Harvard Street.

BASIS OF PAYMENT:
Payment for work under Items 16050.1 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a certified electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; procurement of electrical cabinet, storage and protection of electrical cabinet before installation; installation of footings; installation of electrical cabinet and all accessories shown on the plans and required by the Owner; temporary wiring for existing park lighting and other electrical components; coordination with Eversource Electric for upgraded electric service; final wiring and start-up of electrical cabinet; and all other work not included for payment elsewhere. No components from the existing cabinet shall be reused as part of the new cabinet installation.

NOTES ON EXCLUSIONS:
This item does not include payment for installation of the electrical cabinet on Bishop Allen Drive which is paid for under a separate item.

Item 16050.2 – Greene-Rose Park Electrical Cabinet Demolition

METHOD OF MEASUREMENT:
Measurement for payment for Item 16050.2 will be based on full completion as approved by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16050.2 will be based on the Lump Sum price bid for this item in the proposal and shall include full compensation for all labor, including by a certified electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; de-energizing and confirmation of de-energization of conductors entering the existing cabinet; demolition and disposal of existing electrical cabinet; providing temporary connections to existing park electric components; coordination of work with Eversource Electric and the Owner; and all other work not included for payment elsewhere.

Item 16050.3 – Greene-Rose Park EV Charger Park Restoration

METHOD OF MEASUREMENT:
Measurement for payment for Item 16050.3 will be based on full completion as approved by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16050.3 will be based on the Lump Sum price bid for this item in the proposal and shall include full compensation for all labor, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; restoration of all surfaces, hardscapes, and landscapes in Greene-Rose Heritage Park that are impacted by the removal and demolition of the existing cabinet and the installation of the proposed electrical cabinet and footing, conduit, handholes and all other required work outside

of the limit of sidewalk restoration shown on Harvard Street; and all other work not included for payment elsewhere. Restoration shall be in-kind matching the existing materials, backfill, subbase, and existing material depths including the landscaping, and HMA pathways.

NOTES ON EXCLUSIONS
This item shall include full payment for all restoration work within Greene-Rose Heritage Park impacted by the installation of the EV charging station electrical cabinet and conduits. Separate items included in this Contract for Back of Sidewalk Restoration shall not be used for this work.

Item 16110.1 2-Inch Electric Conduit (Single) Concrete Encased
Item 16110.2 2-Inch Electric Conduit (Double) Concrete Encased
Item 16110.3 3-Inch Electric Conduit (Double) Concrete Encased
Item 16110.4 4-Inch Electric Conduit (Double) Concrete Encased

METHOD OF MEASUREMENT:
Measurement for payment for Items 16110.1 through 16110.4 will be based on the linear foot of conduit installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16110.1 through 16110.4 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including installation by a licensed electrician, materials, equipment, and any other incidental costs necessary for the satisfactory completion of this work including but not limited to removal and disposal of the existing conduit within limits of trench; abandonment of existing conduit and wiring; saw cutting the roadway and/or sidewalk; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install conduit, fittings, spacers, pull ropes in all spare conduits, and warning tape, formwork, and concrete for concrete encasement; and all other work not included for payment elsewhere.

No separate payment shall be made for marking tape, pull rope, concrete, or any incidental materials, but all costs in connection therewith shall be included in the Contract unit price per foot for these Items.

NOTES ON EXCLUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately. Electric conduit and encasement for lighting infrastructure is not included for payment under this item and shall be paid for separately.

Item 16110.5 Eversource Electric Handhole
Item 16110.6 City Electric Handhole

METHOD OF MEASUREMENT:
Item No. 16110.5 through 16110.6 will be measured by the unit Each Handhole installed complete, which price and payment shall constitute full compensation for complete compliance

with requirements of this item, including all labor, equipment, materials, tools, incidental work, excavation, backfill, compaction and construction methods.

BASIS OF PAYMENT:
Payment for work under these items shall constitute full compensation for all labor, including installation by a licensed electrician, materials, equipment, and any other incidental costs necessary for the satisfactory completion of this work including but not limited to sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install handhole and appurtenances; removal of existing handhole and conduit, and all other work not included for payment elsewhere.

NOTES ON EXCLUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately. Handholes for lighting infrastructure is not included for payment under this item and shall be paid for separately.

Item 16110.7 – Ground Rod – 10-FT Long

METHOD OF MEASUREMENT:
Measurement for payment for Item 16110.7 will be based on each ground rod installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16110.7 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; Dig-Safe notification and compliance; furnish and install ground rod with any necessary wiring and bonding connections, and all other work not included for payment elsewhere.

Item 16120.1 Wire No. 6 AWG General Purpose
Item 16120.2 Wire Type 7 No. 8 General Purpose

METHOD OF MEASUREMENT:
Measurement for payment for Items 16120.1 through 16120.2 will be based on the linear foot of wiring installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16120.1 to 16120.2 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; installation of wire and cable runs; splices with compression type fittings; installation of circuit breakers; and all other work not included for payment elsewhere.

SPECIAL NOTES ON EXCLUSIONS:
The following items are not paid for under this item as they are paid for elsewhere: electrical wiring for street lighting.

Item 16130.1 - Single EV Charging Station
Item 16130.2 - Dual EV Charging Station

METHOD OF MEASUREMENT:
Measurement for payment for Item 16130.1 through 16130.2 will be based on the actual number of Single and Dual EV Charging Stations installed, as shown on the Contract Drawings or as otherwise required by the Engineer and as measured by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16130.1 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; procurement of EV Charging Stations, storage and protection of EV Charging Stations before installation; installation of footings; installation of EV Charging Stations; final wiring and start-up of EV Charging Stations; and all other work not included for payment elsewhere.

Item 16135.1 – 2-Inch Electrical Conduit (Single) Concrete Encased (Lighting)
Item 16135.2 – 3 or 4 -Inch Electrical Conduit (Single) Concrete Encased (Lighting)

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.1 through 16135.2 will be based on the Linear Foot of conduit installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.1 through 16135.2 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including installation by a licensed electrician, materials, equipment, and any other incidental costs necessary for the satisfactory completion of this work including but not limited to removal and disposal of the existing conduit within limits of trench; abandonment of existing conduit and wiring; saw cutting the roadway and/or sidewalk; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install conduit, fittings, spacers, pull ropes in all spare conduits, and warning tape, formwork, and concrete for concrete encasement; and all other work not included for payment elsewhere.

No separate payment shall be made for marking tape, pull rope, concrete, or any incidental materials, but all costs in connection therewith shall be included in the Contract unit price per foot for these items.

NOTES ON EXCLUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately.

Item 16135.3 – Electric Handhole (Lighting) – Municipal Standard

METHOD OF MEASUREMENT:
Item No. 16135.3 will be measured by the unit Each installed complete, which price and payment shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, excavation, backfill, compaction and construction methods.

BASIS OF PAYMENT:
Payment for work under these items shall constitute full compensation for all labor, including installation by a licensed electrician, materials sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install handhole and appurtenances; removal of existing handhole and conduit, and all other work not included for payment elsewhere.

NOTES ON EXLCUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately.

Item 16135.4 – Light Standard Foundation (Standard Precast)

METHOD OF MEASUREMENT:
Item No. 16135.4 will be measured by the unit Each installed complete, which price and payment shall constitute full compensation for complete compliance with requirements of this item, including all labor, equipment, materials, tools, incidental work, excavation, backfill, and construction methods.

BASIS OF PAYMENT:
Payment for work under these items shall constitute full compensation for sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.), compaction and backfilling with suitable fill, furnish and install precast foundation, and all other work not included for payment elsewhere.

NOTES ON EXLCUSIONS:
Disposal of any excavated soil not suitable for re-use is not included for payment under this item and shall be paid for separately.

Item 16135.5 – Ground Rod – 10-FT Long

METHOD OF MEASUREMENT:
Measurement for payment for Item 16135.5 will be based on each ground rod installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.5 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; Dig-

Safe notification and compliance; furnish and install ground rod with any necessary wiring and bonding connections; and all other work not included for payment elsewhere.

Item 16135.6 – LED Luminaire and Pole (1 Head)
Item 16135.7 – LED Luminaire and Pole (2 Head)
Item 16135.8 – Contemporary Luminaire and Pole

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.6 through 16135.8 will be based on each Light assembly installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
This work shall be measured for payment for each Item, furnished, installed, wired and lamped in place, which price shall include all materials, labor, including by a licensed electrician, and equipment for a complete and accepted installation. Only functional luminaires shall be eligible for payment under this item. This item includes all wiring and connections within the Luminaire and Pole. No separate measurement for wire within the Pole or fixtures shall be made.

Item 16135.9 – Remove and Stack Existing Street Light

METHOD OF MEASUREMENT:
Payment for work under this Item shall be at the Contract Unit Price bid per Each, which price shall constitute full compensation for the complete removal of existing street lights, and any charges for disconnection.

BASIS OF PAYMENT:
The Contractor shall coordinate with City of Cambridge before starting any work. The work shall include disconnecting wiring, removing and stacking of luminaires at the City's DPW Yard, delivery to Cambridge Electrical Department (CED) Yard any aluminum poles requested for salvage by CED, removal and disposal of unwanted poles, foundations, conduit and hand holes no longer required for proposed installations, and repairing the disturbed area to match surrounding surfaces. In special case, the existing foundation and the like can be left in place, as approved by the Engineer.

Item 16135.10 – Wire Type 7 No. 8 General Purpose
Item 16135.11 – Wire Type 7 No. 4 General Purpose
Item 16135.12 – Wire Type 7 No. 3/0 General Purpose
Item 16135.13 – Wire Type 10 No. 8 Grounding and Bonding
Item 16135.14 – Wire Type 10 No. 6 Grounding and Bonding
Item 16135.15 – Wire Type 10 No. 4 Grounding and Bonding

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.10 through 16135.15 will be based on the linear foot of wiring installed as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.10 to 16135.15 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; installation of wire and cable runs; splices with compression type fittings; and all other work not included for payment elsewhere.

Item 16135.16 – Lighting Control Cabinet

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.16 will be based on each control cabinet installed, components and electrical service as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.16 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; procurement of lighting control cabinet, storage and protection of lighting control cabinet before installation; installation of footings; installation of lighting control cabinet and all accessories shown on the plans and required by the Owner; temporary wiring for existing Parking Lot lighting and other electrical components; coordination with Eversource Electric for upgraded electric service; final wiring and start-up of lighting control cabinet; and all other work not included for payment elsewhere.

Item 16135.17 – Connect to Existing Conductors for Pole Replacements

METHOD OF MEASUREMENT:
Measurement for payment for Item 16135.17 will be based on Each Connection to Existing Conductors for Pole Replacement completed as part of the streetlight footing and pole replacements as indicated in the Contract Documents or as otherwise required by the City or Engineer. This will include all connections made within six-feet of an existing light pole foundation and is for permanent connections only.

BASIS OF PAYMENT:
Payment for work under Items 16135.17 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; scheduling and coordination with Cambridge Electrical Department (CED) and Eversource Electric; sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of construction debris (existing sidewalk, concrete, brick, asphalt, etc.); location and exposure of existing power supply conduits at existing light pole foundations; close coordination with (CED) and Eversource Electric to pull existing conductors back from the foundation to allow a new foundation to be installed, re-feed conductors through new conduit and the new foundation base; concrete encasement, back fill with gravel, place marker tape; and make any splices necessary to complete the foundation and pole replacement. This item also includes the removal and disposal of existing conduits and all other work not included for payment

elsewhere. Should CED determine that a new Handhole is required, the handhole will be installed and compensated under the Handhole Item. All splices and junctions shall be made waterproof by a UL approved method. Conductor splice shall be made by UL listed compression type butt splice kit. Waterproofing method shall be by heat shrink, by sealant in waterproof splice cap, or by sealant in cold shrink.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete, and construction debris from roadway areas; Electric Handholes; concrete encased conduit (all sizes); Wire (all sizes); Light Standard Foundation; Luminaire and Pole (all types); Replacement of existing conduit for distances greater than six-feet; and temporary paving.

Item 16135.18 – Light Pole Overhead Connection (Temporary and Permanent)

METHOD OF MEASUREMENT:
Measurement for payment for Items 16135.18 will be based on each overhead light pole temporary or permanent connection, wiring, components and coordination and as indicated in the Contract Documents or as otherwise required by the Engineer.

BASIS OF PAYMENT:
Payment for work under Items 16135.18 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by a licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; temporary or permanent overhead installation of wire and cable runs; splices with compression type fittings; removal of temporary installations; and all other work not included for payment elsewhere. All work shall be coordinated with Cambridge Electric Department prior to installing any overhead connections.

Item 16135.19 – Replace Existing Conduit at Street Lights

METHOD OF MEASUREMENT:
Measurement for payment for Item 16135.19 will be based on the Linear Feet of conduit replacement at existing street lights as directed by the Cambridge Electrical Department (CED). This item is for replacement of existing failed or failing conduits that are currently servicing existing street lights. This will be used only when directed by CED or the Engineer and is compensation for replacing conduit beyond the six-feet currently included in Bid Item 16135.17.

BASIS OF PAYMENT:
Payment for work under Items 16135.19 will be based on the unit price bid for this item in the proposal and shall include full compensation for all labor, including by licensed electrician, materials, tools, equipment, and any other incidental costs necessary for the satisfactory completion of this work including; scheduling and coordination with Cambridge Electrical Department (CED) and Eversource Electric; sawcutting; excavation of existing pavement and gravel in roadway areas and asphalt, brick and concrete sidewalk pavements; disposal of

construction debris (existing sidewalk, concrete, brick, asphalt, etc.); exposure of existing power supply conduits at greater than six-feet from existing light pole foundations; close coordination with (CED) and Eversource Electric to add or replace failed or failing conduits; install new conduit or split duct of the size required; formwork if needed, concrete encasement, back fill with gravel, place marker tape; removal and disposal of existing conduits; and all other work not included for payment elsewhere. Should CED determine that a new Handhole is required, the handhole will be installed and compensated under the Handhole Item.

SPECIAL NOTES ON EXCLUSIONS:
The following item(s) are not included for payment under this item and are included for payment elsewhere: excavation of bituminous and cement concrete in roadway; disposal of bituminous and cement concrete, and construction debris from roadway areas; Electric Handholes; Wire (all sizes); Light Standard Foundation; Luminaire and Pole (all types) and temporary paving.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01025

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01040

PROJECT COORDINATION AND MEETINGS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes general coordination requirements including preconstruction conference, site mobilization conference, and progress meetings.

1.2 RELATED SECTIONS

A. Specification Section 01311 – SCHEDULING AND REPORTING

1.3 CONTRACTOR COORDINATION

A. Coordinate scheduling, submittals, and the Work to assure efficient and orderly sequence of installation of interdependent construction elements.

B. Coordinate completion of the Work and clean up for Substantial Completion and for portions of Work designated for Owner's partial utilization.

C. Coordinate access to site for correction of nonconforming Work to minimize disruption of Owner's activities where Owner is in partial utilization.

D. Contractor to provide a full-time onsite superintendent for the duration of the project. Refer to Specifications – Statement of Bidder’s Qualifications for superintendent experience requirements.

E. Coordination is considered incidental to the project; no additional payment will be authorized.

F. Construction shall be coordinated with adjacent projects within the City of Cambridge. These projects include, but may not be limited to, the following:

1. Port Infrastructure Phase II Project – Package 2 anticipated to begin construction in Summer 2027. This contract will include work on the adjacent streets including Washington Street, Pine Street, Cherry Street, School Street, Eaton Street, and Windsor Street.

2. Improvements to Clement G. Morgan Park and Paolillo Tot Lot Project

3. Eversource Electric duct bank installation/relocation on Harvard Street

4. Eversource Gas relocation on Harvard Street

5. All utility conflict relocations indicated on the Project U-Sheets.

G. Contractor shall attend all City of Cambridge Utility Coordination meetings. Meetings typically occur virtually on Mondays at 9:15 a.m., unless otherwise scheduled for in person meetings which would typically take place at the City of Cambridge Public Library at 449 Broadway. Meetings typically run between April and November.

1.4 PRECONSTRUCTION CONFERENCE

A. The Owner will schedule a preconstruction conference.

B. Attendance Required: Owner's representatives, Engineer, Contractor, Contractor's Project Manager and Superintendent and major Subcontractors.

C. Sample Agenda:

1. Designation of personnel representing the parties in Contract and the Architect/Engineer.

2. Description of the Project background, purpose, basis of design and major elements of the Work.

3. Community relations requirements

4. Soil and waste management requirements

5. Major geotechnical requirements such as temporary support of excavation; backfill and compaction; geotechnical instrumentation and monitoring, and dewatering.

6. Requirements and procedures for the submission of change orders and pay requisitions.

7. Requirements, procedures and processing of shop drawings and other submittals; schedules and schedule updates; substitutions; and Requests for Information.

8. Scheduling of the Work and coordination with other contractors.

9. Review of Subcontractors.

10. Continuation of City services (trash and rubbish removal, recycling, street sweeping, and snow removal).

11. Meeting requirements (Progress, Work Shops, etc.)

12. Utility coordination

13. Traffic and pedestrian management requirements

14. Refer to Specification Section 01311 – SCHEDULING AND REPORTING for initial schedule submittals.

15. Other

1.5 PROGRESS MEETINGS

A. Project meetings shall be held at a location designated by the Owner and Engineers. Meetings shall be held at weekly intervals, or more frequent intervals if required by the Owner or Engineer.

B. Attendance required: job Superintendent, Contractor's Project Manager, major Subcontractors and suppliers, Owner representatives, and Engineer as appropriate to agenda topics for each meeting.

C. The Owner or Engineer or their representative will make arrangements for meetings, and record minutes.

D. The Owner or Engineer or their representative will prepare the agenda and preside at meetings.

E. Contractor shall provide required information and be prepared to discuss each agenda item.

F. Sample Agenda:

1. Review minutes of previous meetings.

2. Community relations.

3. Review of work progress. Review of work completed work on going and work scheduled within the coming month.

4. Field observations, problems, and decisions.

5. Identification of problems which impede planned progress.

6. Review of submittals schedule and status of submittals.

7. Review of RFI and RFP status.

8. Proposed Change Orders (PCO), claims, credits, Work Change Directive, and change order status.

9. Review of off-site fabrication and delivery schedules.

10. Maintenance of progress schedule.

11. Corrective measures to regain projected schedules.

12. Maintenance of quality and work standards.

13. Effect of proposed changes on progress schedule and coordination.

14. Other item relating to Work.

1.5 COMMUNITY MEETINGS

A. The job Superintendent, Contractor's Project Manager, or other representative acceptable to the Owner will occasionally be required to attend Project related community meetings at a location designated by the Owner or Engineer.

B. The Contractor shall be prepared to present a Project schedule and Sequencing Plan outlining the major components and the overall proposed plan for completing the work at a community meeting within 30 days of Notice to Proceed.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01040

SECTION 01045

CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies administrative and procedural requirements for cutting and patching.

B. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section do not apply to mechanical installations.

1.2 SUBMITTALS

A. Submit proposed procedures for cutting and patching at a minimum of four (4) weeks in advance of the time cutting and patching will be performed. The submittal shall contain, but not be limited to the following information:

1. Describe the extent of cutting and patching required and how it is to be performed; indicate why it cannot be avoided.

2. Describe anticipated results in terms of changes to existing or proposed construction; include changes to structural elements and operating components.

3. List firms or entities that will perform Work.

4. Indicate dates when cutting and patching is to be performed.

5. List utilities, service, or performance that will be disturbed or affected and indicate how long service will be disrupted.

6. Where cutting and patching involves addition of reinforcement to structural elements, submit details stamped by a Massachusetts Professional Engineer to show how reinforcement is integrated with the original structure.

B. Review by the Engineer prior to proceeding with cutting and patching does not waive the Engineer's right to later require complete removal and replacement of a part of the Work found to not meet the requirements of the Contract.

1.3 QUALITY ASSURANCE

A. Requirements for Structural and Utility Work: Do not cut and patch structural elements in a manner that would reduce their load-carrying capacity or load-deflection ratio.

1. Submit the cutting and patching proposal, including a structural analysis and design of additional reinforcement, stamped by a Massachusetts Professional Engineer, before cutting and patching.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance, or decreased operational life or safety.

1. Submit the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:

a. Shoring, bracing, and sheeting.

b. Primary operational systems and equipment.

c. Control systems.

d. Electrical wiring systems.

C. Visual Requirements: Do not cut and patch construction exposed on the exterior, in a manner that would, in the Engineer's opinion, reduce aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work that has been cut and patched that does not meet requirements of the Contract as determined by the Engineer.

1. Retain the original installer or fabricator to cut and patch or if it is not possible to engage the original installer or fabricator, engage another recognized experienced and specialized firm acceptable to the Engineer:

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use materials whose installed performance will equal or surpass that of existing materials.

B. Where cutting and patching occurs on exposed exterior structures or work, use materials that are identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible with regard to

visual effect.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

1. Before proceeding, meet at the site with parties involved in cutting and patching, including but not limited to mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project that might be exposed during cutting and patching operations.

C. Take all precautions to avoid cutting existing pipe, conduit or duct banks that are scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING

A. General: Employ skilled workmen to perform cutting and patching. Complete cutting and patching without delay.

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

C. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction. Where possible, review the proposed procedures with the original installer or manufacturer or with an installer or manufacturer with similar experience. Comply with the installer's and / or manufacturer’s recommendations.

D. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

E. Cut through concrete and masonry using a cutting machine such as carborundum saw or diamond core drill.

F. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned. Cap, valve or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

3.4 PATCHING

A. Inspect and test patched areas to demonstrate integrity of the installation.

3.5 CLEANING

A. Thoroughly clean areas where cutting and patching is performed or used as access. Remove completely mortar, oils, reinforcing, concrete, masonry and items of similar nature. Thoroughly clean piping, conduit and similar features before finishing is applied. Restore damaged pipe to its original condition.

END OF SECTION 01045

SECTION 01060

PERMITS AND REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 REGULATORY AGENCIES

A. The Contractor shall comply with all laws, rules, and regulations and ordinances promulgated by any authority having jurisdiction over the Work.

B. The Contractor shall be fully responsible for obtaining and complying with all required permit(s). The Contractor shall be responsible for including all costs and fees required to obtain and comply with the permits, in the Bid. The Contractor shall ensure that all necessary permits from the Department of Public Safety, Cambridge Fire Department, Cambridge Police Department, Cambridge Electrical Department, Cambridge Water Department, Cambridge Parks Department, Cambridge Department of Public Works, Cambridge Transportation Department, Massachusetts Water Resource Authority, Massachusetts Department of Environmental Protection, Massachusetts Bay Transit Authority and all other regulatory agencies and/or inspectional authorities having jurisdiction are obtained and paid for by the Contractor or its subcontractor (s) as appropriate. Permit fees will be waived for permits administered by the Cambridge Department of Public Works and Cambridge Transportation Department.

1.2 PERMITS OBTAINED BY THE CONTRACTOR

A. The Contractor or its subcontractor shall be responsible for obtaining; paying for; and complying with, as part of its base Bid, all permits; licenses; certifications; and approvals required for the work of this contract. The Contractor's responsibility includes but is not limited to, all permits required for his equipment, work force, and particular operations such as transportation and storage of fuel, chemicals or other materials and air emission.

B. At a minimum, the Cambridge Department of Public Works and Cambridge Transportation Department permits that the Contractor shall be responsible for obtaining and complying with include, but are not limited to, the following:

1. Excavation Permit

2. Street Obstruction Permit

3. Sidewalk Obstruction Permit

4. Street Closing Permit

5. Traffic Management Plans including Detours

6. Pedestrian Management Plans

7. Water Construction Permit

    a. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements include accurate and legible swing tie dimensions to all new water main gate valves, tee's and elbows, required CWD "sign off's" on the Contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The contractor is hereby advised that the CWD will not be responsible for the contractor's slip in project schedule if these requirements for permits are not followed.

8. Noise Variance

    a. For work outside regular hours of construction. Regular hours of construction are Monday through Friday from 7:00 am to 6:00 pm and Saturday 9:00 am to 6:00 pm.

C. At a minimum, the other Permits the Contractor shall be responsible for obtaining, paying for, and complying with include, but are not limited to, the following:

1. NPDES Dewatering General Permit

2. MWRA Dewatering Permit

3. MBTA License Agreement

    a. The City has obtained an MBTA Zone of Influence License for work near the MBTA Red Line tunnel at the intersection of Main Street and Bishop Allen Drive. The Contractor shall comply with all requirements. See Appendix for the license agreement, permit requirements, and insurance limits.

    b. Contractor shall prepare a work plan and schedule as described in the License Agreement Exhibit B – Scope of Activity. Work plan and schedule shall be submitted to the Engineer for review, and then submitted by the Contractor to MBTA. Contractor shall also submit a completed License

Agreement with signature, and certificate of insurance meeting the permit requirements.

4. MWRA Water 8(m) Permit

The City has submitted application for an MWRA Water 8(m) Permit for Work within all of Norfolk Street and Bishop Allen Drive from Prospect to Norfolk Street. The Contractor shall comply with all permit requirements. The anticipated permit requirements include the following, and should be assumed by the Contractor. Contractor shall also comply with additional requirements not included herein once the permit has been issued. The Contractor shall take note that it is anticipated that a non-standard approach, including modifications to allowable construction equipment, will be required when completing full-depth roadway reconstruction on Bishop Allen Drive and Norfolk Street due to the shallow nature of the MWRA's pipeline and the MWRA's permit requirements:

a. The Contractor shall develop and submit a construction plan along with an analysis of the MWRA's pipeline (prepared by a professional engineer licensed in the state of Massachusetts). The pipeline analysis shall take into consideration the construction equipment, which would be used over the Authority's pipeline in instances where the existing roadway surface will be completely excavated away removing the protection of the HS-20 asphalt surface loading barrier. The Contractor must coordinate with and get approval from the MWRA prior to any work being done on Norfolk Street and Bishop Allen Drive.

b. Prior to entry, Permittee or its designee shall provide at least seventy two (72) -hours prior notice to the MWRA's Inspection Department, by calling (617) 305-5833, located at 2 Griffin Way, Chelsea, MA 02150.

c. A minimum vertical clearance of eighteen (18) inches shall be maintained between the MWRA's water mains and other utility crossings unless otherwise noted. However, water/gas and other utility service crossings with a pipe size diameter of two (2) inches or less maybe permitted to cross above the MWRA's pipeline at a reduced clearance subject to MWRA's review. (Except for special provisions, i.e. capped or plugged pipes, thrust blocks and or bends, which would require a greater clearance and separation).

d. A minimum of three (3) feet to five (5) feet horizontal clearance is required between adjacent utilities and the side (spring line) of any MWRA water main. (Except for special provisions, i.e. capped or plugged pipes, thrust blocks, and/or pipe bends,

which would require a greater clearance separation).

e. Crossings of MWRA water mains shall be located a minimum horizontal distance of at least four (4) feet from any joints of the MWRA's water mains.

f. Proposed pipe/utility crossings of the MWRA's water mains shall cross at a ninety (90) degree angle to minimize interference.

g. For distances over four (4) feet of the MWRA's water mains, which are to be undermined, the method and type of pipe support plan shall be submitted and stamped by a Professional Engineer (P.E.) licensed in Massachusetts for prior approval by the MWRA.

h. For distances under four (4) feet from the MWRA's water mains, which are to be undermined, the on-site MWRA inspector shall review and approve the proposed support of the water main. Under no circumstances shall the MWRA's water main be left in an unsupported, undermined position overnight.

i. During construction, appropriate sheeting measures must be taken to protect the integrity of the MWRA's water mains. The sheeting design must be reviewed by the MWRA prior to the start of the construction. The design shall be stamped by a Professional Engineer, licensed in Massachusetts. The use of a Trench Box is not permitted in this application.

j. Suitable compaction methods shall be employed in restoring the beds of the MWRA's water mains and backfilling around the MWRA's water mains shall be placed in maximum six (6) inch lifts and compacted by hand vibratory compactors.

k. The MWRA's water mains shall be protected at all times during construction. The MWRA may require a professional engineer licensed in the State of Massachusetts to submit a construction plan and or pipeline analysis that is to be attached to this Permit.

l. Screened gravel shall be uniformly graded with maximum size of a particle between 3/8 inch and 3/4 inch. Screened gravel shall consist of clean, hard and durable particles free from an excess of soft, elongated and disintegrated pieces or other objectionable material. Crushed rock of suitable size and grading maybe used in place of screened gravel at the option of the MWRA Inspector.

m. For test pit excavations or unearthing of the MWRA's water mains the Permittee shall excavate the last two (2) feet, before the top of pipe, by hand or use a vacuum boring method and backfill with approved material within an fee interest, easement or roadway area.

n. The Permittee is responsible to adjust any or all MWRA frames and covers to grade within their limits of work in accordance with the plans referenced in this Permit. The MWRA will provide the Permittee with new replacement MWRA frames and covers (at no expense to the Permittee) for any existing frames and covers that have been deemed unusable by MWRA personnel.

o. All MWRA manhole openings that were covered during the binder course installation shall be made accessible within forty eight (48) hours. MWRA manhole frame and covers shall not be removed for grinding and or pulverizing. Pulverizing is not allowed over MWRA manhole structures.

p. The Permittee shall provide a logistics construction schedule in writing, along with emergency contact information whenever MWRA valves (manhole covers) or facilities are covered or obstructed.

q. MWRA Inspection personnel must be on site whenever excavation, construction, hoisting or rigging occurs around an MWRA water main.

r. No construction equipment including cranes, backhoes, or material may be parked, stationed, set up, or stored on top of the MWRA's water mains or infrastructure.

s. Replacement (shutdown) of the MWRA's water mains shall be coordinated with the MWRA. Four (4) weeks-advanced notice in writing is required for shutdowns.

t. The Permittee or its designee shall contact the MWRA three (3) weeks in advance of when an MWRA water main valve must be operated. Only MWRA personnel will operate MWRA valves. The Permittee or its designee shall not operate any MWRA water main valves. MWRA Valve Operations are limited during peak demand periods and may not be available between the dates of May 15th and September 15th of each calendar year.

u. The Permittee will be responsible to protect and correct any damage(s) to the MWRA's property, water main pipelines

and/or any related infrastructure at no cost to the MWRA.

v. As-built drawings shall be furnished to the MWRA upon the completion of the work authorized by this Permit. A Professional Massachusetts Registered Land Surveyor or Engineer shall stamp as-built drawings.

w. MWRA Detail Records "field sketches" shall be updated (with accurate field ties) by the Permittee and shall be furnished to the MWRA upon the completion of the work authorized by this Permit.

x. The Permittee understands and agrees that the MWRA and its successors and assigns are not responsible for any damage and/or claims for damages to the Permittee's structures, conduits, facilities and/or property permitted pursuant to this permit as a result of the MWRA's operation, maintenance, repair, and/or replacement of MWRA's infrastructure, or as a result of the failure of an MWRA water main, and that the Permittee shall be solely responsible for replacing and/or repairing said structures and for any costs related thereto, as a result of MWRA's activities, including but not limited to, the operation, maintenance, repair, and/or replacement of MWRA's infrastructure, or as a result of the failure of an MWRA water main. Further, the Permittee shall hold the MWRA and its successors and assigns harmless from any damages and/or claims for damage to the Permittee's structures, conduits, facilities and/or property permitted pursuant to this permit as a result of the MWRA's operation, maintenance, repair, and/or replacement of MWRA property, or as a result of the failure of an MWRA water main.

y. This Permit addresses only MWRA-owned and operated infrastructure. The Permittee is required to obtain all needed separate approvals from Cities, Towns, State Agencies or other entities.

z. The work authorized by this Permit and location of installed facilities and appurtenances shall not deviate from the construction plan that is referenced in this Permit. No field changes are allowed without prior review and written approval by the MWRA 8(m) Permit Project Manager. An MWRA on-site inspector shall review all field changes and coordinate with the Permittee regarding submitting a change of work plan to the MWRA for review and comment. If MWRA field inspection indicates changes undertaken without approval, the Permittee may be issued a cease and desist order and be required to correct/reconstruct any completed work.

aa. The MWRA requires a construction plan along with an analysis of the MWRA's water main pipeline (prepared by a professional engineer licensed in the State of Massachusetts). The pipeline analysis shall take into consideration the construction equipment, which would be used over the MWRA's water main pipeline in instances where the existing roadway surface will be completely excavated away removing the protection of the HS-20 surface loading barrier. This Plan and supporting calculations will need to be submitted to the MWRA for review.

bb. The MWRA requires the submittal of "Cut Sheets and or Shop Drawings" for review of all newly proposed materials that will come under the ownership of the MWRA.

cc. Where pipe jacking is required for work that is in close proximity to the MWRA's water mains, submittals prepared by a professional engineer and reviewed by the MWRA are required.

dd. Permittee shall not expose the spring line or undermine the MWRA's water main pipeline. The Permittee or its designee shall cease excavation operations and secure the open trench by backfilling the open trench to secure the MWRA's water main pipeline whenever the spring line is expose

ee. In instances where the layout of the MWRA water mains are to be accurate and precise beyond the MWRA's regular mark out services the Permittee, at the direction of the MWRA, shall have a professional land surveyor licensed in Massachusetts mark out MWRA water mains using field survey instruments.

ff. Disinfection of MWRA pipelines includes the entire isolated length of MWRA's pipeline(s). Disinfection is the responsibility of the applicant including independent lab testing procedures in accordance with MWRA standards.

5. MWRA Wastewater 8(m) Permit

a. The City has submitted application for an MWRA Wastewater 8(m) Permit for Work within Portland Street. The Contractor shall comply with all permit requirements. The anticipated permit requirements include the following:

b. Permittee shall be responsible to stay apprised of and comply with all applicable federal, state and local laws, rules, and orders including, but not limited to, guidelines and

requirements for construction sites, and all supplements, amendments and/or changes thereto and notices thereof. Prior to commencing work pursuant to this Permit, Permittee shall have obtained all other required permits, written approval(s) and necessary authorizations to perform the work. Failure to comply with the terms stated herein shall render this Permit null and void by the Authority, and Permittee shall bear all responsibility, liability, damages and costs arising from the Permittee's noncompliance.

c. Permittee's use of the permitted land shall at no time interfere with the Authority's activities or operations on the permitted land. The Authority has the right to review and approve all of the Permittee's work including such plans and specifications, as the Authority deems necessary. Any proposed future work beyond the scope of this Permit shall have the prior written approval of the Authority.

d. To the fullest extent permitted by law, the Permittee shall indemnify, defend with counsel acceptable to the Authority, keep and save harmless the Authority and its board members, officers, representatives, contractors, agents, employees, successors, and assigns, in both their individual and official capacities, against all suits, claims, liabilities, damages, losses (including but not limited to loss of use resulting therefrom) and expenses, including but not limited to attorney's fees, caused by, arising out of or resulting from any work or activity under this Permit and/or act, omission, breach or default of the Permittee or of any contractor, subcontractor of vendor of the Permittee or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder.

e. The granting of this Permit shall in no way interfere with the rights of the Authority to exercise its existing rights in or over the permitted land. Permittee acknowledges that the Authority, within its sole discretion, may enter upon the permitted land at any time in order to carry out inspections, maintenance, repairs, replacements, or other activities.

f. The Authority may revoke this Permit at any time. The sale or disposition of the permitted land by its owner will cause this Permit to terminate without further notice. Permittee shall give the Authority at least 72 hours notice before commencing the operations as pursuant herein. This Permit shall not be assigned or transferred.

g. No blasting, drilling or other activity that could in any way affect the integrity or operability of the Authority's property or use of the permitted land shall be permitted without express prior written approval of the Authority.

h. The Permittee shall remove, at its own expense, within six months of the date of written notice from the Authority, any or all conduits and appurtenances installed by the Permittee under this Permit if, in the Authority's sole discretion, such removal is necessary for the operation, maintenance or replacement of the Authority's infrastructure.

i. To the fullest extent permitted by law, and in consideration of the issuance of this Permit, Permittee hereby releases the Authority and its board members, officers, representatives, contractors, agents, employees, successors, and assigns, in both their individual and official capacities, from all suits, claims, liabilities, damages, losses (including but not limited to loss of use resulting therefrom) and expenses, including but not limited to attorney's fees, caused by, arising out of or resulting from any work or activity under this Permit and/or act, omission, breach or default of the Permittee or of any contractor, subcontractor of vendor of the Permittee or anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder. This release includes, but is not limited to, all suits, claims, liabilities, damages (including, but not limited to, direct, indirect, and consequential damages, economic loss, and loss of profits) and losses which are attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, including the loss of use resulting therefrom, together with all attorneys' fees, costs and expenses.

j. The Permittee shall conduct design, construction, and excavation in accordance with all federal, state and local safety regulations, including but not limited to, federal OSHA regulations (29 CFR 1926) and Massachusetts Department of Public Safety regulations (520 CMR 14.00). During construction, Permittee shall take appropriate sheeting and shoring measures to protect the integrity of the Authority's water and/or sewer mains. Permittee shall submit design plans stamped by a professional engineer licensed in Massachusetts to the Authority for approval prior to the start of construction.

k. The Permittee shall adjust any or all Authority frames and covers to grade within the limits of work in accordance with the plans referenced in this Permit. The Authority will provide the Permittee with new replacement Authority frames and covers that have been deemed unusable by the Authority.

l. If the Permittee is proposing to take borings and/or place test pits within the permitted land, the Permittee shall mark the proposed boring and test pit locations on the ground using paint and/or stakes and submit engineering documents to the Authority showing the proposed boring and test pit locations. Authority staff will review all boring and test pit locations at the site. Upon written clearance of the proposed boring and test pit locations by Authority staff and subject to Permittee providing the Authority with seventy-two (72) hours prior notice, Permittee may commence work at the site.

m. The Permittee shall be responsible for the locations of proposed borings and test pits regardless of any act or omission of the Authority. The Permittee shall be responsible for repairing and/or replacing, at the Authority's election, the Authority's property or infrastructure, which is damaged as a result of the Permittee's, its contractors, agents, representatives, employees, and/or invitees activities pursuant to this Permit. The Permittee's obligations under this paragraph shall include payment to the Authority for all costs to repair all such damage caused to the Authority's property.

D. The Contractor shall be responsible for scheduling and coordinating inspections and receipt of local, state, or federal permits, approvals, or certifications for all Work as part of this Contract.

E. The Contractor shall be responsible for obtaining, paying for and complying with MassDEP and City of Cambridge Backflow Prevention Permits.

F. The Contractor is solely responsible for the implementation of the permit requirements and shall include as such in the Bid.

G. The Contractor is solely responsible for any punitive action resulting from any violation of the permit.

H. Actual permits, issued by the respective agencies will be considered part of this Contract.

I. The Contractor shall, at a minimum, include compliance with the provisions and requirements of a typical NPDES Construction Dewatering Discharge General Permit and the MWRA dewatering and 8(m) permits and typical Cambridge permits listed above. The Contractor will receive no additional

compensation for compliance with any permit requirements.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01060

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01063

SEQUENCING OF WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies construction sequencing requirements for the following work:

1. General sequencing requirements.

2. Coordination with abutting businesses and residences.

1.2 SUBMITTALS

A. The Contractor or its subcontractor shall be responsible for submitting sequencing plans for the construction activities described in Section 1.1 of this section and outlined in Part 3 below. Each plan shall describe sequence of activities required to complete work, indicate duration and schedule of work; indicate work zones and equipment used to complete work; provide traffic and pedestrian management description and plans, including abutter access, for each activity.

1.3 RELATED SECTIONS

A. Specification Section 00020 – INVITATION TO BID

B. Specification Section 01010 – SUMMARY OF WORK

C. Specification Section 01300 – SUBMITTALS

D. Specification Section 01311 – SCHEDULING AND REPORTING

E. Specification Section 01390 – PRECONSTRUCTION SURVEY

F. Specification Section 01568 – EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS

G. Specification Section 01570 – MAINTENANCE AND PROTECTION OF TRAFFIC

H. Specification Section 01701 – PROJECT CLOSEOUT

I. Specification Section 02100 – SITE PREPARATION AND TREE PRUNING

J. Specification Section 02500 – PAVING AND SURFACING

K. Specification Section 02524 – CURBS, WALKS AND DRIVEWAYS

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 GENERAL SEQUENCING REQUIREMENTS

A. The Contractor shall sequence the work with the following general requirements.

1. Tree protection, pruning and maintenance.

2. Erosion control.

3. External Pre-Construction Survey

4. Test pits indicated in the Contract Drawings, or described in the Specifications, or as otherwise approved or required by the Engineer shall be performed prior to starting subsurface work on a street.

5. Contractor shall coordinate with utility companies for required relocations and structure adjustments. Refer to Contract Drawings for required relocations and/or test pits required to confirm relocations.

6. The Contractor shall perform CCTV inspection of existing pipes that are to be CIPP rehabilitated prior to performing nearby utility or surface work. The Contractor shall also consider performing CIPP rehabilitation as an early contract activity. Many of the existing lines that are to be CIPP rehabilitated are in fair to poor condition. Any damage to these lines potentially the result of the Contractor's nearby work will be repaired ahead of CIPP rehabilitation at no expense to the City. If the Contractor does not perform pre-construction CCTV, the assumption will be that the Contractor's activities created the damage unless there is documentation that confirms otherwise.

7. Watermain testing and acceptance as well as successful testing and inspections of new drain and sewer infrastructure shall be completed before commencement of full-depth roadway construction activities.

8. Full depth roadway construction and installation of base pavement shall be performed prior to installation of adjacent curb and sidewalk.

9. All castings shall be raised to binder grade within two weeks of

intermediate course paving. Contractor shall raise all City castings. Contractor shall diligently coordinate raising of private castings with the private utility owner including providing advance notice of paving, and regular notifications before and after paving has been completed. Paving over gas castings is not permitted at any time.

10. It is the goal of this project to minimize both the number and overall duration of disruptions caused by construction on a street-by-street basis. The Contractor's proposed sequence and schedule shall demonstrate that to the maximum extent practicable, all work on a given street shall be completed continuously from the start of underground utility construction through final surface restoration. Final surface restoration of sidewalks and roadways shall directly follow completion and acceptance of all water, sewer and drain construction, and private utility installation or relocation, on a street-by-street basis.

11. Once started on a given street, Contractor shall continuously proceed with surface restoration until substantially complete. Intermediate course paving shall not be installed prior to all pipeline testing and acceptance. This will include sewer leakage testing, and PVC pipe deflection testing that can not commence prior to 90-days after pipe backfill. Top course paving must not occur sooner than 60-days, or later than 180 days after intermediate course paving is completed. For the entirety of the Contract, the Contractor shall assume a minimum of four (4) mobilizations for top course paving will be required.

B. Refer to Specification Section 01701 – PROJECT CLOSEOUT for final cleaning and close out requirements.

3.2 GENERAL SEQUENCING REQUIREMENTS FOR COORDINATION WITH ABUTTING RESIDENCES, BUSINESSES AND SCHOOLS

A. This Section specifies construction sequencing requirements for the following work:

1. Contractor to coordinate with abutters to minimize shut-down durations for installation of water services.

2. Contractor to maintain access to abutting properties at all times. Contractor shall sawcut sidewalk behind existing curb to install new curb and maintain off hours sidewalk use to the extent possible. Sidewalks shall be installed within two (2) weeks from the beginning of removal of existing sidewalk.

3. For water service and sewer connections or any other work affecting the water or sewer service provided to commercial or institutional properties, the Contractor shall be prepared to complete work during off-peak hours, including night work, at no additional cost to the City.

B. Contractor to coordinate and communicate construction activities with the Fletcher-Maynard Academy on Harvard Street. To maintain bus operations to the school, Harvard Street shall not be shut down prior to 9:00 AM and shall be reopened for school access by 3:15 PM except on Wednesdays when the road needs to be reopened by 1:30 PM. When construction is within 200' of the school property, Contractor shall be limited to the following work limitations:

1. Work shall not start before 9:00 AM.

2. No work will be allowed within 300' of the school property during Massachusetts Comprehensive Assessment System (MCAS) testing. The Contractor shall expect that this testing will occur for approximately two weeks each Spring and will coordinate with the school to determine dates of testing.

3.3 SEQUENCING REQUIREMENTS FOR COORDINATION WITH ADJACENT CONSTRUCTION PROJECTS

A. Contractor to coordinate with construction activities at and around Clement Morgan Park and Anthony Paolillo Tot Lot as part of the City's Improvements to Clement G. Morgan Park and Anthony Paolillo Tot Lot Project, which is anticipated to begin in spring 2026 and last approximately 20 months. During this time, Contractor will be limited to the following sequencing requirements:

1. The primary site access for that Project will be on Bishop Allen Drive to Columbia Street. No work may be performed on Columbia Street between Bishop Allen Drive and Washington Street before January 02, 2028 without prior agreement by the Park Reconstruction Contractor and City.

2. Bishop Allen Drive shall not be shut down or detoured in a way that limits the Park Reconstruction Contractor access to the Parks from Prospect Street.

3. The subsurface utility work on Pine Street between School Street and Washington Street is included in Milestone #1. The Contractor will coordinate this work with the Park Reconstruction Contractor and will complete the surface reconstruction in this area as outlined in Milestone #2.

4. The City owned Parking Lot on the corner of Bishop Allen Drive and Essex Street (PL4) will be used by the Park Reconstruction Contractor until January 2028. The Contractor will not block driveway access to this lot or have access to this lot until after January 2028. At that time, the Contractor will have use of this lot for the associated electrical and surface reconstruction work and may use this lot as a staging area until

Project Substantial Completion. The Contractor shall reconstruct the lot under the contract unit prices prior to turning it back over to the City.

B. Contractor to coordinate with various private development projects including 390 Washington Street, 39 Essex Street, 16 Worcester Street, 35 Cherry Street to maintain access to their sites. Contractor shall also coordinate work with private utility company work.

3.4 PROJECT MILESTONES

A. MILESTONE #1: November 15, 2026. PL6 Hatch Replacements as shown on Sheet C-125, All utility work on Bishop Allen Drive from School Street to Main Street as shown on Sheets C-121 and U-14, All utility and investigation work on Washington Street from Windsor to Portland Street as shown on Sheets C-18 and U-12 exclusive of the 24" Water, and All Utility Work on Pine Street between School Street and Washington Street, as shown on Sheets C-124 and U-5.

B. MILESTONE #2: August 30, 2027. Pine Street between School Street and Washington Street Shared Street Surface Reconstruction including surface paving, striping, and signs.

C. MILESTONE #3: July 15, 2029 Substantial Completion

3.5 SEQUENCING RESTRICTIONS

A. Harvard Street and Bishop Allen Drive eastbound cannot be simultaneously closed.

B. Columbia Street northbound and Essex Street cannot be simultaneously closed.

C. Columbia Street southbound and Norfolk Street cannot be simultaneously closed.

3.6 "SHARED STREET" SEQUENCING RESTRICTIONS (APPLIES TO ASHBURTON PLACE, WORCESTER STREET, SUFFOLK STREET, AND PINE STREET)

A. Raised Crosswalks at the entry and exit to shared streets shall be completed and in place prior to demolition of existing sidewalks. Temporary HMA ramps are acceptable in lieu of the final concrete ramps.

B. Prior to removal of existing sidewalks, Contractor shall install temporary signage as directed by the City.

C. Immediately after sidewalk removal, Contractor shall provide temporary accessible access to all impacted properties. Temporary access shall be

maintained until final curb, sidewalks and driveways have been installed. Temporary access may include temporarily delineated walkways within the roadway if an accessible route using the sidewalk is not available.

D. Worcester Street and Suffolk Street cannot both be closed simultaneously without prior agreement with the City.

E. No work in Ashburton, Suffolk, Worcester, and Pine (all shared street areas) until July 30, 2026.

3.7 SCHEDULING RESTRICTIONS (TO BE ASSUMED UNLESS MODIFIED BY THE CITY DURING THE COURSE OF THE CONTRACT)

A. No top course paving between November 1 and April 15.

B. No installation of concrete or brick sidewalks, driveways, or ramps between November 15 and April 30.

C. No water bypass between November 1 and April 1.

END OF SECTION 01063

SECTION 01070

ABBREVIATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAB	Architectural Access Board
AAMA	Architectural Aluminum Manufacturer's Association
AAR	Association of American Railroads
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	American Disabilities Act
AFBMA	Anti-Friction Bearing Manufacturer's Association, Inc.
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association or American Parquet Association, Inc.
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASLE	American Society of Lubricating Engineers
ASME	American Society of Mechanical Engineers
ASQC	American Society for Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association

BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CDA	Copper Development Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drill Manufacturer's Association
DCR	Department of Conservation and Recreation
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EIA	Electronic Industries Association
ETL	Electrical Test Laboratories
EPA	Environmental Protection Agency
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute
HPMA	Hardwood Plywood Manufacturers Association
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IP	Institute of Petroleum (London)
IPC	Institute of Printed Circuits
IPCEA	Insulated Power Cable Engineers Association
ISDSI	Insulated Steel Door Systems Institute
ISA	Instrument Society of America
ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
MAAB	Massachusetts Architectural Access Board
MADEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MBTA	Massachusetts Bay Transit Association
MHD	Massachusetts Highway Department
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
MUTCD	Manual of Uniform Traffic Control Devices
MWRA	Massachusetts Water Resource Authority
MTI	Marine Testing Institute
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers

NAGDM	National Association of Garage Door Manufacturers
NB	National Board of Boiler and Pressure Vessel Inspectors (alternate NBBPVI)
NBS	National Bureau of Standards (Now NIST)
NCCLS	National Committee for Clinical Laboratory Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association or National Forest Products Association
NISO	National Information Standards Organization
NLGI	National Lubricating Grease Institute
NMA	National Microfilm Association
NPDES	National Pollution Discharge Elimination
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PPI	Plastics Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SAMA	Scientific Apparatus Makers Association
SDI	Steel Door Institute
SMA	Screen Manufacturers Association
SMACCNA	Sheet Metal and Air Conditioning Contractors National Association
SPI	Society of the Plastics Industry, Inc.
SPIB	Southern Pine Inspection Bureau
SPR	Simplified Practice Recommendation
SSA	Swedish Standards Association
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction
TAPPI	Technical Association of the Pulp and Paper Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau
WCRSI	Western Concrete Reinforcing Steel Institute
WEF	Water Environment Federation
WIC	Woodwork Institute of California

WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01070

SECTION 01090

REFERENCE STANDARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Titles of Sections and Paragraphs: Captions accompanying specification sections and paragraphs are for convenience of reference only, and do not form a part of the Specifications.

B. Applicable Publications: Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

C. Specialists, Assignments: In certain instances, specification text requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements over which the Contractor has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of regulations governing the Work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the Contractor.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Without limiting the generality of other requirements of the Specifications, all work specified herein shall conform to or exceed the requirements of applicable codes and the applicable requirements of the following documents.

B. References herein to "Building Code" or "Uniform Building Code" shall mean Uniform Building Code of the International Conference of Building Officials (ICBO). Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Conference of the Building Officials (ICBO).

"Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the Work is advertised for bids, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.

C. In case of conflict between codes, reference standards, drawings and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the Engineer for clarification and directions prior to ordering or providing any materials or furnishing labor. The Contractor shall bid for the most stringent requirements.

D. The Contractor shall construct the Work specified herein in accordance with the requirements of the Contract Documents and the referenced portions of those referenced codes, standards, and specifications listed herein.

E. Applicable Standard Specifications: References in the Contract Documents to "Standard Specifications" or SSPWC shall mean the Standard Specifications for Public Works Construction, 2021 Edition unless otherwise stated in the specification section.

F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

G. References herein to "OSHA Standards" shall mean, Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including all changes and amendments thereto.

H. References herein to "MUTCD Standards" shall mean, the latest edition of the Manual for Uniform Traffic Control Devices (MUTCD) published by the US DOT, including all changes and amendments thereto.

I. References herein to "MHD Standards" and/or “MASSDOT Standards” shall mean, the Massachusetts Department of Transportation – Highway Division Standard Specifications for Highways and Bridges, latest edition, including all changes and amendments thereto.

J. References herein to "ADA Standards" shall mean, the Americans with Disabilities Act of 1990 including all changes and amendments thereto.

K. ASTM: American Society for Testing Materials

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

M. ACI: American Concrete Institute

N. Final Rule for the Accessibility Guidelines for Recreational Facilities and Outdoor Developed Areas by the Recreational Access Advisory Committee, US Architectural and Transportation Barriers Compliance Board, most recent edition, including all changes and amendments thereto.

O. MAAB: Massachusetts Architectural Access Board, most current edition.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

A. The Contractor is responsible for ensuring that all work included in the Contract Documents, regardless if shown or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other Federal, State, and Local Regulations governing the storage and conveyance of hazardous materials, including petroleum products.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01090

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01105

RODENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This section specifies rodent control and general pest control requirements within project areas, and bordering areas as designated by the Owner and Engineer. This work is to be performed prior to demolition, excavation, and site preparation and throughout the Contract, so that rodents and other pests do not disperse from or infest the project area.

B. The Contractor shall develop and implement an Integrated Pest Management (IPM) approach. As part of that approach, the Contractor shall maintain a cooperative dialogue with appropriate agencies and management/representatives of neighboring properties.

C. The Contractor shall perform the rodent control tasks described in this Scope of Work and also respond to other pest control needs when required by the Owner.

1.2 SUBMITTALS

A. Submit to the Engineer copies of pesticide applicator certifications and licenses within ten (10) days of the start of Rodent Control activities and ten (10) days prior to their issuance or renewal for the duration of this Contract.

B. After performing the survey described in Paragraph 3.2 below and before initiating baiting, submit to the Engineer a written description of proposed pest control procedures, indicating materials, quantities, methods, and time schedule. For all pesticides to be used, submit a copy of the pesticide manufacturer's EPA-approved pesticide label with application directions.

C. Submit to the Engineer documentation of pest control activities and results and follows:

1. Weekly - Submit data sheets with locations of sites treated, amounts and types of pesticide used, number and types of traps set, survey and inspection results, sanitation conditions, complaint calls investigated, and any problem that occurred.

2. Monthly - Submit a written summary that includes determinable results of the IPM program and recommendations.

3. Quarterly - Submit a map that shows bait stations, manholes, and catch

basins where rodent baits are being maintained.

1.3 QUALIFICATIONS

A. The Contractor shall perform this work at all times in accordance with the following minimum standards and as acceptable to the Owner and Engineer.

1. The Contractor and key personnel shall have experience with commercial and residential accounts and construction projects; have experience and technical training in vertebrate pest management and integrated pest management; have experience with various rodent control techniques, equipment, and strategies; have training and experience with insect control; and have knowledge of and experience with techniques to reduce non-target hazards.

2. The supervisor shall be licensed and certified by the Massachusetts Pesticide Bureau and certified in General Pest Control (category 41) and Vertebrate Pest Control (category 44). The supervisor shall have specific training and experience in vertebrate pest management, commercial rodent control, general pest control, and integrated pest management.

3. Applicators shall be licensed by the Massachusetts Pesticide Bureau and certified in General Pest Control (category 41). Applicators shall have specific training and experience in commercial rodent control and integrated pest management.

1.4 COORDINATION

A. Perform this Work in cooperation with the other Work performed under the Contract. Notify City of Cambridge Inspectional Services Department and coordinate all rodent control activities with them.

B. Initiate the work on or before field mobilization begins for the Contract and with adequate timing to achieve control before environmental disruptions. Provide a maintenance program until Contract is completed and all equipment and materials are removed.

C. Perform the Work according to the preliminary schedule described in this section and as accepted or revised by the Owner and Engineer. Estimated durations and start dates may be changed by the Owner or Engineer to suit changes in construction schedules and field conditions. The Work could potentially require performance any day of the week and any hour of the day or night, regardless of weather.

D. Perform this work in such a manner that toxicant or other control tools do no pose a hazard to persons, domestic animals, or non-target wildlife.

1.5 PERMITS

A. Obtain and maintain in coordination with the Subcontractor appropriate permit(s) from city or state agencies for pest control activities associated with this Work.

B. Obtain and maintain in coordination with the Subcontractor all right of entry permits required for the performance of this Work. This includes all utilities and private properties to which entrance is required.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Furnish and use only pesticide formulations registered by the U.S. Environmental Protection Agency (EPA) and the Massachusetts Department of Food and Agriculture, where appropriate according to label directions and as acceptable to the Engineer.

B. Furnish and use devices and supplies (e.g., traps and bait stations) to facilitate the management and effectiveness of the pest control program, where appropriate and as acceptable to the Engineer.

PART 3 - EXECUTION

3.1 MEETINGS

A. Before proceeding with the Work, all pest control personnel shall attend a Work Shop held by the Contractor and Engineer to discuss planned pest control methods and coordination.

B. The supervisor shall meet with the Contractor and Engineer weekly to discuss pest control activities.

3.2 SURVEY

A. Prior to baiting, survey the proposed construction area and accessible or observable bordering areas and record signs of rodent activity and sanitation conditions. Closely inspect all embankments, edge areas, and properties within and abutting the construction area. Maintain survey records in the manner described in Paragraph 3.7 below.

B. Thoroughly inspect construction area and accessible or observable bordering areas and any nearby areas designated by the Owner or Engineer, for rodent activity and sanitation deficiencies weekly throughout the duration of this

Contract and in accordance with the work schedule. Maintain inspection records in the manner described in Paragraph 3.7 below.

C. Plan the control program and allocate resources based on survey and inspection data and as acceptable to the Owner.

3.3 APPLICATION FOR RODENT CONTROL

A. Apply rodenticide in strict accordance with EPA-approved label directions and the Rules and Regulations of the Massachusetts Department of Food and Agriculture. Maintain records of all bait placements in the manner described in Paragraph 3.7 below.

B. Where appropriate, especially for surface placements of rodent baits, use properly secured and tamper-resistant bait stations consistent with EPA regulation. Individually number and properly identify all bait stations.

C. Surface Applications

1. Initial Surface Baiting

Rid the construction area of all detectable rodents before construction begins, or as acceptable to the Owner. Bait all observable rodent burrows. Install and secure bait stations at regular and appropriate intervals and locations, and document rodent activity (burrows, droppings, bait consumed, dead rodents). Replenish bait and shift bait stations as necessary to ensure complete control of rodent populations. Bait edge and accessible bordering areas as necessary to ensure that rodents will not be dispersed by construction activities and that rodents will not infest work areas.

2. Maintenance Surface Baiting

Establish a maintenance baiting program prior to mobilization by the Contractor, including construction areas and accessible bordering areas, as acceptable to the Owner. Check bait placements weekly. Use survey and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute bait and bait stations as appropriate to ensure continued control.

D. Subsurface Applications

1. General

For situations involving underground construction/demolition, utility relocation, or utility construction, and for other situations when determined necessary by the Owner or Engineer, initiate subsurface

baiting and rid underground environments of all detectable rodents before construction begins. Assign an identifying number to each manhole and catch basin where bait is placed so that locations of bait placements can be identified and rodent activity (droppings, bait consumed, dead rats) can be documented. Conduct bait applications during off-peak traffic hours unless otherwise required by the Engineer. Access manholes according to the requirements of appropriate agencies and utility companies. Coordinate the Work with appropriate municipal agencies and utility companies.

2. Initial Subsurface Baiting

Apply appropriate baits to control rodent populations in manholes and catch basins. This will involve suspending and securing bait using noncorrosive wire (e.g., 24 gauge plastic coated). Place bait in all accessible manholes and catch basins within the construction work area. In addition, bait an appropriate set of manholes and catch basins in the blocks bordering the work area and as acceptable to the Owner. Identify all baited manholes and catch basins with a standardized paint mark on the street and a numbered tag to be attached to the suspending wire. Approximately seven (7) days after completion of the first baiting, check all manhole and catch basin baits and record estimates on the amount of bait consumed. Replenish or increase the amount of bait applied according to the amount consumed or as acceptable to the Owner and Engineer. Repeat this process again approximately fourteen days later and until there is little or no bait consumed. Check manholes and catch basins weekly when they repeatedly have 100 percent of the bait consumed.

3. Maintenance Subsurface Baiting

Prior to mobilization by the Contractor, establish a maintenance baiting program appropriate for the rodent infestation patterns identified during initial subsurface baiting. This program shall ensure continued control and shall be performed in a manner acceptable to the Owner and Engineer. Maintain bait in manholes and catch basins that have rodent activity and those that had activity during initial baitings. Check each bait according to rodent activity levels. This could range from weekly to approximately every three (3) months, depending upon the recent history of bait consumption. Use utility maps and baiting data to determine the most effective distribution of baiting locations and bait quantities. Shift and distribute baiting locations as necessary to ensure adequate interception points for controlling immigrating rodents.

E. Cleanup

1. Remove visible rodent carcasses and dispose of them daily consistent

with the pesticide label directions and applicable codes, laws, and regulations.

2. Upon completion of any pest control operations at the site, remove remaining bait and dispose of it according to the pesticide label and applicable codes, laws, and regulations. Also remove all wires used for subsurface baiting and any bait stations or traps.

3.4 SANITATION

A. Prior to construction and throughout the duration of this Contract, identify and document harborage and food sources available to rodents on the construction site and in observable bordering areas. This includes any littering or improper or insufficient use of trash receptacles in construction areas. It also includes any bordering areas with sanitation conditions or structural deficiencies that violate City or State sanitation codes.

B. Maintain records of sanitation conditions in the manner described in Paragraph 3.7 below.

3.5 COMPLAINT CALLS

A. During construction, respond to pest-related complaints from the "adjacent" neighborhood (i.e. within 200 feet of the project limits) within twelve (12) hours when required by the Owner or Engineer. Inspect the particular premises and adjacent areas for sanitation and structural deficiencies and also signs of historic and recent pest activity. Provide sanitation and structural maintenance information to the property owner or manager. Use pesticides or traps as necessary and appropriate to resolve the complaint when there is a relationship between the pest infestation and construction activities, or when required by the Owner or Engineer.

B. Maintain records of all complaints investigated, including location, contact person, inspection results, and actions taken. Document the relatedness of the pest infestation to construction activities.

3.6 GENERAL PEST CONTROL

A. When required by the Owner or Engineer, the Contractor shall determine appropriate methods for any pest control task not specifically identified above and shall submit them in writing to the Owner and Engineer for approval in advance. Such pest control tasks would relate to unanticipated pest control needs within construction areas or adjacent areas. This could include control of insects or vertebrates other than rats and mice.

B. Maintain records of general pest control activities and results in the manner described in Paragraph 3.7 below.

3.7 RECORD KEEPING

A. Use standardized data sheets acceptable to the Owner and Engineer to maintain accurate records of date, placement, type, and amount of pesticides or other control tools (e.g., traps) applied. Similarly, maintain records of surveys, inspections, changes in pest activity, sanitation conditions, and complaint calls. Submit data in a format acceptable to the Owner and Engineer and as required under Paragraph 1.3 (3) above.

END OF SECTION 01105

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01108

HEALTH AND SAFETY PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Prepare a Health and Safety Plan (HASP) that meets all applicable State and Federal health and safety regulations, including, but not limited to, those listed below. The Contractor shall be solely responsible for developing a HASP suitable for the Contractor's use and all work done by their subcontractors. The Owner, Engineer and/or their representative is not responsible for establishing or enforcing the health and safety requirements of the Contractor, and that nothing herein shall relieve the Contractor from its exclusive responsibility for the health and safety of its employees, and/or its representatives, and/or subcontractors.

B. The Contractor shall be responsible for being aware of all potential hazards at the site, and reviewing existing information which provides evidence of contamination within the limit of the work.

C. A copy of the "Environmental Conditions Summary, Complete Streets Project" memorandum is attached to these Specifications.

D. The Contractor shall also be required to defend, indemnify, and hold the City of Cambridge, MA, and the Engineer harmless against any and all claims, liabilities, fines, or penalties arising out of actual or alleged failure of the Contractor and/or its agents, employees, or subcontractors to comply with any health or safety regulation, rule, ordinance, legislation, and/or health and safety plan.

E. All work required in the Specifications regarding development and implementation of a HASP shall be in accordance with State hazardous waste site regulations (310 CMR 40.0018) and OSHA requirements (29 CFR 1910 and 1926). The HASP shall be submitted to the Engineer prior to site mobilization. Work shall not proceed at the site until the Engineer and the City of Cambridge has received a copy of the Contractor's Health and Safety Plan meeting all the requirements specified herein.

F. The Contractor shall be responsible for the construction, maintenance, and dismantling of the decontamination areas specified within the HASP. This includes providing all labor, materials, and equipment to prepare, maintain in working order, and remove the decontamination area, including collection and disposal of decontamination water and solids, and subsequent dismantling and disposal of materials.

G. The Contractor is responsible for establishing, implementing and maintaining of ambient air and dust monitoring programs and all other environmental monitoring programs. All such programs shall be operated by the Contractor whenever there are soils handling construction activities occurring at the site.

H. The Contractor shall be responsible for providing all materials, equipment, and labor associated with applying dust control suppressants, including equipment that shall be required during all soil handling activities, in the event that fugitive dust or excessive odors are encountered.

1.2 DUST CONTROL

A. During excavation of soil and fill material, dust shall be controlled to limit potential spread of contaminants and potential exposure of contaminants to workers and the public. The dust control measures implemented at the site shall be performed in accordance with this Section.

B. During the progress of the work, the Contractor will conduct his operations and maintain the area of his activities, including sweeping and sprinkling of water if acceptable to the Engineer, so as to minimize the generation and dispersion of dust.

1.3 AIR MONITORING

A. Air monitoring shall involve direct reading instruments capable of providing real-time indications of air contaminants to protect on-site personnel and the local population. The Contractor's Site Health and Safety Officer and Superintendent shall be responsible for assuring that monitoring is conducted in an approved manner, that air monitoring/sampling are conducted at a frequency sufficient to ensure accurate assessments of site conditions, and that work practices, engineering controls, and/or personal protective equipment are proper for the conditions.

B. At a minimum, detectors for organic contaminants shall be utilized to monitor on-site and off-site breathing zones and possible sources of potentially hazardous material (e.g., excavations, regrading, etc.). All personnel shall be made aware of the potential hazards and be informed of air monitoring information. Particular attention to air quality shall be made in the work area during earthwork activities to ensure that contaminants do not escape to the atmosphere and affect off-site population, on-site control, working conditions, and personnel protection measures.

C. The Contractor shall keep accurate documentation of all air monitoring, which shall be made available to the Owner and Engineer for review at all times.

PART 2 - PRODUCTS

2.1 HEALTH AND SAFETY PLAN AND CERTIFICATIONS

A. The Contractor shall, prior to the start of work on the site, submit six (6) copies of its site-specific Health and Safety Plan to the Engineer. Submit with the site-specific Health and Safety Plan, a certification that states the following:

1. The Contractor hereby certifies that the Contractor and any workers engaged in work on the project meet the requirements of 29 CFR 1910.120 and the provisions of the American National Standards Institute, Standard Z88.2, for training, medical surveillance, and respirator protection unless the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards. These requirements include, but are not limited to, the following items:

   a. The Contractor's employees have been examined by a licensed physician within the last twelve (12) months, and have been determined to be physically able to perform the work and use the respirator and other protective or safety equipment required for this assignment.

   b. The employees have received health and safety training for working in environments with known and unknown hazards within the past twelve months.

   c. The Contractor has established and is maintaining a respiratory protection program that complies with the provision of 29 CFR 1910.134.

   d. The Contractor maintains appropriate surveillance of the work area conditions and degree of employee exposure or stress.

2. The Contractor shall further certify that only respirators approved or accepted by NIOSH/MSHA shall be provided and used by the Contractor's employees; that each of the Contractor's employees has been properly fitted to the respirators provided by the Contractor, including a test of the face-to-face piece seal; that the Contractor has provided its employees with written procedures covering the use of respirators in dangerous atmospheres; and that the Contractor has established a program for inspection, maintenance, and care of the respirators.

   The certification shall be signed and dated by the Contractor.

3. Work shall not proceed at the project site until the Engineer has received all certification(s) and the Contractor's Health and Safety Plan. Any delays incurred by the Contractor relating to the Health and Safety

Plan shall be the responsibility of the Contractor, and constitute no additional costs or claims to the City of Cambridge.

PART 3 - EXECUTION

3.1 HEALTH AND SAFETY PLAN CONTENTS, MAINTENANCE, AND IMPLEMENTATION

A. The Contractor's Plan shall address the specific work activities to be conducted by the Contractor. The HASP shall include, but not be limited to, the following:

1. All anticipated hazards based on site conditions, construction activities and the levels of contamination and information presented in previous studies.

2. Provisions for continually updating the Plan in accordance with any new applicable state and federal regulations or any additional information regarding conditions at the site.

3. The following information, shall be included in the HASP in accordance with the minimum standards set forth in 29 CFR 1910.120, 29 CFR 1910.1000, and 29 CFR 1926, and 310 CMR 40.0018:

a. Contractor's Standard Operating Procedures, including Personnel Training and Field Orientation; Personal Hygiene Requirements and Guidelines; Field Monitoring of Site Contaminants; Respiratory Protection Training and Requirements; Levels of Protection and Selection of Equipment Procedures; Zone Delineation of the Project Site; Site Security and Entry Control Procedures; Contingency and Emergency Procedures; and Listing of Emergency Contacts.

b. Identification of Contractor's Site Safety Officer.

c. Identification of Contractor's Designated Field Personnel.

d. Identification of hazard and risks associated with the Contractor's work.

e. Type of Medical Surveillance Program.

f. List of all hazardous materials that the Contractor shall have on site; the location of the latest Material Safety Data Sheets (MSDS) for each material listed; and the plan for notifying all on-site personnel, including, but not limited to, the Engineer and/or their representatives, of the presence of hazardous

materials on site. If there are no hazardous materials to be brought on site, the Contractor shall provide a written statement to the Engineer and/or their representative, prior to initiating work activities, certifying that the Contractor shall not transport, store, or use hazardous materials on site.

B. The Contractor shall keep a copy of the HASP on site during all operations and shall conduct daily health and safety meetings. Failure to keep a copy of the HASP on site, or any other breach of the Contractor's Plan, shall be cause for stopping work at the cost of the Contractor. Delays caused by the Contractor's failure to comply with the health and safety regulations, or any health and safety plan, shall not entitle the Contractor to recover any additional costs or time lost. The Contractor shall not be allowed to resume activities until corrective measures are implemented.

C. Medical surveillance records, OSHA 40-hour training forms, accident forms, and all other documentation requirements of the Contractor's health and safety plan for personnel working on the site shall be up-to-date and kept on file at the site. The Contractor shall provide documentation of employee status upon request of the Engineer.

D. The Contractor shall make available Level C personal protective equipment and clothing, not including respirators, to the Engineer and/or their representative for use during site inspections by the Engineer and/or their representative, up to a maximum of three (3) complete sets per day. These shall be supplied and maintained at no cost to the Owner and shall be returned to the Contractor upon completion of the work (except for expendable disposal protective clothing). The Contractor shall provide a repository for collection of disposed health and safety materials. Collection and disposal of contaminated expendable supplies shall be the Contractor's responsibility.

E. The level of dermal and respiratory protection shall be determined based upon continuous air monitoring to be performed by the Contractor. The Engineer may conduct duplicate air monitoring for quality control purposes. As air monitoring indicates the levels of contaminants in the air, the personal protective equipment shall be determined based upon established standards and the standards set forth in the Contractor's Health and Safety Plan. Regardless, modified Level D protection for all on-site personnel is the minimum project requirement.

F. The Contractor shall be aware of site-specific requirements, such as site security during non-working hours, limited work space, and minimizing the effects of soil excavation, in preparing its health and safety program.

3.2 ROUTINE SAFETY MEETINGS

A. The Contractor shall keep a copy of the HASP on site during all operations, and shall conduct routine health and safety meetings to ensure that all work is

being performed in accordance with OSHA regulations, the Contractor's HASP, and prior to initiating a new task, following an incident or following any changes to the HASP necessitated by site conditions. Failure to conduct routine safety meetings may be cause for stopping work at the cost of the Contractor.

END OF SECTION 01108

SECTION 01200

GENERAL REQUIREMENTS FOR UTILITY WORK

PART 1 - GENERAL

1.1 DESCRIPTION

A. This Section specifies general requirements for construction, protection, support, maintenance, and restoration of underground and overhead utilities affected by construction of the Project. This section includes coordination with private utility companies. The Work includes new construction, reconstruction, relocation, and abandonment. This Section also specifies requirements for layout, installation, and as-built information turnover of pipelines and structures installed under this Contract.

B. The utility works and services that may be affected include, but are not limited to:

1. Storm drain, sanitary sewer, and combined sewer
2. Water distribution and transmission mains
3. Gas distribution and transmission
4. Electric power, utility poles, and street lighting (underground and overhead)
5. Telephone
6. Traffic signals
7. Fiber optic communications
8. Cable Television
9. Signal communication
10. City fire signal lines and pull boxes
11. Steam
12. MBTA overhead and underground electric

C. This Section shall be used in conjunction with the specific underground utility work sections that apply to the Contract.

1.2 WORK BY UTILITY COMPANIES

A. Certain parts of the utility work shall be performed, where shown or specified, by the utility company.

B. Disconnecting and connecting of storm drains; sanitary sewers; and combined sewers services shall be the Contractor's responsibility as required in the Specifications or after having received permission from the Cambridge Department of Public Works. Disconnecting and connecting of water services shall be the Contractor's responsibility as required in the Specifications or after having received permission from the Cambridge Water Department.

C. Contact the utility companies in advance of construction to allow sufficient time for the utility companies to accomplish their work. Provide the utility company at least thirty (30) days advance notice prior to the scheduled date for commencement of work under this Contract.

D. Work performed by utility companies to facilitate the Work under this Contract, and other work performed by utility companies solely for the convenience of the Contractor, shall be at no additional cost to the Owner.

1.3 DEFINITIONS

A. Abandoned means that use of a utility asset has been discontinued by the utility company.

B. To be abandoned means that use will be discontinued as part of the Work under this Contract.

C. Maintenance means providing continuous service that meets project requirements during construction.

D. Maintain complete-in-place means to protect, support, and otherwise maintain the existing condition and function of a facility during construction.

E. Restoration means replacement of a facility or portions of a facility that have been removed or made inoperative by the Contractor in the performance of the Work.

F. Utility Company means the company, agency, owner, or operator of the facility concerned.

G. Temporary Facility means a facility provided, in lieu of an existing or new facility, to ensure continuity of service. When a temporary facility is not shown on the Contract Drawings, but is provided for the convenience of the Contractor, it shall be constructed at no additional cost to the Owner.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS

1. Submit working drawings and, if applicable, shop drawings showing the details, procedures, and scheduling for performance work for each utility. Show verified field locations of existing utilities that are affected by the Work under this Contract; interferences which these facilities present to the new work; location of settlement markers; methods proposed to proceed with the construction; and, if applicable,

procedures for restoration and method of testing to demonstrate restoration was performed satisfactorily.

2. Submit to the Engineer specifications and drawings describing the method to be used to temporarily support existing subsurface, surface and overhead utilities during construction. Include working drawings that indicate proposed materials and details. Submit to the Engineer plans and specifications for temporary streetlights where light poles are required to be temporarily removed.

3. Submit to the Engineer for review a detailed excavation procedure for subsurface utilities. At a minimum, the procedure shall include:

    a. Equipment to be used for anticipated subsurface utility investigation and excavation.

    b. Personnel to be used and designated utility coordinator.

    c. Duration and schedule of investigation and excavation.

    d. Techniques proposed to isolate and protect existing utilities.

    e. Method for the Contractor to provide utility information derived from subsurface investigation to field personnel doing the excavation.

    f. A disciplinary plan that delineates all steps to be taken because of a utility disruption or tree damage caused by negligence or failure to follow proper procedures or the Contract requirements, including possible removal of Contractor personnel from the site.

    g. Techniques proposed to identify and protect existing tree roots from damage, including notification of the City Arborist, exploration procedure with air spade, and protection of exposed roots as outlined in section 02100.

4. Submit an emergency action plan outlining procedure to be followed by the Contractor in case of unplanned utility interruptions or unplanned damage to utilities in service. Obtain concurrence from each affected utility company.

    a. List Contractor's personnel assigned responsible charged with emergency action on site for each shift, and those on call.

    b. List phone notification numbers for each utility company, fire, and police departments, and other relevant agencies.

c. Include copies of utility plans showing the valve or switch locations to isolate each line.

B. Transmit to the Engineer the as-built utility location survey data as specified in Article 3.11 of this Section.

1.5 APPROVAL BY UTILITY COMPANIES

A. All personnel performing work to expose and support existing utility facilities shall be fully qualified and able to meet the standards of the affected utility company. If the Contractor does not have the required utility experience, Contractor shall retain a specialist firm acceptable to the affected utility company to perform the Work.

B. Prior acceptance of temporary support methods for each affected utility facility shall be obtained by the Contractor from each utility company concerned.

C. Prior permission for disrupting a utility shall be obtained by the Contractor from each utility company concerned.

D. Prior approval for disrupting fire signal lines, high pressure fire water mains and hydrants, and fire service lines shall be obtained from the Cambridge Fire Department.

1.6 NOTIFICATION

A. In addition to the initial thirty (30) day utility company notification, the Contractor shall notify the appropriate utility companies and the Engineer at least seven (7) days prior to starting any work involving or adjacent to surface, subsurface, or overhead utility facilities.

B. Eversource Gas Requirements:

1. If cut-off or connection is expected, notify the Eversource Gas Company Engineering Department four (4) weeks prior to cut-off or connection to gas main.

2. Immediately notify the Gas Company Engineering Department if surface or subsurface settlement or movement is observed, regardless of the proximity to an existing gas facility.

3. Gas valves shall remain exposed at all times during work. Contractor shall coordinate with Eversource Gas at least four (4) weeks prior to any required gas valve adjustments (raising or lowering).

4. At locations where the sand bedding material of gas mains are excavated and removed by the Contractor, the Contractor shall restore

or replace the bedding material, in kind. Crushed stone shall not be used as backfill or bedding material for gas mains.

1.7 STANDARD SPECIFICATIONS OF UTILITY OWNERS

A. Specifications and construction methods from each utility owner apply to individual utility specification sections.

B. It is the Contractor's responsibility to ensure that, unless otherwise specified, the standards for materials and construction methods required by the utility owner are met.

PART 2 - MATERIALS

2.1 GENERAL

A. Materials for temporary and permanent work shall be of the type, grade, and class specified by reference to utility company standards.

PART 3 - EXECUTION

3.1 GENERAL CONSTRUCTION REQUIREMENTS

A. Unless otherwise noted, conform to the construction standards, specifications, and standard practices of the affected utility companies. Coordinate with each utility company the work to be done by the Contractor and the work to be done by utility company. Ensure continuity of all existing utility services, except when the utility company determines that temporary interruption is acceptable.

B. Unless otherwise indicated, maintain all utility facilities complete in place. Provide temporary support of utilities during construction only by methods acceptable to the utility company concerned. Provide temporary support plans and designs stamped by a Professional Engineer in the Commonwealth of Massachusetts as required by the utility owner.

C. Provide and maintain all temporary facilities required to provide interim utility service when a utility facility is to be relocated and when a utility facility to be replaced is abandoned prior to replacement.

D. Where an existing utility is encountered that is not indicated or that is determined to be different than that indicated, promptly notify the Engineer. The Contractor is responsible for determining the owner of the facility and the disposition of the facility.

E. All water, sanitary, and storm services must be maintained throughout the project through the use of temporary pumps and piping. Unless otherwise noted, no service interruptions will be permitted.

F. In addition to notices previously specified, the Contractor shall notify the Cambridge Water Department, Owner, and Engineer forty-eight (48) hours prior to excavating or working near existing large diameter (>18-inch) water transmission mains.

G. Permits to excavate the public way cannot be issued until the applicant has notified the appropriate utility companies, as required by Massachusetts General Laws, Chapter 370 of the Acts of 1963. The applicant must either: 1) obtain written receipts from the affected utilities and provide copies of same to the owner; or 2) utilize the Dig-Safe System for the required notifications and submit written notifications for those utilities not participating in the Dig-Safe System. Written notifications must state that utility companies have been notified and the contractor cleared to begin work.

The Contractor is responsible for identifying all utilities requiring written notification that are not part of the Dig-Safe System. At a minimum, the following utility companies must be notified in writing:

M.B.T.A. (617) 222-3200
10 Park Plaza, Suite 3910
Boston, MA 02116

M.W.R.A. (617) 242-6000
100 First Avenue
Charlestown Navy Yard
Boston, MA 02129

The following utility companies must be notified in writing or through Dig-Safe.

Verizon (781) 376-8172
Attention: Matt King
matthew.i.king@one.verizon.com
275 Wildwood St.
Woburn, MA 01801

Eversource Electric (339) 987-7503
Attention: Matt Viens
Matthew.viens@eversource.com
1165 Massachusetts Avenue
Dorchester MA 02125

Eversource Gas (339) 987-7354
Attention: Rich Dell Isola

Richard.dellisola@eversource.com
101 Linwood Drive
Somerville, MA 02143

COMCAST (617) 406-9645
Attention: Shane Flewelling
Shane_Flewelling@comcast.com
55 Concord St.
North Reading, MA 01864

MBTA (617) 222-3199
Attention: Jack Martin
JackMartin@mbta.com
55 Concord St.
North Reading, MA 01864

Vicinity Energy (978) 853-3094
Attention: Jason Clark
Jason.Clark@vicinityenergy.us

Cambridge Water Department (617) 349-4788
Attention: Richard Holly
rholly@cambridgema.gov
250 Fresh Pond Parkway
Cambridge, MA 02138

Cambridge Electrical Department (617) 349-4925
Attention: Mark Melo
mmelo@cambridgema.gov
250 Fresh Pond Pkwy., 1st Floor
Cambridge, MA 02138

Dig-Safe
811
At least a 72 business hour notice is required for DIG SAFE in Massachusetts.

The Contractor shall have all utilities marked out along the course of the work by such means as the Owner shall approve and shall preserve such marked locations until the work has progressed to the point where the encountered utility is fully exposed and protected as required. It shall be the Contractor's responsibility to notify utilities at least three (3) working days prior to the start of any excavation.

The Contractor is responsible for contacting any other utilities that are not listed herein.

3.2 SUBSURFACE UTILITY INVESTIGATION

A. The Contractor shall excavate test pits as indicated on the Contract Drawings, or described in the Specifications, and as directed by the Engineer.

3.3 UNSAFE AND UNSUITABLE UTILITY STRUCTURES

A. If, upon exposure, the condition of a facility to be maintained complete-in-place is found to be unsafe, the Contractor shall notify the utility company, for support or for maintenance of service. The Contractor shall replace or reconstruct or coordinate the replacement or reconstruction of the facility with the utility Owner and shall promptly notify the Engineer of additional costs anticipated prior to beginning the work.

3.4 ABANDONED FACILITIES

A. Demolish and remove abandoned utility facilities that interfere with the Work of this Contract. Abandoned facilities that do not interfere with the Work of this Contract shall remain.

B. Do not undertake demolition or removal until permission for such Work has been obtained from the utility company.

C. When abandoned facilities are to be left in place, plug or cap the ends of conduits and pipes, and fill with controlled density fill (CDF) unless otherwise indicated. Remove abandoned utility manholes, junction boxes, and similar structures to a minimum depth of four (4) feet below finished grade, fill any remaining portion of the structure with approved backfill and puncture or break the bottom slabs of manholes and similar structure to allow drainage. Backfill and compact excavations resulting from removal of utility facilities as required to restore original grade.

3.5 SETTLEMENT OR MOVEMENT

A. In case of settlement or other movement that causes or could cause damage, take immediate remedial measures to correct the conditions and repair the damage.

3.6 ACCESS

A. At all times permit free and clear access to the affected facilities by personnel of the utility companies.

B. Throughout the construction period, maintain access to all utility vaults and structures.

3.7 SERVICE CONNECTIONS

A. Work required for maintaining, supporting, relocating, restoring, and constructing all service connections is included as part of the Work of this Contract, even though some existing service connections, for which record information is not available, may not be shown on the Contract Drawings.

3.8 REPAIR AND RESTORATION

A. Repair all damage to utilities caused by Work under this Contract. Clean all utility structures of dirt caused by Work under this Contract. Immediately notify the Engineer and the utility company of damage to utilities.

3.9 EXCAVATION AND BACKFILL

A. Perform excavation and backfill in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Excavation and handling of contaminated soil is specified in Sections 02080 - SOIL AND WASTE MANAGEMENT, and 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL.

3.10 CLEANING UP

A. In accordance with Section 01630 – RESTORATION OF GROUNDS AND CLEANING UP, the Contractor shall, upon completion of the Work, remove all temporary construction facilities, equipment, debris, and unused materials, and shall restore the project area and adjacent affected areas to a neat and clean condition.

3.11 AS-BUILT LOCATION SURVEY

A. For each new or relocated utility installed, including those installed or relocated by others in the Project Area, perform an as-built location survey by coordinates prior to backfilling the excavation.

B. For each new hardscape feature installed perform an as-built location survey by coordinates. Hardscape features to be surveyed for location and elevation include but are not limited to; top and bottom of curb lines, limits of sidewalks and wheelchair ramps, roadway crown, manhole covers, gate box covers, pavers and limits of loam and seed. Hardscape features to be surveyed for location include but are not limited to; street lighting, pedestrian lighting, pedestrian signals, traffic signals, crosswalks, control panels, benches, trash receptacles, parking and traffic striping, landscaping features, fences and irrigation heads.

C. The survey work, including verification of the existing survey data, shall be performed by a licensed Professional Land Surveyor registered in Massachusetts to accurately record progress of the work throughout the duration of the Contract

1. The Surveyor is subject to the approval of the Owner. The Contractor shall submit the qualifications of the Surveyor documenting performance of similar scopes of work utilizing software specified below.

2. All coordinates shall be geographically registered in the project datum coordinate system using the control points for horizontal and vertical controls.

3. Horizontal accuracy shall be 0.1 feet.

4. Elevation accuracy shall be 0.1 feet except benchmarks, topography, and structure foundations (including manholes pipe inverts) shall be accurate to 0.01 feet.

5. Digital As-built drawings, including surface data shall be provided in AutoCAD Civil 3D format to match the text styles and line types of the design drawings provided by the Engineer.

6. It is recommended that the Surveyor attend the Preconstruction meeting.

7. Prior to submitting a monthly payment application, the Contractor's progressive electronic as-built drawings shall be acceptable to the Engineer.

D. The Contractor shall also maintain red line record documents at the site to accurately record progress of the work throughout the duration of the Contract.

1. Contractor shall delegate the responsibility for maintenance of the record documents to one person on the Contractor's staff as approved by the Owner.

2. Changes to the record documents shall be coordinated with adequate and proper entries on each page of the specifications and each sheet of drawings and other documents where such entry is required to show progress and changes properly, including change orders, approved shop drawings, RFIs, and other modifications.

3. Record information shall be updated within 24 hours of installation or survey.

4. All locations of utilities exposed by the work shall be checked with the plans. Utilities not shown as indicated on the plans shall be recorded and show in its accurate location with notes about where the utility is located at versus what is shown on the plans and submitted with the record drawings.

5. All utilities shall be recorded whether shown on the plans or not and shall be submitted with the record drawings.

3.12 BENCHMARKS

1. The Contractor shall be responsible for verifying the existence and elevation of all benchmarks shown on the Contract Drawings, and reporting any missing benchmarks or inconsistent elevations between benchmarks to the Engineer.

2. The Contractor shall be responsible for setting additional benchmarks in areas of the Work where benchmarks do not exist or have been removed as part of recent construction.

PART 4 – COMPENSATION (Not Used)

END OF SECTION 01200

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes general requirements for project submittals by the Contractor.

1.2 PROGRESS REPORTS, RECORDS AND DATA

A. The Contractor shall submit to the Owner such schedules of quantities and costs, progress schedules, payrolls, reports, estimates, records and other data as outlined in Section 01311 – SCHEDULING AND REPORTING and as the Owner may request concerning work performed or to be performed under this Contract.

1.3 OPERATION MANUALS

A. Unless the specified operations manuals for equipment are submitted along with shop drawings at the time of submission no action will be taken on reviewing the shop drawings. The manuals shall include, at a minimum, operating instructions and recommended maintenance schedules for all the equipment to be furnished.

1.4 SHOP DRAWINGS, SAMPLES, PROJECT DATA

A. Shop Drawings and engineering data (submittals) covering all materials, equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review and approval, as required. Submittals shall verify compliance with the Contract Documents and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

1. Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Contractor shall submit a complete initial submittal including all components. When an item consists of components from several sources, Contractor's initial submittal shall be complete including all components.

2. All submittals, regardless of origin, shall be clearly identified with the

name and number of this Contract, Contractor's name, and references to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified, and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

3. All deviations from the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Contractor's letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Contractor (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

4. Contractor shall submit shop drawings electronically through the "ProCore" construction management software system. For electronic submittals, drawings and the necessary data shall be submitted to Engineer as specified below. Submittal documents shall be in black and white unless color is required for the review of the submittal. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file. The PDF documents shall have a bookmark created in the navigation frame for each major entry ("Section" or "Chapter") in the Table of Contents. Thumbnails shall be generated for each page or graphic in the PDF file.

   The opening view for each PDF document shall be as follows:
   - Initial View: Bookmarks and Page
   - Magnification: Fit In Window
   - The file shall open to the Contractor's transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.

   PDF document properties shall include the submittal number for the document title and the Contractor's name for the author. Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created. The Contractor shall post submittals and retrieve the Engineer's submittal review comments through the Engineer's project website accessible through the Internet. Instruction on procedures for posting and

retrieving submittals will be provided after award of the Contract. Facsimiles (fax) will not be acceptable. Engineer will not accept submittals from anyone but Contractor. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

5. In addition, upon request, two hard copies of each *full-size* drawing shall be submitted to Engineer who will return two marked copies (or one marked reproducible copy) to Contractor.

6. Engineer's submittal review period shall be a maximum of twenty-one (21) consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal on the project website. The time required to mail any hard copies of the submittal or resubmittal back to Contractor shall not be considered a part of the submittal review period.

7. Contractor shall accept full responsibility for the completeness of each resubmittal. Contractor shall verify that all corrected data and additional information previously requested by Engineer are provided on the resubmittal. When corrected copies are resubmitted, Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal. Resubmittals shall be made within 30 days of the date of the letter returning the material to be modified or corrected, unless within 20 days Contractor submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time. The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Contractor within the specified review period.

B. When submitted for the Engineers' review, all shop drawings shall bear the Contractor's certification that they have reviewed, checked and approved the shop drawings, that they are in agreement with the requirements of the Project and with the provisions of the Contract Documents, and that they have verified all field measurements and construction criteria, materials, catalog numbers and similar data. The Contractor shall also certify that the work represented by the shop drawings is recommended by the Contractor and the Contractor's Guaranty will fully apply.

C. All samples called for in the Specifications or required by the Engineer shall be

furnished by the Contractor and shall be submitted to the Engineer for his review. Samples shall be furnished so as not to delay fabrication, and to allow the Engineer reasonable time for the consideration of the samples submitted.

D. Checking of submittals is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.

E. The Contractor may only proceed with fabrication and construction of items with returned submittals marked "No Exception Taken", "Make Corrections as Noted" or “Noted: No Action Required”. Resubmit submittals if marked "Rejected", "Revise and Resubmit" or "Submit Specified Item."

F. The Contractor shall furnish such samples of material as may be required for examination and test. All samples of materials for tests shall be taken according to ASTM Specifications or as provided in the Contract Documents.

G. All samples shall be submitted by the Contractor with a covering letter indicating that such samples are recommended by the Contractor for the service intended and that the Contractor's Guaranty will fully apply.

H. All materials, equipment and workmanship shall be in accordance with samples guaranteed by the Contractor and reviewed by the Engineer.

I. Submittals requiring a Certificate of Design will be considered incomplete and not acceptable unless a complete Certificate of Design is submitted.

J. The Certificate of Design requires that the engineer providing the submittal carries Professional Liability insurance meeting the requirements laid out in Section 00800 “General Terms and Conditions” and additionally meeting the requirements of Section 00825 “Supplemental General Conditions”.

1.5 CONTRACTOR'S ORDER OF CONSTRUCTION

A. The Contractor shall submit schedules and reporting information in accordance with the requirements of Section 01311 – SCHEDULING AND REPORTING.

1.6 CERTIFICATE OF DESIGN

CERTIFICATE OF DESIGN

The undersigned hereby certifies that he/she is a Professional Engineer registered in the state of _____ and that he/she has been employed by (Name of Contractor) _____ to design _____ in accordance with Specifications Section _____ for the (Name Project) _____. The undersigned further certifies that he/she has performed similar designs previously and has performed the design of the _____; and regulations and professional practice standards; that his/her signature and Professional Engineer (P.E.) Stamp have been affixed to all calculations and drawings used in, and resulting from, the design; and that the use of that stamp signifies the responsibility of the undersigned for that design.

The undersigned hereby certifies that he/she has Professional Liability Insurance and a Certificate of Insurance is attached.

The undersigned hereby agrees to make all original design drawings and calculations available to the City of Cambridge or Owner's representative with seven (7) days following written request therefore by the Owner.

_____	_____
P.E. Name	Contractor's Name
_____	
P.E. Registration Number, State of Registration and Discipline	
_____	_____
Signature	Signature
_____	_____
Title	Title
_____	_____
Address	Address
_____	_____
Telephone	Telephone
_____	_____
Email Address	Email Address

1.7 OWNER'S CONSTRUCTION MANAGEMENT PLATFORM SOFTWARE

A. For Project archival purposes, the Owner uses "Procore" – a third-party Construction Project Management Platform software. The platform will be used to manage all submittals as well as other design document packages, Construction Change Directives (CCD), Requests for Information (RFI), quality and testing reports, and other project-related documents for records retention purposes. Project financial information such as Pay Requisitions and Change Orders will not be included in the Construction Management Platform Software.

B. The contractor will be expected to use the Platform for managing all project submittal and design documentation. This will include submittal and document posting, and coordination with subcontractors and suppliers. The Owner will provide all access to the system and be responsible for all software access licensing fees associated with use under this contract.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01300

SECTION 01301

SCHEDULE OF VALUES

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section defines the process whereby the Schedule of Values shall be developed and incorporated into the cost loading function of the Schedule as specified in Section 01311 – SCHEDULING AND REPORTING. Monthly progress payment amounts shall be determined from the monthly progress updates of the Schedule activities.

B. The Schedule of Values shall be developed independently but simultaneous with the development of the Schedule activities and logic as follows:

1.2 PRELIMINARY SCHEDULE OF VALUES

A. The Contractor shall submit a preliminary Schedule of Values for the major components of the work at the Preconstruction Conference. The listing shall include, at a minimum, the proposed value for the following major work components:

1. Mobilization.

2. The total value of civil piping work inclusive of excavation, support of excavation, pipe installation, testing and backfill of pipe or other structures, and all incidental work associated with underground pipe installations. Additionally, this total value shall be broken down into separate values for water lines, drain lines, sanitary sewer lines, and appurtenant work such as manholes and service connections constructed or modified as a part of the work.

3. The total value of site civil work inclusive of full depth roadway reconstruction, cold planing, regrading, paving, grading, curbs and sidewalks, and landscaping.

4. The total value of all other work not specifically included in the above items.

B. After the Pre-construction Conference, the Contractor and Engineer shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the Engineer, these are necessary to establish fair and reasonable allocation of values for the major work components. Front end loading will not be permitted. The Engineer may require reallocation of major work components from items in the above listing if in the opinion of

the Engineer such reallocation is necessary. This review and any necessary revisions shall be completed within fourteen (14) calendar days from the date of Notice to Proceed.

1.3 DETAILED SCHEDULE OF VALUES

A. The Contractor shall prepare and submit a detailed Schedule of Values to the Engineer within twenty-eight (28) calendar days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major work components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The Engineer shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the Engineer, a greater number of Schedule of Values items than proposed by the Contractor is necessary, the Contractor shall add the additional items so identified by the Engineer.

B. All lump sum, allowance and unit price items included for payment in the Contract shall be included in the schedule of values. Greater detail shall be provided for the following items and as further required by the Engineer.

1. Temporary Utility Support and Coordination

2. Mobilization by activity.

3. Erosion and Sedimentation Control

4. Traffic and Pedestrian Management

5. Vibration Monitoring

6. Soil and Waste Management

7. Tree Protection and Maintenance

8. Geotechnical Instrumentation Monitoring

9. Survey Construction Layout and Baseline, As-Builts

10. All other work not specifically included in the above items shall be broken down as necessary for establishment of pay and Schedule activity items.

C. The Contractor and Engineer shall meet and jointly review the detailed Schedule of Values within thirty-five (35) calendar days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to

determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to provide cost loading of the Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the Contractor and a revised detailed Schedule of Values shall be submitted within thirty-eight (38) calendar days from the date of Notice to Proceed.

D. Following acceptance of the detailed Schedule of Values, the Contractor shall incorporate the values into the cost loading portion of the Schedule. The activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the Schedule activities, where interfacing these two (2) documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the Schedule activities. Where such instances arise, the Contractor shall propose changes to the Schedule of Values and to the Schedule activities to satisfy the Schedule cost loading requirements.

1.4 CROSS REFERENCE LISTING

A. To assist in the correlation of the Schedule of Values and the Schedule, the Contractor shall provide a Cross Reference Listing which shall be furnished in two parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.

B. These listings shall be updated and submitted in conjunction with the monthly Schedule submittals as stated in Specification Section 01311 – SCHEDULING AND REPORTING.

C. Approved change orders reflected in the Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.5 CHANGES TO SCHEDULE OF VALUES

A. Changes to the Schedule which add activities not included in the original schedule but included in the original work (schedule omissions) shall have values assigned as approved by the Engineer. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the Engineer.

B. In the event that the Contractor and Engineer agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

1.6 LIQUIDATED DAMAGES

A. The Schedule of Values information is an integral part of the scheduling and reporting under Section 01311 – SCHEDULING AND REPORTING and the progress payment information. As such, it is critical information to evaluating the project's progress and the proper planning of the Owner's and Engineer's work effort as well as their financial obligations associated with this Project. Accordingly, if any submittal required by this Section is found to be incomplete or is submitted later than required, the Owner will suffer financial loss and, accordingly, liquidated damages will be assessed against the Contractor in accordance with the Agreement.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01301

SECTION 01311

SCHEDULING AND REPORTING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes scheduling and reporting requirements of the Contractor.

B. The scheduling of the Work under the Contract shall be performed by the Contractor in accordance with the requirements of this Section. Where submittals are required hereunder, the Contractor shall submit an electronic copy and four hard copies of each item.

1.3 RELATED SECTIONS

A. Specification Section 01040 – PROJECT COORDINATION AND MEETINGS

B. Specification Section 00825 - SPECIAL CONDITIONS

1.4 INITIAL SCHEDULE SUBMITTALS

A. The Contractor shall submit three (3) short term schedule documents at the First Progress Meeting which shall serve as the Contractor's Plan of Operation for the initial sixty (60) day period of the Contract Time and to identify the manner in which the Contractor intends to complete all work within the Contract Time. The Contractor shall submit: (1) A Project Sequencing Plan, (2) a 60-day Plan of Operation bar chart, and (3) a project overview bar chart type plan for all work as indicated below.

B. Project Sequencing Plan: Within 30 days of Notice To Proceed, the Contractor shall develop a Project schedule and Sequencing Plan outlining the major components and the overall proposed plan for completing the work. The contractor shall be prepared to present this plan at an off-hours Community meeting.

C. 60-Day Plan of Operation: During the initial 60 days of the Contract Time, the Contractor shall conduct Contract operations in accordance with the 60-day bar chart Plan of Operation. The bar chart so prepared and submitted shall show the accomplishment of the Contractor's early activities (mobilization, permits, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, initial site work and other submittals and activities required in the first 60 days).

D. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the project work and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the Work will be made substantially complete and placed into service. The Owner and the Contractor shall meet to review and discuss the 60-day plan of operations and project overview bar chart within one week after they have been submitted to the Owner. The Contractor shall make corrections to the schedules necessary to comply with the Contract requirements and shall adjust the schedules to incorporate any missing information requested by the Owner.

E. Refer to Specification Section 01040 – PROJECT COORDINATION AND MEETINGS for general coordination requirements.

1.5 SCHEDULE SUBMITTALS

A. Original Schedule Submittal: Within twenty-one (21) calendar days after the commencement date stated in the Notice to Proceed, the Contractor shall submit for review by the Owner an electronic and a hard copy of the Schedule. This submittal shall have already been reviewed and approved by the Contractor's Project Manager, Project Superintendent, and the Project Estimator prior to submission.

B. Original Schedule Review Meeting: The Contractor shall, within 30 calendar days from the commencement date stated in the Notice to Proceed, meet with the Owner and Engineer to review the original schedule submittal. The Contractor shall have the Project Manager and Project Superintendents in attendance. The Owner's review will be limited to the submittal's conformance to the Contract requirements. However, the review may also include:

1. Clarifications of the design intent, process, and startup requirements.

2. Directions to include activities and information missing from the submittal.

3. Requests to the Contractor to clarify the schedule.

C. Revisions to the Original Schedule: Within fifty (50) calendar days after the commencement date stated in the Notice to Proceed, the Contractor shall have revised the original schedule submittal to address all review comments from the original schedule review meeting and resubmit the Schedules and reports for the Owner's review. The Owner, within fourteen (14) calendar days from the date that the Contractor submitted his revised schedule will either (1) accept the schedule and cost loaded activities as submitted, or (2) advise the Contractor in writing to review any part or parts of the schedule which either do not meet the Contract requirements or are unsatisfactory for the Owner to monitor the project's progress and status or evaluate monthly payment requests by the Contractor. When the schedule is accepted, it shall be considered as the "Original

Construction Schedule" until an updated schedule has been submitted. The Owner reserves the right to require that the Contractor adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of the Work or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions or clarifications.

D. Acceptance: The acceptance of the Contractor's schedule by the Owner will be based solely upon the schedule's compliance with the Contract requirements. By way of the Contractor assigning activity duration and proposing the sequence of the Work, the Contractor agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.

E. Submission of the Contractor's progress schedule to the Owner shall not relieve the Contractor of total responsibility for scheduling, sequencing, and pursuing the Work to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work.

F. Monthly Updates and Periodic Schedule Submittals: Following the acceptance of the Contractor's Original Construction Schedule, the Contractor shall monitor the progress of the Work and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submitted must be complete including all information requested in the original schedule submittal. Each update shall continue to show all work activities including those already completed. These completed activities shall accurately reflect the "as built" information by indicating when the work was actually started and completed.

G. Neither the submission nor the updating of the Contractor's original schedule submittal nor the submission, updating, change or revision of any other report, curve, schedule or narrative submitted to the Owner by the Contractor under this Contract, nor the Owner's review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying, in any way, the Contract completion date or milestone dates or of modifying or limiting, in any way, the Contractor's obligations under this Contract. Only a signed, fully executed change order can modify these contractual obligations.

H. Weekly schedule updates shall be submitted by the Contractor and will be reviewed with the Contractor during the weekly construction progress meetings. The goal of these meetings is to enable the Contractor and the Owner to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the Work and to determine the amount of Work completed since the last month's schedule update. These meetings are considered a critical component of the overall monthly schedule update submittal and the Contractor shall have appropriate personnel attend. As a minimum, these meetings shall be attended by the Contractor's Project Manager and General Superintendent.

J. The Contractor shall submit the revised Schedule with the Contractor's Application for Payment. Applications for Payment which are submitted without the proper Schedule Updates shall be held until the Contractor has satisfied the Contract requirement. Within five (5) working days of receipt of the above noted revised submittals, the Owner will either accept or reject the monthly schedule update submittal. If accepted, the percent complete shown in the monthly update will be the basis for the Application for Payment to be submitted by the Contractor. If rejected, the update shall be corrected and resubmitted by the Contractor before the Application for Payment for the update period can be processed.

K. Schedule Revisions: The Contractor shall highlight or otherwise identify all changes made from the previous schedule. The Contractor shall modify any portions of the schedule which become infeasible because of activities behind schedule or for any other valid reason.

1.6 CHANGE ORDERS

A. Upon written approval of a change order, or upon written receipt by the Contractor of authorization to proceed with additional work, the change shall be reflected in the next submittal of the schedule by the Contractor.

1.7 SCHEDULE REPORTS (FORMAT)

A. Schedule Reports: Schedule Reports shall be prepared based on the Construction Schedule, and shall include the following minimum data for each activity:

1. Estimated Activity Duration

2. Activity Description

3. Start Date

4. Finish Date

B. Project Information: Each Schedule Report shall be prefaced with the following summary data:

1. Project Name

2. Contractor

3. Type of Tabulation

4. Project Duration

5. Contract Completion Date (revised to reflect time extensions)

6. The Commencement Date Stated in the Notice to Proceed.

7. If an update, cite the new schedule completion date

1.8 PROJECT STATUS REPORTING

A. In addition to the submittal requirements for the scheduling identified in this Section, the Contractor shall provide monthly project status reports (Overview Bar Chart and a written narrative report). Status reporting shall be in the form specified below.

B. The Contractor shall prepare and submit monthly an Overview Bar Chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current schedule (original and as updated and adjusted throughout the entire construction period). It shall be limited to not more than four sheets which shall not exceed 8-1/2-inch by 11-inch. The major project components shall be represented as time bars which shall be subdivided into various types of work.

C. Each major component and subdivision shall be accurately time scale plotted consistent with the project overview bar chart specified above. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original schedule is submitted to the Owner. The Contractor shall amend the overview schedule to include any additional detail required by the Owner. The Contractor shall include any additional information requested by the Owner at any time during the construction of the Work.

D. The Contractor shall prepare monthly written narrative reports of the status of the project for submission to the Owner. Written status reports shall include:

1. The status of major project components (Percent Complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.

2. The progress made on critical activities indicated on the schedule.

3. Explanations for any lack of work on critical path activities planned to be performed during the last month.

4. Explanations for any schedule changes.

5. A list of the critical activities scheduled to be performed in the next two (2) month period.

6. The status of major material and equipment procurement.

7. The value of materials and equipment properly stored at the site, but not yet incorporated into the work-in-place.

8. Any delays encountered during the reporting period.

9. An assessment of inclement weather delays and impacts to the progress of the Work.

10. A statement as to the adequacy of remaining contract time to complete Work.

E. The Contractor shall include copies of the last month's daily logs, field reports, and As-Built redlines with the written monthly narrative report.

F. The Contractor may include any other information pertinent to the status of the project. The Contractor shall include additional status information requested by the Owner.

1.9 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

A. The Contractor's construction schedule shall include lost days due to inclement weather during an active period of Work.

1.10 OTHER IMPACT PROVISIONS OF THE SCHEDULE

A. The Contractor's construction schedule shall also include lost days due to Owner required shutdowns due to events unrelated to inclement weather during the active period of Work. The Contractor's schedule shall include lost days due to Holidays, Harvard University and Massachusetts Institute of Technology final exams and commencement, Head of the Charles Regatta, scheduled voting days, work activity limitations during MCAS testing or other required shutdown by the Owner, see Article 2 of the Special Conditions.

PART 2 – PRODUCTS

2.1 OWNER'S CONSTRUCTION MANAGEMENT PLATFORM SOFTWARE

A. For Project archival purposes, the Owner uses "Procore" – a third-party Construction Project Management Platform software. The platform will be used to manage all submittals as well as other design document packages, Construction Change Directives (CCD), Requests for Information (RFI), quality and testing reports, and other project-related documents for records retention purposes. Project financial information such as Pay Requisitions and Change Orders will not be included in the Construction Management Platform Software.

B. The contractor will be expected to use the Platform for managing all project submittal and design documentation. This will include submittal and document posting, and coordination with subcontractors and suppliers. The Owner will

provide all access to the system and be responsible for all software access licensing fees associated with use under this contract.

END OF SECTION 01311

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01390

PRE-CONSTRUCTION SURVEY

PART 1 - GENERAL

1.1 SUMMARY:

A. The work under this item shall consist of the furnishing all necessary labor, equipment, professional services, and materials required to perform preconstruction condition surveys to document the condition of exterior surface features, building exterior surfaces and interiors of buildings adjacent to the project area and as otherwise required by the Engineer by an independent Consultant employed by the Contractor.

B. Pre-construction surveys shall be performed on all buildings adjacent to the project area, as confirmed by the Engineer, prior to commencement of work.

C. Pre-construction surveys shall be performed no earlier than four (4) weeks before commencement of work.

D. Perform additional interior and/or exterior pre-construction conditions surveys as directed by the Engineer.

E. Perform post-construction survey at properties where a damage claim has been reported.

1.2 QUALITY ASSURANCE

A. Qualifications

1. The company engaged for professional photography shall, during the past five (5) years, have successfully completed photographing and video recording three construction projects of similar scope and dollar value as the construction project which is the subject of this Contract.

2. Inspections shall be performed by or under the direct supervision of a Registered Professional Engineer, licensed in the state of Massachusetts. This individual shall have at least three (3) years' experience in the inspection or design of residential and commercial structures.

B. The Contractor shall provide sufficient notice to the Engineer to allow the Engineer to be present to observe the Work. Cooperate with the Engineer in all respects to facilitate any testing or observations.

C. The presence of the Engineer (including observations and review of the data) shall not relieve the Contractor of its sole responsibility to perform the work in

accordance with the Contract Documents, nor shall they be construed to relieve the Contractor from full responsibility for the means and methods of construction and for safety on the construction site.

1.3 SUBMITTALS:

A. Submit in accordance with Section 01300 - SUBMITTALS.

B. Within thirty (30) days of Notice to Proceed and prior to performing any photography and video work, submit the qualifications of Professional Engineer(s) that will oversee the pre- and post-condition survey of buildings, and qualification of the firm performing the photography and video recording work. Include a list of projects and a sample report to demonstrate compliance with paragraph 1.2.A.1 of this section. For each project, include project name, location, owner, year(s), name of general contractor, and current address and phone number of the owner or owner's representative.

C. Submit written release(s) from the photographer and photographic studio covering all videos, photographs, and photo images taken as specified. Submit each release at the time of development of the subject video and/or photograph.

D. Within thirty (60) days of Notice to Proceed, submit "Pre-Construction Building Condition Survey" reports and videos of inspected buildings.

1.4 Submit separate reports for each structure in accordance with Section 01300 – SUBMITTALS. Each report shall include the following, as a minimum:

A. Location and description of property and improvements.

B. Results of visual inspections including sketches, photographs, and video showing deterioration or lack of deterioration.

C. Information provided by property owners.

D. All photos taken of the property.

1.5 PROPERTY ACCESS

A. Right of entry for building conditions survey: Contractor shall obtain the right of entry for all structures to be surveyed.

B. Prior to contacting the individual building owners, the Engineer will provide a general notice describing the project and the need to obtain access to each building. The Contractor shall not contact individual building owners until at least two (2) weeks after the Engineer has provided notice to the building owners.

PART 2 – PRODUCTS – NOT USED

2.1 MATERIALS:

A. Video

1. Format: Digitally recorded and submitted on DVD or harddrive.

2. Video identification:

a. Video Number: AAA-##Str
Where: AAA = Contract Number
= Street Number
Str = Street Name
b. Project name and Contract No.
c. Property Address
d. Date of Video

3. Log of Videos: Provide a binder or digital PDF document with the log of all videos taken for this Contract. Format of the log shall be tabular and shall include the following:

a. Project name and Contract No.
b. Video Number
c. Property Address
d. Date of Video and weather conditions

B. Photographs:

1. Format: photograph package on compact disc, DVD or harddrive.

2. Photo package identification:

a. Photo package Number: AAA-##Str
Where: AAA = Contract Number
= Street Number
Str = Street Name
b. Project name and Contract No.
c. Property Address
d. Date of Video

3. Photograph identification: AAA-##Str-XX
Where: AAA = Contract Number
= Street Number
Str = Street Name
XX = sequential number for given property

4. Log of photos: Provide a binder or digital PDF package with a separate log for each address of all photos taken for this Contract. Format of the log shall be tabular and shall include the following:

    a. Project name and Contract No.
    b. Photo CD/package identification
    c. Property address
    d. Date of Photos and weather conditions
    e. Photograph identification
        i. The view/orientation of the photograph (compass direction and vertical declination of view e.g. horizontal, looking up, looking down, etc).
        ii. Identification of main features in view.
        iii. Any other data and information pertinent to the purpose and identification of the exposure.

PART 3 - EXECUTION

3.1 EXTERNAL PRE-CONSTRUCTION SURVEY

A. External pre-construction surveys shall be performed on all properties and structures adjacent to the project area and as directed by the Engineer. The Contractor shall develop a list of all properties within the project area which shall be confirmed by the Engineer prior to beginning pre-construction survey. Survey shall include detailed examination of the structure exterior including documentation of exterior visual survey of the property, onsite improvements and plantings; detailed video inspection of the exterior of building; digitized color photographs of the exterior showing visually evident structural faults, and including but not limited to:

1. Exterior façade of building.

2. Location of cracks in exterior walls, especially instances of cracked or missing plaster or bricks within the defined survey areas;

3. Damaged masonry or roofing within the defined survey areas;

4. Walls which are not vertical within the defined survey areas;

5. Damage to foundations; and tightness of fit of doors and windows in their respective jambs.

6. Sidewalks, planters, paved areas, utility poles, stairways, patios, fencing and landscaped areas including condition of trees to be measured.

B. All views shall contain a relative dimension reference that is easily recognizable. In views where dimensions are critical, use a recognizable measuring device such as folding ruler or measuring tape in a manner that the markings are clean and sharp in the photograph and the device located in close relationship to the subject of the photograph.

C. The design professional conducting the survey shall interview the property owners regarding existing conditions and structural faults and determine dates and extent of recent repairs. This information shall be documented in the reports.

3.2 INTERNAL BUILDING INSPECTIONS

A. Internal pre-construction surveys shall be performed on properties as directed by the Engineer. Survey shall include detailed examination of the structure interior including documentation of interior visual survey of the property, onsite improvements; detailed video inspection of the interior of building; digitized color photographs of the interior showing visually evident structural faults, and including but not limited to:

1. Interior of building.

2. Location of cracks in interior walls, especially instances of cracked or missing plaster or bricks within the defined survey areas;

3. Damaged masonry or roofing within the defined survey areas;

4. Walls which are not vertical within the defined survey areas;

5. Damage to foundations; and tightness of fit of doors and windows in their respective jambs.

B. All views shall contain a relative dimension reference that is easily recognizable. In views where dimensions are critical, use a recognizable measuring device such as folding ruler or measuring tape in a manner that the markings are clean and sharp in the photograph and the device located in close relationship to the subject of the photograph.

C. The design professional conducting the survey shall interview the property owners regarding existing conditions and structural faults and determine dates and extent of recent repairs. This information shall be documented in the reports.

END OF SECTION 01390

SECTION 01400

QUALITY CONTROL

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes quality assurance and control of installation and manufacturer's field services and reports.

1.2 WATERTIGHTNESS

A. All structures, pipes, and equipment which are to contain water shall be watertight under all operating conditions for which they are intended. The Contractor shall furnish all labor, materials and equipment and do all work required by the Engineer to make all such parts of the work watertight, or to replace them if in the opinion of the Engineer any leakage is excessive. All such parts of the work filled with water for testing watertightness shall be left filled as required by the Engineer.

1.3 LAYOUT OF WORK

A. The Contractor shall employ a Massachusetts Registered Land Surveyor, acceptable to the Engineer and direct them to establish an initial "Construction Base Line" as indicated on the Drawings. Said base line shall be staked at 25 foot stations. The Engineer shall also provide bench mark information on the Drawings or separately in writing. The Contractor shall do all layout of the work from said base line and bench marks.

B. The Contractor shall employ a Professional Land Surveyor registered by the Commonwealth of Massachusetts and approved by the Engineer and cause them to establish permanent benchmarks during the entire progress of the work, to which easy access may be made to determine and assure all lines and grades and to verify same from time to time. The Contractor shall keep on the job a level and transit and allow the Owner's Representative and the Engineer unrestricted use of same at the work site. Such check shall not be considered as approval of the Contractor's work.

C. The Contractor shall maintain the construction base line stakes at all times. Should stakes or marks be destroyed during the course of the work, by the Contractor or by others, the Contractor shall, at their own expense, provide the services of a Massachusetts Registered Land Surveyor, acceptable to the Engineer, to reestablish such stakes and marks.

1.6 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When specified in individual specification sections, provide material or

product supplier's or manufacturer's technical representative to observe site conditions; conditions of surfaces and installation; quality of workmanship; start-up of equipment; operator training, testing, adjustment, and balance of equipment as applicable; and to initiate operation, as required. Conform to minimum time requirements for start-up operations and operator training if defined in specification sections.

B. At the Owner's or Engineer's request, submit qualifications of the manufacturer's representative fifteen (15) days in advance of required representative's service. The representative shall be subject to approval of the Owner and Engineer.

C. Manufacturer's representative shall report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions. Submit reports within fourteen (14) days of observation to Engineer for review.

1.7 THIRD-PARTY MATERIALS TESTING

A. The Contractor shall employ a qualified third-party quality control testing company certified in the applicable materials testing procedure required by the Specifications and shall have adequate staffing available and laboratory capacity to provide testing results in a reasonable timeframe. The quality control testing company hired by the Contractor shall be subject to approval by the Owner and Engineer.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01400

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUBMITTALS

A. The Contractor shall submit a complete work plan including: proposed hours of operation, sequencing of work, number of shifts, number of work crews, and anticipated conflicts with existing utilities and facilities throughout the project. The work plan shall also include dates for temporary facility service interruption and required utility relocation. The plan shall also include a detailed schedule of all cooperation requirements with owners/operators of existing utilities and facilities.

1.2 TEMPORARY USE OF PRIVATE LAND

A. The Contractor shall not enter or occupy private land outside of easements, except by permission of the property owner.

1.3 TEMPORARY PIPE LOCATIONS

A. Pipes shall be located substantially as indicated on the Drawings, but the Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference with existing utilities, structures or for other reasons.

B. Where fittings are noted on the Drawings, such notation is for the Contractor's convenience and does not relieve the Contractor from laying and jointing different or additional items where required.

1.4 HAULING, HANDLING AND STORAGE OF MATERIALS

A. The Contractor shall, at their own expense, handle and haul all materials furnished by the Contractor and shall remove any surplus materials at the completion of the work. The Contractor shall provide suitable and adequate storage for equipment and materials furnished by the Contractor and shall be responsible for any loss or damage to any equipment or materials by theft, breakage, or otherwise. The Contractor shall be responsible for all damages to the work under construction during its progress and until final completion and acceptance even though partial payments have been made under the Contract.

1.5 OPEN EXCAVATIONS

A. All open excavations shall be adequately safeguarded by providing temporary barricades, steel plates, construction and caution signs, concrete barriers,

protective fencing no less than 6-feet tall, lights and other means to prevent accidents to persons, vehicles, and damage to property. The Contractor shall, at their own expense, provide suitable and safe means for completely covering all open excavations and for accommodating pedestrian and/or vehicular travel when work is not in progress. Bridges provided for access to private property during construction shall be removed when no longer required. The length of open trench will be controlled by the surrounding conditions but shall always be confined to the limits prescribed by the Engineer or required in the contract documents. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, then special construction procedures shall be taken, such as limiting the length of open trench.

B. All trenching operations and end of day conditions shall be in accordance with 520 CMR 14.00 – Excavation and Trench Safety.

1.6 TEST PITS

A. Test pits for the purpose of locating underground pipeline or structures in advance of the construction shall be excavated and backfilled by the Contractor in accordance with the requirements of the Engineer, as shown on the Drawings, or described in the Specifications, or as directed by the Owner or Engineer. Test pits shall be backfilled and compacted immediately after their purpose has been completed and the surface restored and maintained as required by the Engineer.

1.7 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. The Contractor shall assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, sewers, drains, and electric and telephone cables, fiber optic lines, fire signals, cable television cables, whether or not they are shown on the Drawings. The Contractor shall carefully support and protect all such structures and utilities from injury of any kind. The Contractor shall notify the owner/operator of the proposed work and proposed protection plan so the owner/operator can review and approve protection measures. The Contractor is required to comply with all provisions of Massachusetts General Laws Chapter 353 entitled "Excavations-Public Ways-Notice Requirements" otherwise known as Dig Safe. Any damage resulting from the Contractor's operations shall be repaired at the Contractor’s expense.

B. Fire hydrants on or adjacent to the work shall be kept accessible to fire-fighting equipment at all times.

C. The Contractor shall bear full responsibility for obtaining all locations of underground structures, utilities, and services. Services to buildings shall be maintained and all costs or charges resulting from damage thereto shall be paid by the Contractor.

D. Protection and temporary removal and replacement of existing utilities and structures as described in this section shall be a part of the work under the Contract. The Contractor is responsible for the removal and replacement of existing utilities upon receiving approval from the utility owner, or coordination with the owners/operators of the existing utilities and assisting the existing utilities where required.

E. If, in the opinion of the Engineer, permanent relocation of a utility owned by the City of Cambridge is required, that is not shown on the plans or the specifications; the Engineer may require the Contractor, in writing, to perform the work. Work so ordered will be paid for as extra work under provisions of the General Conditions. If relocation of a privately owned utility is required, the Contractor will notify the utility to perform the work as expeditiously as possible. The Contractor shall fully cooperate with the Owner and utility and shall have no claim for delay due to such relocation. The Contractor shall notify public utility companies in writing at least seven days (excluding Saturdays, Sundays and legal holidays) before excavating or working in any public way. The Contractor shall notify public utilities 30 days prior to any service call wherever possible.

1.8 WATER FOR CONSTRUCTION PURPOSES

A. The Contractor will be allowed to purchase water from the City of Cambridge, MA for construction testing and start-up purposes.

B. The express approval of the Cambridge Water Department shall be obtained before water is used. Water shall be metered as specified by the Cambridge Water Department. Hydrants shall only be operated by or under the supervision of Cambridge Water Department personnel.

C. No direct cross connections will be permitted between the public water supply and the new water mains, temporary connections or any other point where the possibility of backflow of contaminated water exists. All connections to points where there is the possibility of backflow shall be arranged to prevent backflow and shall be approved by the City's Plumbing Inspector before they are put into operation.

1.9 PROTECTION OF CONSTRUCTION AND EQUIPMENT

A. All newly constructed Work shall be carefully protected. No driving or wheeling, walking or placing of heavy loads on newly constructed Work shall be allowed. All portions damaged shall be reconstructed, repaired, or replaced by the Contractor at his own expense.

B. All elements of the Work shall be protected in a manner approved by the Engineer. Should any part of the Work become heaved, cracked, or otherwise damaged, all such damaged portions of the Work shall be completely repaired

and made good by the Contractor at his own expense as required by of the Engineer.

C. If, in the final, or any daily inspection of the Work, any defects, faults or omissions are found, the Contractor shall cause the same to be repaired or removed and replaced by proper materials and workmanship without extra compensation for the materials and labor required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein for at least the guarantee period described in the Contract Documents.

D. The Contractor shall take all necessary precautions to prevent damage to all elements of the Work due to excess water pressure during and after construction and until such Work is accepted and taken over by the Owner.

1.10 CARE AND PROTECTION OF PROPERTY

A. The Contractor shall be responsible for the preservation of all public and private property and shall use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the Work on the part of the Contractor, such property shall be restored by the Contractor at the Contractor's expense to a condition similar or equal to that existing before the damage was done or the Contractor shall make good the damage in another manner acceptable to the Owner and Engineer.

B. Along the location of this Work, all fences, walks, bushes, trees, shrubbery, and other physical features shall be protected and restored in a thoroughly workmanlike manner. Fences and other features removed by the Contractor shall be replaced in their original location or at a location indicated on the Drawings as soon as conditions permit. All grass areas beyond the limits of construction which have been damaged by the Contractor shall be graded and seeded.

C. Trees close to the work shall be protected against injury as described in 02100 SITE PREPARATION AND TREE PRUNING.

D. The protection, removal, and replacement of existing physical features along the line of work shall be a part of the work under the Contract, and all costs in connection therewith shall be included in the Bid Proposal unless a Bid Item has been established elsewhere in these Construction Documents for the express payment of that specific item of Work.

1.11 SLEEVES AND OPENINGS

A. The Contractor shall provide all openings, channels, etc., and install anchor bolts and other items to be imbedded in concrete, as required to complete the work under this Contract.

1.12 TEMPORARY UTILITIES

A. Temporary Light and Power: The Contractor shall at their own expense, provide their own temporary light and power as required for the prosecution and completion of work, including light and power for the construction and engineering trailers as well as light and power for dewatering pumps, and trench and staging area lighting.

B. Temporary Heat: The Contractor shall, at their own expense, provide sufficient temporary heat to maintain minimum temperatures specified elsewhere, in all areas designated elsewhere in these documents.

C. Temporary Water: Water for drinking purposes and other usage will be provided by the Contractor at their own expense.

D. Sanitary Provisions: The Contractor shall provide and maintain sanitary accommodations for the use of their employees, the Engineer, and the Owner as may be necessary to comply with the requirements and regulations of the local and state departments of health.

E. Maintaining Operation of the Existing Facilities:

1. The Contractor shall provide temporary utilities and/or cooperate with utilities to maintain full service to the residences and buildings in the project area. The Contractor shall be responsible for careful consideration of the construction scheduling and anticipation of potential interferences with existing utilities, operations and structures. The Contractor shall maintain close communications with the Engineer and provide the Engineer with a detailed description of each proposed activity sufficiently in advance of its commencement for review and comments to be made.

2. Temporary facilities which may be required include, but are not limited to, electrical power; lighting; heating; cooling; ventilating; telephone; cable television; potable water; fire protection; drainage; sanitary facilities; trench covers; protection of existing utilities; structures; streams; trees and shrubs; access roads; sewage conveyance; piping; and pumping. The Contractor will be responsible for providing, connecting, and maintaining emergency generators to serve homes in the event temporary electrical services cannot be established by the power company. The Contractor will be responsible for furnishing a licensed electrician to connect the houses to the emergency generators, maintain the generators twenty-four (24) hours a day, and disconnect the houses when service can be reestablished to the power lines. The generators will be provided and maintained at no additional cost to the Owner.

3. The Contractor shall coordinate efforts with the owners and/or operators of the existing facilities to avoid any service interruption. The Contractor

shall keep utilities informed of proposed work activity and notify utilities of required work four weeks in advance. The Contractor must schedule work to avoid repeated, unnecessary, or last-minute service calls by the owners/operators of existing facilities.

4. Where the Contractor's work sequence requires interruption or removal of existing lighting in the public right-of-way, parks, or other public property, the Contractor shall, at its own expense, provide adequate temporary lighting until permanent lighting is installed and operational.

1.13 ACCESS TO THE WORK

A. The Contractor shall provide sufficient and proper facilities at all times for inspection of all work under this project in preparation or in progress, by the Owner, the agents and employees of the Owner, by authorized representatives of the Commonwealth of Massachusetts and the Federal Government and by the Engineers.

B. The Contractor shall furnish the Engineer, or their authorized representative and other personnel mentioned above, with such facilities and assistance as are necessary to ascertain performance of the work in accordance with the plans and specifications.

C. The Contractor must provide sufficient and safe access to existing facilities for the owners/operators of existing facilities to maintain service.

1.14 POLLUTION CONTROL

A. Refer to section 01560 TEMPORARY ENVIRONMENTAL CONTROLS.

1.15 CARE OF WATERCOURSES

A. The Contractor shall maintain the flow in all watercourses, whether open channels or in pipes, in all sewers and other pipes interfered with in the line of work and convey the flow to a suitable point of discharge so as not to flow upon the work or create a nuisance. In the discharge of water removed from the excavations by pumping or by gravity similar precautions shall be observed as well as those outlined in specifications relating to contaminated and hazardous materials.

PART 2 – PRODUCTS

2.1 TEMPORARY BARRIERS

A. Refer to 01570 MAINTENANCE AND PROTECTION OF TRAFFIC for barriers and fencing for temporary protection of work zone.

PART 3 – EXECUTION (Not Used)

END OF SECTION 01500

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01505

MOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

A. This section consists of moving all equipment onto the site required for the Contractor's operations; furnishing and erecting plants, temporary buildings, and project and other construction facilities; erecting project signs and traffic management signs; implementing security features and requirements; all as required for the proper performance and completion of the Work. Mobilization shall further include the following principal items:

1. Installing temporary construction power, wiring, and lighting facilities.

2. Developing construction water supply.

3. Providing on-site sanitary facilities and potable water facilities.

4. Arranging for and erection of Contractor's work and storage/staging yard(s).

5. Having all OSHA required notices and establishment of safety programs including the Contractor's HASP submittal.

6. Having the Contractor's superintendent at the job site full time and project manager at regularly scheduled project meetings and available as requested by the Engineer and/or Owner. The project manager shall not have superintendent duties.

7. Submission and approval of initial shop drawings, traffic management plans, work plans, and sequencing plans including the original schedule submittal.

8. Providing field office and/or construction trailers for the Contractor and the Engineer, complete with all specified furnishings, office equipment, communications facilities, computers, and utility services.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01505

SECTION 01520

FIELD OFFICE

PART 1 - GENERAL

1.1 ENGINEER'S FIELD OFFICE

A. The Contractor shall provide and maintain at an approved location at or near the site, for the duration of the Contract, a separate office area for the exclusive use of the Engineer and Owner. The office will not be shared with the Contractor. The location, layout, and construction of the office shall be determined and approved by the Engineer and Owner.

B. The types of Items which the Contractor shall expect to be responsible for payment under the Allowance include, but are not limited to, the following, and only as directed and approved by the Engineer:

1. Office Lease costs, including cleaning and maintenance.

2. 5-pound fire extinguisher.

3. Industrial type first aid kits.

4. Potable water cooler with hot and cold taps and water delivery service.

5. Office materials and supplies as requested by the Engineer and/or Owner including cleaning supplies, paper towels, waste baskets, paper or plastic kitchen supplies, standing fans, office appliances such as refrigerator, and microwave.

6. Six (6) surge protector power strips.

7. One (1) photocopy machine, approved by the Engineer, capable of wireless printing from remote work stations, photocopies, scanning to remove email locations and associated maintenance plan.

8. High speed internet connectivity for the field office.

9. Four (4) standard office desks and chairs and one (1) conference table and chairs. Submit first for approval by Engineer and Owner.

10. Individual computer monitors and cabling/docking station to connect laptop and allow for work on two (2) additional screens. Include all cable, manuals, and associated equipment. Manufacturer on site warranty shall cover the time period of the Contract.

11. New 1 TB portable hard drives with 3.0 USB connection, factory formatted in the NTFS file system and with a minimum 2 year limited warranty.

12. Filing cabinets for storage of RFIs/Submittals/General Documentation. Supply hanging folders and manila folders for filing cabinets.

13. Plan racks for storage/hanging drawing sets.

14. 96" x 48" dry erase boards with cleaner, erasers, and markers.

15. Field equipment such as survey level, rod, smart levels, manhole access equipment, measuring tapes, field books, or other.

16. As part of the field office Allowance, the Contractor shall supply up to three (3) Verizon or AT&T smart phones acceptable to the Engineer for the use by the Owner and Engineer. If required, the Contractor shall have a Verizon or AT&T Wireless representative provide a service demonstration for the Project Team and shall connect all internet and e-mail access. Contractor shall pay for the cost of the phone, maintenance and all monthly service and telephone charges for the duration of the Contract. A baseline program of unlimited minutes and unlimited direct connect and e-mail usage shall be included. Prior to the purchase of the phones and plans, the Owner and Engineer will provide the specific phone type and plans requested. Contractor shall set up phones with previously held phone numbers as directed by Engineer.

C. The Contractor shall maintain the office during construction. Operation and maintenance of the field off shall include:

1. Cleaning service for the inside of the office on a weekly basis.

2. Supplying copier paper, field books, office supplies, paper towels, refills for potable water cooler, paper/plastic kitchen supplies, cleaning supplies, and restocking the first aid kit on a monthly basis.

3. Monthly utility costs covering high speed internet/wi-fi, electricity, water/sewer, gas, heating, and cooling costs.

1.2 OWNER'S RIGHT TO REVIEW

A. Upon request, the City of Cambridge shall be provided copies of all invoices, lease agreements, or other documentation related to this Allowance Item.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01520

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01560

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes temporary environmental controls necessary for the project including dust abatement, rubbish control, sanitation, chemicals, and cultural resources. Snow removal and sweeping of streets and sidewalks are discussed in Section 01570 - MAINTENANCE AND PROTECTION OF TRAFFIC.

1.2 DUST ABATEMENT AND CONTROL

A. The Contractor shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity. The Contractor shall be responsible for any damage resulting from dust originating from its operations. The dust abatement measures shall be continued until the Contractor is relieved of further responsibility for the Work. Dust abatement measures shall include but not be limited to spraying water, applying calcium chloride, or placing temporary pavement on and around trenches and at work sites.

B. During excavation of soil/fill material dust shall be controlled to limit potential spread of contaminants and potential exposure of contaminants to workers and the public.

C. Ambient dust levels at the site shall be monitored by the Contractor prior to construction. During construction, real-time dust monitoring shall be conducted during any soil/fill handling activities. The monitoring shall consist of total dust testing using MIE, Inc. Miniram PDM-3 Dust Monitors, or like instruments. The total dust criteria at the site shall conform to the requirements of the HASP. Should fugitive dust quantities exceed twenty percent (20%) of the ambient level, the Contractor shall perform additional measures to reduce the total dust concentrations.

D. Nuisance dust levels may be encountered during regrading activities and excavation. Dust levels shall be reduced by pre-wetting the surface soils and by establishing and maintaining clean access roads. The Contractor's Dust, Vapor, and Odor Control Plan shall describe the procedures and materials to minimize dust. The Contractor shall refer to Section 02080 - SOIL AND WASTE MANAGEMENT for the Dust, Vapor and Odor Control Plan submittal requirements. At a minimum, the Contractor shall provide clean water, free from salt, oil, and other deleterious materials.

E. Failure to maintain positive and effective dust control may result in a suspension of the work, at no additional cost to the Owner and with no extension to the contract time, until dust control is addressed to the Owner's satisfaction.

F. Areas of exposed earth to be excavated shall be lightly sprayed with water before excavation. Additional water spray may be utilized only when any indication of excessive dust is observed. The Contractor shall minimize the use of water within the limits of excavation.

G. Access roads shall be sprayed with water on a regular basis to minimize the generation of dust.

1.3 RUBBISH CONTROL

A. During the progress of the Work, the Contractor shall keep the Site and other areas used by it in a neat and clean condition and free from any accumulation of rubbish. The Contractor shall dispose of all rubbish and waste materials of any nature occurring at the Site and shall establish regular intervals of collection and disposal of such materials and waste. The Contractor shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of all rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal, and in conformance with all applicable safety laws, and to the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

B. In the event that the Contractors work zone restricts municipal trash or recycling collection or makes it difficult for residents to bring trash or recycling to the street, the Contractor shall collect all trash and recycling within the work zone and transport it outside the work zone for municipal collection. Return trash and recycling receptacles back to respective properties.

1.4 SANITATION

A. Toilet Facilities: Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.

B. Sanitary and Other Organic Wastes: The Contractor shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the Contractor or organic material wastes from any other source related to the Contractor's operations shall be disposed of away from the Site in a manner satisfactory to the Work and in accordance with all laws and regulations pertaining thereto.

1.5 CHEMICALS

A. All chemicals used during project construction or furnished for project operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer.

1.6 CULTURAL RESOURCES

A. The Contractor's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").

B. The Contractor shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.

C. In the event potential cultural resources are discovered during subsurface excavations at the site of construction, the following procedures shall be instituted:

1. The Engineer will issue a Field Order requiring the Contractor to cease all construction operations at the location of such potential cultural resources find.

2. Such Field Order shall be effective until such time as a qualified archaeologist can be called to assess the value of these potential cultural resources and make recommendations to the State Historic Preservation Office.

D. If the archaeologist determines that the potential find is a bona fide cultural resource, at the direction of the State Historic Preservation Office, the Contractor shall suspend work at the location of the find under the provisions for changes contained in the General Conditions.

1.7 NOISE CONTROL

A. The Contractor shall comply with the City of Cambridge Noise Ordinance.

B. The Contractor shall make every effort to minimize noises caused by their operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with State and Federal (OSHA) regulations.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01560

SECTION 01568

EROSION CONTROL, SEDIMENTATION AND CONTAINMENT OF CONSTRUCTION MATERIALS

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall provide all work and take all measures to control soil erosion resulting from construction operations and prevent flow of sediment from construction site.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Two weeks prior to the start of the work, the Contractor shall submit for review and approval, a plan with detailed sketches showing the proposed methods to be used for controlling erosion during construction.

2. Contractor shall submit manufacturer's literature describing products, installation procedures, and routine maintenance of the sediment filter device and composting sock.

3. Contractor shall submit one sample of a sediment filter fabric device as produced by the manufacturer for the City's Approval.

1.3 QUALITY ASSURANCE

A. Use acceptable procedures, including water diversion structures, diversion ditches, composting socks, settling basins, and sediment filter devices.

B. Operations restricted to areas of work indicated on Contract Drawings.

C. If construction materials are washed away during construction, Contractor shall remove materials from fouled areas.

PART 2 – PRODUCTS

2.1 COMPOSTING SOCKS

A. Composting socks shall consist of a three-dimensional tubular sediment control and storm water runoff filtration device.

B. The compost material for the composting socks shall consist of unvegetated composting material and be made with sanitized, mature compost that has no identifiable feedstock constituents or offensive odors. The compost used in the composting sock shall meet all local, state, and Federal quality requirements.

C. The mesh material for the composting socks shall be biodegradable.

2.2 SEDIMENT FILTER DEVICE

A. Sediment filter device shall be manufactured to fit the opening of the catch basin or drop inlet. The sediment filter device shall have the following features:

1. Two dump straps attached at the bottom to facilitate the emptying of the device and shall have lifting loops as an integral part of the system.

2. Yellow restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls. Yellow restraint cord is also a visual means of indicating when the sack should be emptied.

3. Fabric shall consist of a woven polypropylene geotextile and be sewn by a double needle machine, using a high strength nylon thread.

4. Sediment filter device shall have a certified average wide width per ASTM Standard D-4884 standard of 165 lbs/in.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall not discharge chemicals, fuels, lubricants, bitumen, raw sewage, and other harmful waste into or alongside any body of water or into natural or manmade channel.

B. It is the intent of these Specifications to prevent the unnecessary occurrence of sedimentation or siltation of waterways and private properties. In the event the sedimentation or siltation prevention measures used by the Contractor prove to be inadequate as determined by the Owner and Engineer, the Contractor shall be required to adjust their operations to the extent necessary to prevent any such sedimentation or siltation from occurring, at no additional cost to the Owner.

3.2 INSTALLATION

A. Composting Socks shall be placed to form temporary water stops, dams, diversions, dikes, berms and for other uses connected with water pollution control and; composting socks shall be disposed of by the Contractor upon completion. Composting socks shall be installed per manufacturer's written installation procedures.

B. The Contractor shall protect catch basins by installing sediment filter devices in every catch basin within and downstream of the project limits.

C. The Contractor shall coordinate the installation of the sediment filter devices with the planned sequence of the work. The Contractor shall not install sediment filter devices in areas that are not impacted by project work until two weeks ahead of the work being performed in that area.

D. The Contractor shall install the sediment filter device before any work begins and shall place the device so that it is flush with the material around the frame of the grate of the catch basin structure. The Contractor shall be responsible for maintenance and placement of the strap lift holes to ensure that they do not become a hazard for pedestrians.

E. The Contractor shall maintain the sediment filter device and remove the collected debris as required by the Engineer. If any material is lost in the removal of the sediment filter device, then the Contractor shall be responsible for cleaning of the catch basin. The Contractor shall inspect the position of the device to ensure that the sediment filter device will work properly during any heavy rain or any storm greater than a 10 year return period.

F. Existing natural drainage patterns and vegetative cover shall be preserved to the maximum possible extent.

G. The Contractor shall use temporary vegetation, mulching, and paving to protect areas exposed during construction. The Contractor shall minimize the amount of bare earth exposed at any one time during construction, and shall also minimize the length of time bare earth is exposed.

H. On sloping terrain, composting socks may be used to trap sediment until vegetation has become established. The details of their placement shall be as approved by the Engineer.

I. Water that is being pumped from the trenches or excavations shall not be pumped directly into water courses or pipe conveyance systems. At a minimum, sedimentation control measures shall include portable sedimentation tanks, pumps, and piping, or other means acceptable to the Owner and Engineer to meet the water quality parameters specified in both the NPDES Dewatering Permits and these Specifications, whichever is more stringent.

J. Spoil resulting from the trench excavation shall be leveled or removed to permit free entry of water from adjacent land surfaces without excessive erosion or harmful ponding.

END OF SECTION 01568

SECTION 01570

MAINTENANCE AND PROTECTION OF TRAFFIC

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish all labor, equipment, and materials and perform all operations in connection with the maintenance and protection of vehicular, transit, bicycle, and pedestrian traffic on all roads, state and local, directly or indirectly affected by the construction. The work of this section also includes maintaining access to all properties adjacent to the work.

B. The Contractor is responsible for preparing and submitting a plan for traffic management to the City and Engineer, including updates as conditions warrant. The Contractor is responsible for design and implementation of revisions to the traffic management procedures during the course of the project at the requirements of the City or Engineer and at no additional cost to the Owner.

C. The Contractor shall develop and implement a detailed Traffic Management and Control Plan and obtain approval from the City of Cambridge Transportation Department and Department of Public Works two (2) weeks prior to proceeding with the work.

D. The Contractor will be responsible for coordination with the MBTA associated with temporary relocation of bus stops when work zones impact existing MBTA bus stops. This work shall include providing signage and creating or keeping clear, accessible, pathways from the existing bus stops to the temporary locations.

E. Furnish, erect, set, reset, relocate, move, remove, maintain, and dismantle sufficient signs, temporary lighting, barrels, flashers, channelizing devices (concrete barriers), fencing, and other traffic control devices on a continuous basis as necessary to protect the work and the general public at all times during construction in accordance with Contractor's approved Traffic Management and Control Plans. The work of this Section shall also include temporary bridging or plating for traffic across excavations.

F. The design, application, and installation of all traffic control devices required by this section shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) published by U.S. DOT, latest edition; American Disabilities Act (ADA); Massachusetts Architectural Access Board (MAAB); and the Massachusetts Department of Transportation – Highway Division (MassDOT), Standard Specifications for Highways and Bridges, latest edition. All traffic signs provided by the Contractor must be gender-neutral.

G. "Approved by the City" throughout this Section shall mean the approval of the Cambridge Department of Public Works and Transportation Department.

H. Traffic control during construction also includes street sweeping and snow removal from sidewalks and streets within the work zone as described in section 3.1 D. Maintaining rubbish and recyclable removal is also required and described in Section 01560 - TEMPORARY ENVIRONMENTAL CONTROLS.

I. Designated accessible parking spaces must be maintained at all times. If a designated accessible parking space must be impeded the Contractor must make arrangements to temporarily relocate the spot to the nearest reasonable space as possible. The Contractor must coordinate relocating an accessible parking space ahead of time with the City and the Engineer. The Contractor must supply MUTCD and City approved signage to designate the relocated accessible spot. The accessible spot must be coordinated with the intended user and notification shall be provided in advance.

1.2 REFERENCES

A. Reference is made herein to the MassDOT, Standard Specifications for Highways and Bridges, latest edition. References made to particular sections or paragraphs in the Standard Specifications for Highways and Bridges shall include all related articles mentioned therein.

B. Manual of Uniform Traffic Control Devices Part VI, Temporary Traffic Control, latest edition.

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Traffic Management and Control Plan: Before starting any work under this Contract, the Contractor shall prepare a plan that indicates construction equipment movement and the traffic routing proposed by the Contractor during the various stages and time periods of the work, and the location of temporary pedestrian, bicycle routes and construction facilities, temporary barricades, signs, drums, and other traffic control devices to be employed during each stage and time period of the work, to maintain traffic and access to abutting properties. The plan must be in accordance with the latest edition of the MUTCD and certified by the Contractor's Engineer. The Plan must specifically identify any proposed temporary relocation of MBTA or private bus stops; and/or detours of MBTA or private bus routes from their pre-construction routings. Particular care shall be taken to establish and maintain methods and procedures that will not create unnecessary or unusual hazards to public safety. The Plan shall be submitted a

minimum of two weeks prior to the start of construction for acceptance by the Engineer and approved by the City prior to start of Work. The Plan shall include procedures for the Contractor to coordinate with the Owner and City Departments (Department of Public Works, Transportation Department, Police, Fire, and Emergency Medical Services). Traffic management Plans shall depict the actual site, traffic lights, pedestrian crosswalks, proposed MUTCD traffic control signs, proposed vehicular detours, bike lanes and their protection thereof, pedestrian travel, pedestrian detours, sidewalk closed and pedestrian detour routes and signage, maintenance of ADA access, temporary pedestrian ramps if the sidewalk closures are not at existing ADA ramps, accessible parking spaces, bus stops for public, school and private busses.

2. Temporary Pedestrian Access Ramp Work Plan, Temporary Pedestrian Protection Work Plan and Temporary Pedestrian Detour Plan: Contractor shall provide a work plan detailing the location and layout of ramps and their protection, type of ramps and protection to be used with manufacturer's information, and duration the ramps and protection will be utilized. All pedestrian detours required shall be submitted for approval with these plans.

B. Shop Drawings shall be submitted for review two (2) weeks prior to start of construction. Thereafter, the Contractor shall submit to the Engineer updated Traffic Management and Control Plans a minimum of 10 working days prior to the start of construction at any new location or updates required in the work zone resulting from progress of Work throughout the duration of construction.

1. Submit complete shop drawings and work plans for staged construction and traffic movement including temporary vehicle, pedestrian, and bicycle as needed.

2. Show on the shop drawings all materials, dimensions, sizes, and methods of installation.

3. Safety Signing for Construction Operations: The Contractor shall submit temporary pedestrian, bicycle, and traffic management sign placement and sign size sketches showing the proposed sign setups intended to be used to provide the necessary traffic control and protection during the progress of work, plus the sign and legend size and layout. These sketches shall be submitted to the Engineer and City for review and approval before work begins.

4. When a detour or by-passing of vehicular traffic is anticipated, the Contractor shall submit for approval by the Engineer, and City, a detour plan showing the proposed alternative routes and location, size, and type of signs and traffic controls to be used. The traffic routing through or

around the Work and provisions for control of same shall be approved by the Engineer, and City.

5. The Contractor shall submit a Truck and Hauling Route Work Plan for all proposed truck routes prior to mobilizing. No trucking or hauling will be allowed without the approval of the City of Cambridge. No trucking or hauling will be allowed outside the proposed routes without the prior approval of the Engineer, Owner, and City. The Contractor is responsible for obtaining all permits and permissions. The Contractor is further responsible for obtaining approval for and coordinating parking restrictions required to facilitate trucking and hauling.

6. The Contractor is responsible for providing appropriate advance warning signs discouraging truck access and to update controls as needed if a problem of truck detours to local streets develops.

1.4 SPECIAL REQUIREMENTS

A. The Contractor shall provide access for fire apparatus and other emergency vehicles through the work zones to abutting properties at all times. Equipment and materials shall be stored at least twenty-five 25 feet away from an intersection so as to not obstruct turning radii for emergency vehicles or lines of sight and is subject to approval by the City and the Engineer.

B. At the end of each workday, where trenches in areas of public travel are covered with steel plates, each edge of the plates shall be either beveled or protected by a bituminous concrete ramp as accepted by the Engineer. Temporary bituminous patching material may be used to construct the ramps. The cost of patching materials, and their maintenance and removal, will be considered incidental to the Traffic Management item with no separate payment elsewhere. Plates shall be pinned or welded together to eliminate movement, noise or vibration. Use of steel plates are as approved by the City and the Engineer. Steel plates shall be removed from the right of way during inclement weather. The subsurface shall be flat to minimize deflection of the plates. Steel plates shall be supported to allow for H-20 loading when traffic is resumed on top of the plates. All steel plates shall be signed with “STEEL PLATES AHEAD” to advise motorists of the steel plates.

C. Open excavations adjacent to the traveled way or shoulders shall not remain open through non-work hours unless steel plated for the passage of heavy vehicles or protected by concrete barricades and fencing or barriers and specifically authorized by the City and Engineer.

D. Do not block more than one-side of the roadway at a time when making open cut or other street crossings unless otherwise approved.

E. For Shared Street construction, the Contractor shall provide signs that are specific to shared street construction including revised parking requirements and notification that pedestrians are to be expected in the roadway.

F. For Shared Street construction, the contractor shall provide temporary pavement markings on the binder course for parking delineation and to provide visual warning to vehicles as directed by the City or Engineer.

G. The Contractor shall be responsible for the costs in obtaining all permits to perform the Work.

H. At least one serviceable driveway access to all residences and businesses within the project shall be maintained at all times unless otherwise approved.

I. The Contractor shall provide temporary lighting to properly illuminate the work area and approaches in the event of nighttime work. Equipment must not exceed 65 decibles (dB) measured 10 feet away.

J. The Contractor shall not allow unnecessary idling of trucks and/or equipment throughout the entire project area. The City of Cambridge prohibits idling of trucks and equipment for periods of time exceeding five (5) minutes when not in use.

K. The Contractor shall notify the Cambridge Fire and Police Departments of any street closings.

1.5 SEQUENCING AND SCHEDULING

A. All streets within or adjacent to the contract limits, not specifically cited shall have their full roadway widths available for traffic or permitted parking at all times except for such restrictions as may be approved by the City and Engineer.

B. Notify the City and Engineer at least 48 hours in advance (not including Saturday or Sunday or Holidays) prior to the access lane restriction of the roadway. Notification shall include the date of the restriction, the hours of the day the roadway access will be restricted, and the estimated completion date.

C. The City and Engineer shall be notified of any re-routing of traffic 48 hours in advance (not including Saturday or Sunday or Holidays). Approval shall be obtained from the City and Engineer prior to any re-routing of traffic (except emergencies).

D. The Contractor shall verify street sweeping schedules in the work zone. Delivery related parking restrictions will not be permitted on days where street sweeping is scheduled unless otherwise approved.

1.6 HAULING AND TRUCK ROUTES

A. The Contractor is advised that all roads and bridges within or adjacent to the project shall be subject to legal loads, heights of vehicles and vehicle type / use restrictions. The Contractor is responsible for understanding the restrictions and obtaining all necessary permits.

B. The Contractor is advised that no agreements have been made by the Owner, the City of Cambridge, MassDOT, or with surrounding cities or towns to relieve the Contractor of liability for damage to local roads and bridges caused by the Contractor's operation. The Contractor shall contact appropriate officials of the surrounding cities, towns or agencies concerning hauling over city or town roads and bridges.

1.7 STORAGE OF MATERIALS, PARKING OF CONSTRUCTION EQUIPMENT AND WORKER PARKING

A. No material shall be stored within the work area or on adjacent roadways or residential streets except that which is needed to complete the work for that day and approved by the City and the Engineer. Any material approved to be stored in the roadway shall be at a minimum of twenty-five (25) feet away from an intersection to allow for all emergency response vehicles to navigate the corners and intersections and to minimize line of sight obstruction.

B. If permitted by the City and the Engineer, the Contractor shall park construction equipment within the work zone and protect equipment with barriers or barricades. Parking outside the work zone will be required if the equipment obstructs traffic flow. All equipment parking and storage must be approved by the City and Engineer. Any equipment approved to be stored in the roadway shall be at a minimum of twenty-five (25) feet away from an intersection to allow for all emergency response vehicles to navigate the corners and intersections and to minimize line of sight obstruction.

1.8 BARRICADES, WARNING SIGNS AND OTHER PROTECTIVE DEVICES

A. Install, inspect, remove, maintain, and reset all temporary construction controls as frequently as required and in accordance with an approved construction staging sequence and traffic management plan.

B. Regulatory and warning devices shall be subject to removal, replacement and repositioning as often as necessary, and as directed by the Owner and Engineer.

C. Temporary pavement markings and devices shall be used as shown on the approved plans and as required by MUTCD and ADA standards for traffic control and pedestrian safety.

D. Existing pavement marking shall be maintained at all times. When existing pavement marking are disrupted by the work they shall be replaced at no additional expense to the Owner.

1.9 POLICE DETAILS SERVICE

A. Uniformed City, Municipal, or State police officers shall be utilized to assist with traffic flow throughout the construction period. Scheduling Police Details shall be the responsibility of the Contractor. To schedule a detail officer, call (617) 349-3350.

B. The Cambridge Police Department requires 48-hour advance notice to obtain a Police Detail, except in emergencies and 12-hour advance notice to cancel a detail. Contractor shall request as many police details as needed to support the safety of pedestrians and traffic at all times.

C. The Contractor shall coordinate all work with the police officers including but not limited to: locations of work, delivery of materials, equipment movement, required traffic management and schedules.

D. The Contractor must submit all signed detail forms to the project managers or engineer, so that Public Works can pay all submitted and approved Police Detail invoices. Any invoices that are not approved will be the responsibility of the Contractor to pay.

E. The City of Cambridge Police Department shall bill the City of Cambridge Department of Public Works or whatever department has oversight of the contract for the services of uniformed police officers provided by the Police Department.

F. The Contractor will be required to reimburse Public Works or whatever department has oversight of the contract for Police Details, if the Contractor fails to show for the job or if the Contractor fails to cancel the detail with adequate advance notice.

1.10 PEDESTRIAN TRAFFIC

A. Sidewalks and pedestrian ramps shall be maintained at all times through the construction period. Temporary sidewalks, pedestrian detours, crosswalks and other pedestrian facilities shall be constructed as needed to maintain pedestrian traffic and business access, as ordered. The Contractor shall anticipate that temporary pavement markings (paint or tape) will be required in order to comply with this provision. **Constructed items such as approved temporary sidewalks and ramps will be paid for under the appropriate items of the Contract. Temporary signage, markings, barricades and other traffic control devices will be paid for under Item 1570.1 Traffic and Pedestrian Management.**

1. Pedestrian access shall be provided to abutting land uses and businesses at all times, as approved by the City and Engineer and in accordance with MUTCD and ADA requirements.

2. Unobstructed walkways of 4-feet minimum width, unless otherwise approved by the City and Engineer shall be provided at all times.

B. Temporary pedestrian walkways shall be separated from roadway and construction areas by barricades and fence as approved by the City and Engineer. Pedestrian walkway barricades shall be firm, cane-detectable at top and bottom and securely fixed in place. These provisions will be strictly enforced. The use of isolated, discontinuous, and non-detectable channelizing devices such as traffic cones or barrels is not acceptable.

C. The Contractor shall be notified by telephone of any location not providing adequate pedestrian access. The Contractor shall acknowledge notification of the call within one (1) hour by contacting the Engineer or the Public Works Dispatcher at (617) 349-4800.

D. The Contractor shall respond to the work site within one and a half (1.5) hours of acknowledged notification with sufficient equipment and labor to perform the required work.

E. The Contractor's failure to respond within the specified response time twice within the Contract time will result in a permanent deduction of $250.00 from Contract payments due.

F. The Contractor's failure to respond within the specified response time three times within the Contract time will result in an additional permanent deduction of $400.00 from Contract payments due.

G. The Contractor's failure to respond within the specified response time four or more times within the Contract time will result in an additional permanent deduction of $500.00, per each additional occurrence, from Contract payments due.

H. Continued failure to provide adequate pedestrian access may result in the City terminating the Contract in accordance with Section 800 (General Terms and Conditions of the Contract).

1.11 VEHICULAR TRAFFIC

A. The Contractor shall meet the following conditions, unless otherwise specifically approved by the Owner, City, and Engineer:

1. All work shall be prosecuted with proper regard for the convenience of the public and in a manner to permit unimpeded traffic flow whenever possible. The interruption of traffic will not be permitted unless specifically allowed by the City and Engineer and in accordance with the requirements of the City and in conformance with MUTCD requirements.

2. The Contractor shall be responsible for necessary coordination with the City departments affected by the project.

3. With the exception of approved road closures or as otherwise approved by the City and Engineer, the Contractor shall provide travel lanes throughout the project area at all times as follows:

   a. Provide 20-foot minimum temporary road width for a two-way and 10-foot minimum temporary road width for a one-way road.

   b. Provide 5-foot minimum temporary bicycle lanes on roads where existing bicycle lanes exist.

   c. Maintain or install working vehicle, bicycle and pedestrian signals at all times. Temporary signals, if approved by the Engineer and Owner, may be utilized at no additional cost to the Owner.

4. Traffic control devices and signs shall be removed, demounted or properly covered for those periods of the day not in use.

5. The Contractor shall coordinate the work with the schedules of City Rubbish and Recycling Collection trucks and delivery trucks to the adjacent stores and property owners so as not to impede their access and cooperate with delivery personnel to facilitate deliveries to properties within the work zone.

6. No operations shall be conducted, including the loading or unloading of equipment or materials, on or near the traveled lanes or road shoulders without first erecting warning signs and channelizing devices. These precautions shall be maintained at all times while work, loading and unloading is in progress.

7. Construction signs and channelizing devices shall be used to separate traffic from the work areas and for traffic control. Placement, other than required by MUTCD, will require prior approval. The Contractor shall locate temporary signs and channelizing devices so that they do not impede safe travel for pedestrians and bicycles.

8. Temporary signs and channelizing devices shall not be set up until there is adequate visibility or appropriate construction lighting. The Contractor shall schedule his work so that temporary signs and channelizing devices are removed and traffic is returned to its normal pattern before the end of the work period.

9. Work requiring overnight lane closures shall not begin until all materials required for the completion of each nights work are delivered

or available to the project site, unless otherwise approved by the Owner, City and Engineer. Night work is to occur only with approval by City and with appropriate Noise Ordinance variances.

10. Accesses to residential and commercial buildings shall be maintained at all times.

11. Work operations shall not be performed on the roadway in such a manner that traffic is obstructed or endangered simultaneously from both sides of the roadway unless otherwise approved.

12. The Contractor shall keep all roadway areas open to traffic as clear as possible at all times. Materials shall not be stored on any roadway area or within four (4) feet. of the traveled way. Material shall be delivered to the installation areas as they are needed to provide a continuous installation. Location of storage areas shall be subject to approval.

13. The Contractor may occupy a maximum of 200 linear feet of curb lane at any time for its active operations, or 100 linear feet for storage during non-working periods, with multiple operations allowable, being separated by a minimum of 500 linear feet. The remainder of available curbside frontage shall be available for parking/loading or bus stops as appropriate.

14. The Contractor shall remove all equipment and construction vehicles from the traveled way and shoulders open to traffic during non-work hours. Vehicles shall be parked no closer than four (4) feet from the traveled way in pre-approved areas unless specifically permitted.

15. Each driver of any vehicle or piece of equipment used on this contract shall be furnished written instructions concerning the manner of operation for that vehicle or piece of equipment. Specifically, these instructions shall warn against stopping on the traveled portions of the roadway, against passing other vehicles, and against traveling in close proximity to other vehicles. A copy of these instructions shall be given to the City.

16. Temporary signs and channelizing devices shall not be set up when the Contractor or City has determined inclement weather makes such installations impractical.

17. The Contractor shall furnish 60-inch x 30-inch approved signs reading "CONSTRUCTION VEHICLE - DO NOT FOLLOW" to be used on trucks hauling to the project, when such signs are deemed necessary by the City and/or Engineer. The color, type of sheeting and size of lettering shall conform to that of the permanent construction signs.

18. The Contractor shall furnish, install, and maintain 36-inch x 36-inch approved signs reading “ROUGH ROAD” AND “MOTORCYCLES USE CAUTION” in advance of all roadway areas which have been cold-planed or wherever trenching has created rough road conditions. If the road has exposed soils place “GRAVEL ROAD AHEAD” signs in advance of the exposed soil sections.

19. The Contractor shall furnish, install and maintain additional temporary cones and barrels, as required by the Engineer, after Traffic Calming devices (horizontal and vertical deflections) have been constructed.

20. The Contractor will be responsible for snow removal within active work zones. Snow shall be removed from the entire right of way inclusive of the entire traveled way, bike lanes, parking lanes and sidewalks within the areas the contractor is working.

21. Driveways cannot be blocked for weekends. During sidewalk pours the driveway apron must be available for the weekend. If the Contractor elects to pour a driveway apron on a Friday they must commit to removing the forms on Sunday morning to allow for driveway access over the weekend. Driveway apron blocking must be coordinated with the property owners ahead of time and in some cases a temporary driveway access must be provided by the Contractor to the property at no additional cost to the Owner.

22. Traffic signals shall be maintained in normal operation at all times. Traffic loops shall be repaired immediately if the traffic lights are critical to maintaining traffic flows as in systematic programmed signals that include operation of more than one set of signals at no additional expense to the Owner. Where traffic signals are simple in their application and allowed by the City and Engineer, traffic loops shall be repaired within a week of their disruption at no additional expense to the Owner.

1.12 BICYCLE TRAFFIC

A. The Contractor shall meet the following conditions, unless otherwise specifically approved by the City, and Engineer:

1. Bicycle traffic shall be accommodated on all public streets either within bicycle lanes where existing or in vehicular travel lanes.

2. Where bicycle lanes are not present, provide a shared vehicle lane as wide as physically feasible.

3. When travel lanes are restricted to less than fourteen (14) foot in width, warning signage (W11-1/W16-1 combination - Bicycle warning symbol with SHARE THE ROAD plaque) shall be placed warning

motor vehicle operators of the presence of bicycles in the roadway.

4. If the disruption occurs in a bicycle lane over a short distance (approximately 500 feet or less), bicyclists should be routed to share a motor vehicle lane. In locations where bicycles and vehicles share the same lane a "BICYCLES MAY USE FULL LANE" sign shall be placed with the construction signage.

5. When existing bicycle lanes are to be transitioned to shared lanes due to construction, the following shall also apply:

   "BICYCLE LANE ENDS" sign shall be placed as directed by the Engineer. This sign shall not be placed in the bicycle lane. To create the merge of the bicycle lane and the vehicular lane, orange traffic cones should delineate a taper. Cones must be spaced 6 feet apart and be connected with traffic cone bars. The taper length for bicycle traffic must be 18 feet long and the downstream end should be 6 feet upstream of the work zone.

6. Steel plates:

   When steel plates are used in the travel way warning signage (Warning Steel Plates 100 FT) shall be placed at least 100 feet in advance.

   Steel plates shall be set so there is no vertical lip over 1/4 inch between the plate and adjacent pavement. This shall be accomplished in one of the following ways:

   a. Recessing the plate so that the top of the plate matches adjacent pavement (with no lip over 1/4 inch).

   b. Providing bituminous concrete lip painted reflective pink to provide a smooth transition slope up from existing pavement to top of plate.

   Non-slip surface steel plates are preferred for use at an intersection, on a hill, or within a crosswalk.

   Steel plates used to support traffic must be at least H-20 rated.

   Steel plates that deflect under the weight of vehicles must be removed and reset with additional support provided to minimize deflection.

7. Raised castings: Where raised castings are present after cold planing and/or in anticipation of final paving and/or anytime castings will be left raised for more than 12 hours, provide the following:

a. Advance warning signs saying: “Caution – Raised Castings Ahead.”

b. Spray paint reflective fluorescent pink the raised portions of the castings in their entirety. Spray paint shall be re-applied daily, or as needed, on all raised castings to maintain visibility.

8. Cold planing and pavement installation: Where cold planing or the installation of pavement in lifts results in vertical joints greater than 1/4 inch, provide temporary bituminous concrete lip painted reflective pink to provide a smooth transition slope between the pavement layers. Paint shall be reapplied daily, or as needed, to maintain a visible queue of joint.

9. When the roadway or travel lanes narrow due to construction, advance warning signs should be placed at least 20 feet in advance.

10. Narrow cuts that are parallel with the direction of travel create an extreme hazard for cyclists, whose tires could get caught. These should never be made and left in an area where bicyclists will be traveling. If necessary, they should be blocked off and cyclists routed around the hazard. When performing advance pavement cutting for trenching or other roadway excavation, use only saw cutting (approximately 1/4 inch or narrower).

11. Debris should be swept to maintain a reasonably clear riding surface in the bicycle lanes or, where there are no bicycle lanes, the outer 5 or 6 feet of roadway. Promptly remove gravel, debris, litter, sand, stone, and other obstructions from bicycle lanes and travel lanes.

12. Advance construction signs shall not be placed in bicycle lanes and shall not otherwise obstruct bicyclists’ path.

13. Temporary ramps for site access ramps. The creation of ramps in the roadway is not permitted unless being created in an area that is otherwise used by on-street parking.

14. Restore pavement markings for bike lanes within 2 weeks of paving.

PART 2 – PRODUCTS

2.1 MATERIAL

A. All barricades, drums, cones and other channelizing devices shall meet the requirements for MassDOT Standard Specifications for Highways and Bridges Section 850 Traffic Control for Construction and Maintenance Operation

(Latest Revision) and the Manual of Uniform Traffic Control Devices (Latest Revision).

B. Traffic Control Materials

1. Materials required for the work of this Section need not be new, but must be in first-class condition and acceptable to the Owner and Engineer. Any materials that in the judgment of the Owner are unsatisfactory in appearance or performance shall be removed and immediately replaced by acceptable units.

2. Signs, portable barricades, and drums shall have "High Intensity Encapsulated Lens Reflective Sheeting" in accordance with Section M9.30 of the MassDOT Standard Specifications for Highways and Bridges and MUTCD requirements.

3. Signs shall be fabricated with "High Intensity Encapsulated Lens Reflective Sheeting". Transparent red, blue, yellow or black opaque paint (ink) may be used over "High Intensity Encapsulated Lens Reflective Sheeting" in accordance with the MassDOT Standard Specifications for Highways and Bridges, where these colors are specified.

4. Safety signage for construction operations shall consist of furnishing, positioning, repositioning, inspecting, maintaining, and removing regulatory, warning, and guide signs and temporary bus stop signs and taxi stop signs and their supports as approved by the Owner, City and Engineer.

5. Replace all signs and posts, which are damaged or are missing from their location at no additional cost to the Owner.

6. Maintain all signs in a satisfactory manner including the removal of dirt or road film that cause a reduction in sign reflective efficiency.

C. Portable Barricades

1. Furnish, install, relocate, remove, re-install, and maintain portable barricades in accordance with MassDOT and MUTCD requirements or as directed by the Owner, City and Engineer.

2. Portable barricades shall conform with Section 850.51 of the MassDOT Standard Specifications for Highways and Bridges. Reflectorized sheeting shall conform to Section M9.30.0, of the MassDOT Standard Specifications for Highways and Bridges.

3. Eight-foot-long units of portable barricades shall be constructed, as needed.

4. Alternating 6 inches wide diagonal stripes shall be orange and white and shall slope downward at 45 a degree toward the end by which traffic is to pass. Barricades that block the passage of traffic or designate the end of the traveled way shall have alternating vertical orange and white stripes on the rails.

5. Barricades shall be maintained in good and serviceable condition throughout the duration of the Contract.

6. Temporary pedestrian and construction facilities shall be kept clean and freshly painted as required.

D. Signs, Covered

1. Cover any existing regulatory and warning signs as required by the Owner, City and Engineer.

2. Use a cover approved by the Owner, City and Engineer which shall be securely fastened to the existing sign and shall completely cover the legend of the existing sign. The cover shall remain in place as long as necessary at which time it shall be promptly removed.

3. Signs shall be covered without causing any damage to the existing sign.

4. All construction signage that cannot be removed at the end of the day shall be covered at the end of the work day during non-work hours.

E. Traffic Signals

1. Traffic signals shall remain operable at all times throughout the duration of the contract unless approved otherwise by the City.

2. It shall be the Contractor's responsibility to maintain the traffic signal system in continuous and good working order. The Contractor at their expense, shall repair any damage to the traffic signal system resulting from the Contractor's work.

3. Traffic signals shall be maintained in normal operation at all times. Traffic loops shall be repaired immediately if the traffic lights are critical to maintaining traffic flows as in systematic programmed signals that include operation of more than one set of signals at no additional expense to the Owner. Where traffic signals are simple in their application and allowed by the City and Engineer, traffic loops shall be repaired within a week of their disruption at no additional expense to the Owner.

F. Temporary Precast Concrete Barriers and Work Zone Protection

1. Temporary precast concrete barriers shall be furnished and installed as shown on the approved traffic management plans and where required to protect work zones and excavations which cannot be completed and backfilled or plated within a daily work period. Fencing shall be affixed to the barriers to a height of six feet above the road surface and shall not have any holes in the perimeter barriers or fencing larger than the chain link fencing spacing (2 inches by 2 inches). Barriers shall be removed or relocated when no longer required and with the approval of the Owner, City and Engineer.

2. Precast concrete median barrier shall conform with Drawing Number 853 of the MassDOT Construction Standard Details, as well as be acceptable for temporary pedestrian and construction facilities and signage.

3. Temporary precast barrier for use for temporary pedestrian and construction facilities shall have three sleeves cast in the barrier to receive a post for panel and fence installations.

4. Temporary chain link fence, four (4) feet high, shall be erected at work zones abutting pedestrian travel paths and around work zones hazardous to pedestrians in conjunction with precast barriers to form a "safety zone" seven (7) feet high, or as required by the City and Engineer. The top two (2) feet shall be fixed with plywood panels painted as required by the Owner and Engineer. The barriers and fencing shall be overlapped at the corners of the excavated area to provide a continuous protective screen.

G. Remote Controlled Changeable Message Signs

1. The internally illuminated changeable message sign shall consist of a magnetically operated matrix, LED, fiber optic, or lamp matrix message board; battery or solar power supply; hardware for connection to a 110 volt power source; and a computer operated interface, all mounted on a towable, heavy-duty trailer.

2. The sign shall be controlled by an on-board computer. The sign shall automatically change to a pre-selected default message upon failure. That default message shall remain on display until the problem is corrected.

3. The Remote Controlled Changeable Message Sign unit shall be equipped with a security system to prevent unauthorized access. The security system shall allow access only through use of a code or password unique to that sign. If the proper code or password is not entered within 60 seconds of initial telephone contact, the call will be

terminated. Remote control for the changeable message sign shall be by cellular telephone and touch tone modem decoder.

4. The lamp matrix, LED or fiber optic sign, shall be equipped with a top-mounted photocell for automatic sign dimming during nighttime use.

5. The remote controlled portable changeable message sign shall be capable of performing all functions at ambient temperatures ranging from -31° to 165°F (–35 to 74°C). There shall be no degradation of operation due to fog, rain or snow. Maintenance shall include periodic cleaning. When not being used the sign shall be stored in a secure area approved by the Engineer.

6. Message Sign

   a. Type – The technology can be LED or a combination of both Flip Disk and LED (Hybrid).

   b. Matrix Displays – Shall be character, line or full matrix.

   c. Size – The message sign shall have a minimum height of 4 feet, a minimum width of 5 feet, and maximum width of 8 feet.

   d. Colors – The display shall be either fluorescent yellow or ITE amber.

   e. Lines – The message sign shall have the capability of displaying at least three lines of 18 inch characters with a minimum of 8 characters per line.

7. The sign shall be capable of storing 100 pre-programmed messages and be able to display any one of those messages upon call via the trailer-mounted terminal or through the cellular telephone hookup.

8. The sign shall be capable of operation from a battery, or solar power. The power supply shall be protected from the weather and be locked for security.

9. The trailer shall include swivel jacks capable of leveling the trailer on a 1:6 (1 vertical to 6 horizontal) slope and capable of stabilizing the trailer in winds of up to 80 miles per hour. The sign shall be capable of being locked in a stowed position while being towed

PART 3- EXECUTION

3.1 GENERAL

A. Conduct the work in manner that interferes as little as possible with public travel, whether vehicular or pedestrian.

B. Provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel whenever it is necessary to cross, or obstruct roads, driveways, and walks, whether public or private.

1. Give a minimum of 48 hours (not including Saturday, Sunday or Holidays) written notice to owners of private driveways before interfering with them.

C. Provide temporary surfacing on shoulders when necessary.

D. Provide snow removal within the work limits to maintain safe and efficient vehicular and pedestrian traffic flow, including accesses and sidewalks. Contractor shall plow snow out of the work zone in all areas where municipal snow removal is prevented by construction in the opinion of the City and Engineer. The Contractor shall also remove snow from all sidewalks in areas where construction related activities are occurring or have recently occurred.

E. Provide street sweeping within the work limits to maintain safe and efficient vehicular and pedestrian traffic flow, including accesses and sidewalks. The Contractor shall sweep sidewalks, pedestrian walkways and detours, and streets within the work zone on a daily basis. In the event that the Contractors work zone restricts municipal street sweeping in the area, the Contractor shall sweep the restricted streets (including streets outside the work zone) to a point where municipal street sweeping can continue.

F. Street sweeping shall be done a minimum twice per week by mechanical sweepers capable of adding water to the sweeping operation as directed by the Owner. Power brooms are prohibited. Small mechanical sweeps (not including power brooms) should be done in conjunction with watering operations unless otherwise approved by the Owner. Sweeping, watering, and/or the use of calcium chloride shall be used at a minimum at the end of each day and more frequently as directed by the Owner. Temporary paving as a means of dust control shall be completed, at a minimum each Friday, or more frequently, as directed by the Owner.

G. Sufficient and adequate signs, flashers, channelizing devices, lights, arrow boards and other precautions necessary to protect the work and the public, as determined by the Engineer shall be used at all times during construction.

H. Provide trench bituminous paving repairs on a daily basis, but at intervals no longer than weekly, unless required or allowed otherwise by the City and Engineer or applicable agency having jurisdiction.

I. Pedestrian access shall be maintained at all times. Access shall be a minimum of four (4) feet, clear of all obstructions and meet all American with Disability Act (ADA) requirements. If an existing pedestrian walkway is interrupted, temporary walkways with ramps shall be provided.

J. Contractor shall post "No Parking" signs 48-hours in advance for residential permit parking locations and 24-hours in advance for metered, public, etc. If work does not take place that day, signs must be reposted. Standard Cambridge signs shall be used that provide information regarding proposed construction and parking restriction hours. Signs shall be placed at a minimum of 25-foot intervals. Signs shall be removed or updated immediately upon the completion of the range of dates depicted on the signs.

3.2 DETOURS

A. If approved by the Owner, City, and Engineer, construct and maintain detours around the work to maintain traffic over any construction work in a public street, road, or highway where traffic cannot be maintained on alignment of original roadbed or pavement.

B. When detours are allowed, the Contractor shall provide all detour signs approved by the City and/or Engineer with directional arrows. Signs shall be placed at all streets and intersections to provide required direction to allow motorists to return to the street location beyond the detour. The Contractor must submit a written detour plan for the City and/or Engineer's approval prior to implementation of the detour.

C. All detouring and signing shall meet the requirements of the applicable references specified in Parts 1 and 2 above.

D. The Contractor shall request Police details in the work areas. Contractor shall coordinate vehicle towing with the police.

E. The Detour Plan shall be reviewed and approved by the Owner, City, and Engineer prior to establishing any detours.

F. The Contractor is responsible for the notification of any parties affected by the detour, including, but not limited to Cambridge Fire Department, Cambridge Police, State Police, MBTA, Cambridge Transportation Department, and abutting property owners.

G. Detour signs shall have a street name placard indicating the name of the road that is being detoured.

3.3 PROTECTION

A. Signs and Channelizing Devices:

1. Locate signs and channelizing devices with lights to protect public thoroughfares which are closed to traffic.

2. Ensure that all open trenches and other excavations have signs, channelizing devices and lights to provide protection to the public.

    a. Provide similar warning signs and lights for obstruction such as material piles and equipment.

    b. Ensure that the material storage and conduct of the work on or alongside streets causes minimum obstruction and inconvenience to the traveling public.

3. Install and maintain all signs, channelizing devices, lights, and other protective devices in conformity with applicable statutory requirements and as required by the municipalities or agencies having jurisdiction.

4. Illuminate all channelizing devices with flashing lights.

5. No traffic control devices shall be stored adjacent to the roadway.

6. During inclement weather (hurricanes, high winds, snow, etc.) as directed by the City or the engineer and after the work has suspended for the day or the weekend; remove all signs, barrels, cones and other traffic management devices from the right of way to prevent traffic management devices from blowing over and creating a hazard in the right of way. Any traffic management devices to remain shall be secured in a manner that prohibits winds from blowing them over or prohibits them from serving their intended function.

B. REMOTE CONTROLLED CHANGEABLE MESSAGE SIGN

1. The Contractor shall furnish, place, operate, maintain and relocate the sign as required. When the sign is no longer required, it shall be removed and become the property of the Contractor. The cellular telephone required for the Remote Controlled Changeable Message Sign shall be provided to the Engineer for use, and subsequently returned to the Contractor. When the sign is not in use, it shall either be turned off or turned from view.

2. Any signs that are missing, damaged, defaced or improperly functioning so that they are not effective, as determined by the Engineer and in accordance with the ATSSA guidelines contained in "Quality Standards for Work Zone Traffic Control Devices," shall be replaced by the Contractor at no cost to the State.

END OF SECTION 01570

SECTION 01600

PRODUCTS, MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install products, equipment and materials as specified and indicated in accordance with the Contract Documents.

B. Provide transportation, handling, storage, and protection of all products, materials and equipment in accordance with the Contract Documents.

1.2 DEFINITIONS

A. The word "Products," as used herein, is defined to include purchased items for incorporation into the Work, regardless of whether specifically purchased for the project or taken from Contractor's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form units of work. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.

B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying and erection of the Work.

C. Spare Parts are defined as subassemblies or components of the Products installed in the Work.

1.3 QUALITY ASSURANCE

A. Source Limitations: To the greatest extent possible for each unit of work, the Contractor shall provide products, materials, and equipment of a singular generic kind from a single source.

B. Compatibility of Options: Where more than one (1) choice is available as options for Contractor's selection of a product, material, or equipment, the Contractor shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.4 PRODUCT DELIVERY AND STORAGE

A. The Contractor shall deliver and store products, materials, and equipment for the Work in accordance with manufacturer's written recommendations and by methods and means that will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of materials, products, and equipment at site and overcrowding of construction spaces. In particular, the Contractor shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive products, materials, and equipment to deterioration, theft, and other sources of loss.

1.5 TRANSPORTATION AND HANDLING

A. Products, materials and equipment shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

B. The Contractor shall provide equipment and personnel to handle products, materials, and equipment by methods to prevent soiling and damage.

C. The Contractor shall provide additional protection during handling to prevent marring and otherwise damaging products, materials, equipment, packaging, and surrounding surfaces.

1.6 STORAGE AND PROTECTION

A. Products, materials and equipment shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products, materials and equipment shall be stored in weather-tight climate-controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.

B. For exterior storage of fabricated products, materials and equipment, the products, materials and equipment shall be placed on sloped supports above ground. Products, materials and equipment subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.

C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.

D. Storage shall be arranged to provide access for maintenance and inspection. The Contractor shall periodically inspect to assure products, materials and equipment are undamaged and are maintained under required conditions.

E. Storage of materials and equipment in resource areas shall not be permitted.

1.7 MAINTENANCE OF STORAGE

A. Stored products, materials and equipment shall be periodically inspected. The Contractor shall maintain a log of inspections and shall make the log available on request.

B. The Contractor shall comply with manufacturer's product, material and equipment storage requirements and recommendations.

C. The Contractor shall maintain manufacturer-required environmental conditions continually.

D. The Contractor shall ensure that surfaces of products, materials and equipment exposed to the elements are not adversely affected and that weathering of finishes and coatings does not occur.

E. Products, materials and equipment shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to acceptance by the Owner in accordance with the Contract Documents.

PART 2 - PRODUCTS

2.1 GENERAL

A. Do not use materials and equipment removed from existing premises, except as specifically required by the Contract Documents.

B. Where similar Products (such as grease fittings, flexible couplings, etc.) are used on different pieces of equipment or in different areas within the Work, standardize the Products by providing all Products from the same Supplier.

2.2 SPARE PARTS

A. Provide spare parts for Products as indicated and specified.

B. The Contractor shall deliver to the Owner all spare parts except those requiring maintenance in storage, at least thirty (30) days prior to scheduled starting of system. Spare parts that require maintenance in storage shall be held and maintained by the Contractor until Substantial Completion and then a separate delivery of the remaining spare parts will occur. The spare parts that do not require maintenance in storage shall be packed so that they are protected from damage and the environment during storage.

C. Tag spare parts and containers to clearly identify them. Cross reference all parts to the Tag ID numbers as indicated and as specified.

D. All spare parts are to be identical and interchangeable with similar parts installed in the Work.

E. The Contractor is to submit to the Owner at least 120 days prior to startup, all initial submittals of spare parts for review and approval.

1. Early submittal is encouraged.

2. The Contractor will have all spare parts submittals finalized, submitted and approved, and all spare parts shall be delivered to the Owner at least thirty (30) days prior to scheduled starting of systems.

2.3 GENERAL MATERIAL AND EQUIPMENT REQUIREMENTS:

A. The following requirements shall constitute the acceptable minimum standards for the equipment specified herein. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements.

B. Grease Fittings:

1. Provide extension fittings and tubing on all grease fittings that are installed so that equipment can be lubricated from the operating level without the use of ladders, staging, or shutting down the equipment. Tubing shall be of corrosion resistant materials compatible with the material to which it is attached.

C. Concrete Inserts:

1. Use concrete inserts for hangers to completely support the maximum load that can be imposed by the hangers used in the inserts.

2. Provide inserts for hangers of a type which will permit adjustment of the hangers both horizontally (in one plane), and vertically, and locking of the hanger head or nut. Galvanize all inserts by the hot-dip process in conformity with ASTM Standard Specification for Zinc (Hot -Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip, Designation A123-78, or ASTM Standard Specifications for Zinc Coating (Hot Dip) on Iron and Steel Hardware, Designation A153-80.

D. Sleeves:

1. Provided sleeves shall be of ample diameter to pass the pipe and its insulation, if any, and to permit expansion.

2. Provide sleeves that are flush at the walls and at the bottom of slabs. Sleeves must project one inch above the finished floor surface. Threaded nipples shall not be used as sleeves.

E. Protection against Electrolysis:

1. Where dissimilar metals are used in conjunction with each other, provide insulation between adjoining surfaces to eliminate direct contact and any resultant electrolysis. Provide bituminous insulation, heavy bituminous coatings, nonmetallic separators or washers, impregnated felt, or similar arrangement.

PART 3 - EXECUTION

3.1 GENERAL MATERIAL AND EQUIPMENT INSTALLATION REQUIREMENTS

A. The following requirements shall constitute the acceptable minimum standards for installing the equipment specified herein. Should these requirements conflict with the Supplier's recommendations or in any way be less stringent than the Supplier's requirements, they shall be superseded by the Supplier's requirements.

1. Bolts, Anchor Bolts, and Nuts

a. Set anchor bolts and expansion bolts as indicated and as specified.

b. If anchor bolts are set before the concrete has been placed, use templates.

c. Where indicated, or specified, provide anchor bolts with square plates at least 4 in. by 4 in. by 3/8 in., or with square heads and washers set in the concrete forms with pipe sleeves, or both.

d. If anchor or expansion bolts are set after the concrete has been placed, do all drilling and grouting or caulking without damaging the structure or finish by cracking, chipping, or spalling.

B. Equipment Foundations and Grouting

1. In setting pumps, motors, and other grouted equipment, make an allowance of at least one inch for grout under the equipment bases. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and inconspicuous in the completed work. Use non-shrink grout.

2. Mix and place grout in accordance with the recommendations of the Supplier and as indicated and as specified. Place grout through the grout holes in the base, work outward and under the edges of the base, and across the rough top of the concrete foundation to a peripheral form to provide a chamfer around the top edge of the finished foundation.

3. After the grout has hardened, remove all forms, hoppers, and excess grout. Patch all exposed grout surfaces, give a burlap-rubbed finish, and coat with at least two coats as specified.

C. Sleeves and Openings

1. Provide all chases or openings for the installation of the Work or cut the same in existing Work.

2. Provide all sleeves or forms at the Work, and set them as indicated and as specified, and in ample time to prevent delays.

3. Locate all chases, openings, and sleeves as specified and indicated. If the location is not specified or indicated, locate all openings to avoid interference with equipment and piping.

4. If openings and/or sleeves were not provided prior to concrete placements, the Contractor shall provide and set them afterwards at no additional cost to the Owner. Confine the cutting to the smallest extent possible. In no case shall piers or structural members be cut without the written consent of the Owner.

5. Fit around, close, repair, patch, and point around the work specified herein to the requirements of the Owner.

6. Perform all this work by workmen using small hand tools. Do not use power tools except where, in the opinion of the Owner, the type of tool proposed can be used without damage to any work or structures and without interference with the operation of any facilities. The Owner's concurrence with the type of tools shall not in any way relieve or diminish the responsibility of the Contractor for such damage, or interference resulting from the use of such tools.

7. Do not cut or alter the work of any subcontractor or any other contractor, nor permit any subcontractor to cut or alter the work of any other contractor or subcontractor, except with the written consent of the contractor or subcontractor whose work is to be cut or altered, and with the written consent of the Owner. All cutting and patching or repairing made necessary by the Contractor or any subcontractors shall be done at no additional cost to the Owner.

END OF SECTION 01600

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01630

RESTORATION OF GROUNDS AND CLEANING UP

PART 1 - GENERAL

1.1 REQUIREMENTS

A. The Contractor on or before the completion of the work, except as otherwise expressly required or permitted in writing by the Owner, shall tear down and remove and legally dispose of all temporary structures built or used by the Contractor; shall remove all rubbish and debris of all kinds from all Contract structures and from any grounds which he shall have occupied within the limits of the project site; shall leave the site of the work in a satisfactorily neat and clean condition; shall remove from the land all abandoned materials and plant; and shall leave the spoil areas and the property which may have been affected by their operations in a neat and satisfactory condition and shall clean any affected by over spatter on fences, stairs, curbs, plaques, etc. Also included is the restoration of all private grounds, including lawns, landscaped areas, driveway aprons and walkways damaged or disturbed in connection with the new work not elsewhere specified. Unless otherwise specified, all materials salvaged and not required to be reused shall be the property of the Contractor and shall be legally disposed of away from the work site.

B. Included in the work under this Section is the restoration, including replacement of damaged and disturbed shrubs and trees, retaining walls, fence and stairs of all grounds and grassed and landscaped areas removed or disturbed or damaged during the construction of the work, and storage and field office areas.

C. Also included in the work under this Section is the furnishing of all labor, materials, and equipment required to remove, store, and reset or replace bumper posts, stone walls of all types, flagstone, brick, concrete, asphalt walks, fences of all types, railings, signs and sign posts, signal posts, mailboxes and such other miscellaneous objects damaged or disturbed during construction.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01630

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01701

PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes the requirements for project closeout including final clean up, closeout timetable, Owner's manual submittal, final submittals, maintenance and guarantee, and bonds.

1.2 RELATED SECTIONS

A. Specification Section 01063 – SEQUENCING OF WORK

1.3 FINAL CLEANUP

A. The Contractor shall promptly remove from the vicinity of the completed work, all rubbish, unused materials, concrete forms, construction equipment, gravel, paving materials, construction debris and temporary structures and facilities used during construction. Final acceptance of the Work by the Owner will be withheld until the Contractor has satisfactorily complied with the foregoing requirements for final cleanup of the project site.

B. The Contractor shall cleanup and restore all areas affected by the work on public and private property.

C. The Contractor shall cleanup and restore all areas affected by staging, trailer(s) placement and parking. Restoration includes regrading, re-establishing topsoil and reseeding.

D. Refer to Specification Section 01063 – SEQUENCING OF WORK for construction sequencing requirements.

1.4 CLOSEOUT TIMETABLE

A. The Contractor shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established as specified elsewhere in the Contract Documents.

1.5 FINAL SUBMITTALS

A. The Contractor, prior to requesting final payment, shall obtain and submit the following items to the Engineer for review and approval prior to transmittal to the Owner:

1. Written guarantees, where required.

2. Testing Results, where required.

3. Close-out of any Permits with local, state and federal agencies.

4. Provide Construction Photographs as described in the General Conditions.

5. New permanent cylinders and key blanks for all locks.

6. Maintenance stock items; spare parts; special tools.

7. Completed as-built / record drawings as described in Section 01200 GENERAL REQUIREMENTS FOR UTILITY WORK.

8. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

9. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.6 MAINTENANCE AND GUARANTEE

A. The Contractor shall comply with the guarantee and warranty requirements contained in the General Conditions.

B. The Contractor shall comply with the guarantee and warranty requirements contain in the Contract Documents.

C. Replacement of earth fill or backfill, where it has settled below the required finish elevations within the one (1) year warranty period, shall be considered as a part of such required repair work, and any repair or resurfacing installed by the Contractor which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the Contractor shall have obtained a statement in writing from the affected private owner or public agency releasing the Owner from further responsibility in connection with such repair or resurfacing.

D. The Contractor shall make all repairs and replacements as required by product or installation warranties and as required in these contract documents, promptly upon receipt of written order from the Owner. If the Contractor fails to make such repairs or replacements promptly, the Owner reserves the right to perform the Work and the Contractor and his surety shall be liable to the Owner for the cost thereof.

1.7 BOND

A. The Contractor shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and of the General Conditions.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01701

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 01740

WARRANTIES AND BONDS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.2 RELATED WORK

A. Refer to General Conditions of the Contract for the general requirements relating to warranties and bonds.

B. General closeout requirements are included in Section 01701 - PROJECT CLOSEOUT.

C. Specific requirements for warranties for the Work and products and installations that are specified to be warranted are included in the individual Specification Sections.

D. Certifications and other commitments and agreements for continuing services to Owner are specified elsewhere in the Contract Documents.

1.3 SUBMITTALS

A. Submit written warranties to the Owner prior to the date fixed by the Engineer for Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the Work, or a designated portion of the Work, submit written warranties upon request of the Owner.

B. When a designated portion of the Work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within fifteen days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Engineer for approval prior to final execution.

D. Refer to individual Specification Sections for specific content requirements, and particular requirements for submittal of special warranties.

E. At Final Completion, compile two copies of each required warranty and bond properly executed by the Contractor, or by a subcontractor, supplier, or manufacturer. Organize the warranty documents into an orderly sequence based on the table of contents of the Contract Specifications.

G. Table of Contents: Neatly typed. Identified each item with the number and title of the Specification Section in which the Work and Warranty and Bond requirement was specified, and the name of the product or work item.

H. Provide heavy paper dividers with celluloid covered tabs for each separate warranty. Mark the tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product, and the name, address and telephone number of the installer, supplier, and manufacturer.

I. Identify each binder on the front and the spine with the typed or printed title "WARRANTIES AND BONDS," the Project title or name, and the name, address, and telephone numbers of the Contractor and equipment supplier. The Contractor may propose to submit an electronic version of the Warranty and Bond Manual. This will require submission of an outline and example to the Engineer for review and approval. The Engineer and Owner reserve the right to require a hard copy of the manual.

J. When operating and maintenance manuals are required for warrantied construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

1.4 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warrantied Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warrantied Work.

B. Reinstatement of Warranty: When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

F. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

G. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

1.5 DEFINITION

A. Standard Product Warranties are pre-printed written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01740

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02010

SUBSURFACE INVESTIGATION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes the basic requirements and expectations of the Contractor in all work pertaining to subsurface conditions.

1.2 GENERAL REQUIREMENTS

A. The Contractor acknowledges that they have satisfied themself as to the nature and location of the Work; the general and local conditions, particularly those bearing upon groundwater table or similar physical conditions at the site; the characterization and conformation of subsurface materials to be encountered; and all other matters that can in any way affect the work or the cost thereof under this Contract. Any failure by the Contractor to acquaint himself with all available information concerning these conditions will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the Work.

1.3 SUBSURFACE DATA

A. The findings of recent subsurface investigations are provided in the Geotechnical Data Report – The Port Infrastructure Improvements Complete Streets, Cambridge, MA, May 3, 2021 included in the Appendix to these Specifications.

B. Such data is offered in good faith solely for the purpose of placing the Contractor in receipt of information available. The Contractor shall interpret such data according to their own judgment and acknowledges that they are not relying upon the same as accurately describing the actual subsurface conditions or quantities of materials that may be encountered. The Contractor further acknowledges that they assume all risk contingent upon the nature of the subsurface conditions to be actually encountered in performing the work covered by the Contract, even though such actual conditions may result in the Contractor performing more or less work than originally anticipated. In the event that quantities of waste soil/fill and related work as established in this Contract vary significantly from estimates provided, the unit bid prices will be the basis for compensation.

C. Re-use of excavated soils on- or off-site is subject to local, state and federal regulations and as specified in Section 02080 – SOIL AND WASTE MANAGEMENT and 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL.

D. Since individual disposal facilities will have different permit conditions and specific pre-characterization data requirements, the Contractor shall use the information provided for waste characterization; however, the Contractor shall be responsible for final waste characterization prior to transport and disposal. The Contractor is hereby made aware that for the purposes of disposal, final waste characterization testing is the responsibility of the Contractor, and costs for any additional characterization shall be incorporated into the Contractor's lump sum bid price for Soil Management.

E. Additional subsurface investigation may be warranted to satisfy data requirements and shall be the responsibility of the Contractor. Contractor shall submit a work plan that details the Contractor's approach for obtaining the data in accordance with Section 01300 and Section 02080. The work plan shall be reviewed and accepted by the Owner's Licensed Site Professional prior to commencement of any subsurface investigation activities. The work plan must indicate the location and frequency of sampling; sampling parameters and sampling methodology. The Contractor shall allow a minimum of 14 days for review and comment.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 02010

SECTION 02015

GEOTECHNICAL MONITORING AND INSTRUMENTATION

PART 1 – GENERAL

1.1 SUMMARY

A. Work in this Section shall include, but not be limited to, all materials, equipment, labor, and services required to install, protect, replace, monitor and report on geotechnical instrumentation specified herein.

B. The work included in this section includes the following:

1. Vibration monitoring shall be performed continuously during all concrete or reinforced concrete slab removal, and installation of temporary earth support for excavations greater than 8'deep, or as directed by the Engineer. A seismograph shall monitor vibrations adjacent to the nearest private property. Vibration levels shall not exceed the criteria indicated herein.

2. The vibration monitoring equipment shall be capable of providing instantaneous readings and in the absence of the vibration monitoring consultant, shall be capable of remote notification of threshold exceedances so that immediate corrective actions can be taken if necessary.

3. The Contractor shall retain the services of a Vibration Monitoring Consultant to monitor, maintain and report on vibrations levels during the slab removal work and at other times indicated or directed.

4. Replace instrumentation damaged or made inaccessible by the construction operations immediately and at no additional cost to the Owner.

1.2 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS.

1. Submit the qualifications of the Vibration Monitoring Consultant at least three weeks prior to the construction.

2. Shop drawings that indicate the manufacturers' data and specifications, installation procedures, and other data. Provide description of work, equipment, and remote notification capabilities.

3. A mitigation plan shall be submitted prior to any slab removals and prior to the installation of the excavation support system. The mitigation plan

shall detail the Contractor's course of action in the event threshold or limiting response values are met or exceeded. Such mitigation plan shall be revised as appropriate for each instance threshold and/or limiting values are reached.

1.3 QUALITY CONTROL

A. The Contractor shall provide sufficient notice to the Engineer to allow the Engineer to be present to observe the Work. Cooperate with the Engineer in all respects to facilitate any testing or observations.

B. The Contractor may conduct additional testing or monitoring for its own information, at no additional cost to the Owner.

C. The presence of the Engineer (including observations and review of test results) shall not relieve the Contractor of its sole responsibility to perform the work in accordance with the Contract Documents, nor shall they be construed to relieve the Contractor from full responsibility for the means and methods of construction and for safety on the construction site.

D. Work not in conformance with the specified requirements shall be improved, or removed and replaced, at no additional cost to the Owner. All costs related to testing of nonconforming Work or materials shall be paid for by the Contractor, at no additional cost to the Owner.

E. Retain the services of Vibration Monitoring Consultant to monitor the vibration monitoring specified herein.

1. The consultant shall have demonstrated at least five (5) years' experience and at least three (3) projects of similar type, size, and complexity including installation and monitoring of vibrations with seismographs.

2. The Vibration Monitoring Consultant shall not be an employee of the Contractor, or any subcontractor engaged in excavation, demolition, or utility work on the Project.

3. The Vibration Monitoring Consultant shall be approved by the Engineer and must be approved two (2) weeks prior to mobilization for construction.

4. The Vibration Monitoring Consultant shall adhere to all methods and standards described in this Specification.

PART 2 – PRODUCTS

2.1 NOT USED

2.2 VIBRATION MONITORING

A. Construction vibrations shall be monitored as described in the Contract Specifications in terms of peak particle velocity using a seismograph with continuous recording capability. The vibration sensors shall be capable of recording three orthogonal components of vibration.

2.3 NOT USED

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. Do not install any seismographs or other instrumentation until the Owner and the Engineer have been notified.

3.2 INSTALLATION

A. Seismographs

1. The seismograph shall be installed adjacent to the existing above grade structure nearest to the work. If there are no existing structures within 50 feet, the seismographs shall be installed on firm surfaces, at not more than 40 feet from the work zone.

2. The seismograph shall be properly relocated throughout the work shift if relocation of the active work zone requires the seismograph be relocated to more accurately reflect the vibrations resulting from the work.

3. If there are multiple crews working on slab demolition and removal, and or SOE installation, the contractor shall provide a vibration monitor meeting the specified requirements with each crew.

4. Vibration sensors shall be firmly mounted on the surface of concrete or asphalt, or firmly on undisturbed soil.

5. The daily report shall clearly describe the location of the seismograph relative to the work zone and the work performed on that date.

3.3 MONITORING

A. Monitoring frequency or number of seismographs may be increased as required by the Engineer if the limiting response values are approached or exceeded during the Work, at no additional cost to the Owner.

1. Seismographs shall be set up to monitoring vibrations continuously during all slab demolition and installation of temporary earth support greater than 8’ deep. One seismograph shall monitor vibrations, per crew, and shall be located adjacent to the nearest building. Vibration levels shall not exceed the criteria indicated herein.

B. The Contractor shall make its own interpretations for the data. The Contractor shall monitor and interpret data from additional instrumentation that it deems necessary to ensure the safety of its work. The Engineer is not responsible for the safety of the work based on its review of the instrumentation data.

C. Criteria for "threshold" and "limiting" vibration acceptance measured from seismographs during demolition, construction of temporary excavation support, shall be as follows:

1. "Threshold" values in peak particle velocity (inches per second): for wood, steel and brick buildings shall be 0.6, and for historical stone structures 0.3 as measured from the ground surface within the limits of the work zone or adjacent areas where vibrations are monitored.

2. "Limiting" values in peak particle velocity (inches per second): for wood, steel and brick buildings shall be 0.8, and for historical stone structures 0.5 as measured from the ground surface within the limits of the work zone or at other adjacent areas where vibrations are monitored.

D. If the “Threshold” values are reached, the work causing the threshold vibration levels shall immediately stop, and the Engineer shall be immediately notified. The Contractor and Vibration Monitoring Consultant will review the means and methods being utilized and make modifications to bring the resulting vibration levels below the threshold values. The Engineer shall be notified of the modifications. No claim for additional contract time or additional costs will be considered for any delay or impacts associated with this paragraph.

E. If the “Limiting” values are reached, ALL Work contributing to the vibration levels shall immediately stop, and the Engineer shall be immediately notified. The Contractor and Vibration Monitoring Consultant will revise the means and methods being utilized. The Contractor will submit a revised work plan that will bring the vibration levels below the threshold levels. The submittal will outline the modifications and work can not resume until the revised plan is approved. No claim for additional contract time or additional costs will be considered for any delay or impacts associated with this paragraph.

F. The Contractor shall pay a penalty $1,000 for each day the Contractor works in violation of any limiting values being reached or exceeded as determined by the Engineer.

D. In the event the Contractor does not comply with the approved mitigation plan or continues to work in violation of threshold or limiting values being reached or exceeded, the Contractor shall not be allowed to continue work until proper mitigation procedures and corrections have been made as required by the Owner and Engineer.

E. The Contractor shall be responsible for repairing all property damage caused by construction activities.

3.4 PROTECTION OF INSTRUMENTATION

A. Protect all instruments during the course of the Work. Any damage or loss of function caused by the Contractors operations, or by any other cause, to new or existing instrumentation devices, shall be immediately repaired or the equipment replaced at no additional cost to the Owner.

END OF SECTION 02015

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02051

DEMOLITION, MODIFICATION, AND ABANDONMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish all plant, labor, tools, equipment, materials, and supplies as required for utility and structure removal, demolition, modification, and/or abandonment as specified.

B. The Work of this Section shall include the following significant items; all other activity shown on the Drawings; and work necessary and defined herein pertaining to the project area: disposal of existing roadway section, temporary paving, and sidewalk; demolition, removal, and disposal of existing catch basins, manholes and other structures; abandonment of existing catch basin laterals; abandonment and removal of existing pipe; and selective demolition.

1.2 RELATED DOCUMENTS

A. Section 02080 – SOIL AND WASTE MANAGEMENT

B. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

C. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

D. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

E. Section 02590 – BRICK MASONRY

F. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

G. Section 03315 – GROUT

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Removal and abandonment procedures that shall provide for safe conduct of the Work, careful removal and disposition of materials and equipment, protection of utilities, structures, property, or other features which are to remain undisturbed and coordination with existing utilities or owners responsible for those nearby elements to remain in service.

2. A detailed work plan to include a list of items to be removed and/or abandoned, a sequence and schedule, and a list of salvageable materials and equipment.

3. Proposed Dust-Control and Noise-Control Measures: Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate.

B. Schedule of Selective Demolition, Modification and Abandonment Activities.

1. The Schedule of Selective Demolition, Modification and Abandonment Activities shall be subject to approval by the Owner and Engineer.

2. Indicate the following:

a. Detailed sequence of selective demolition, modification, and abandonment work, with starting and ending dates for each activity. Ensure the Owner's operations are uninterrupted.

b. Interruption of utility services.

c. Coordination for shutoff, capping, bulkheading and continuation of utility services.

d. Proposed materials, construction details, locations of temporary utilities, abandonment materials, and means of access.

e. Coordination of Owner's continuing use of portions of utilities, structures, property, or other features and of Owner's partial occupancy of completed Work.

C. Additional Submittals for Selective Demolition, Modification, and Abandonment Activities.

1. Inventory: After selective demolition or modifications are complete, submit a list of items that have been removed and salvaged.

2. Pre-demolition Photographs or Videotape: Show existing conditions of adjoining utility construction and site improvements that might be misconstrued as damage caused by selective demolition or modification operations. Submit before Work begins.

3. Landfill Records: Indicate receipt and acceptance of all wastes by disposal facility licensed to accept the wastes to be disposed.

D. Masonry Plugs and Bulkheads

1. For each permanent and temporary bulkhead and masonry plug, the Contractor, at a minimum, shall submit the following:

a. Design Loads

b. Restraining Mechanisms

c. Method of Installation

d. Results of Field Inspection after Installation

e. Decommissioning Method

2. If temporary pneumatic or hydro plugs are proposed, in addition, the Contractor shall submit the method and procedure of maintaining bladder pressure.

E. Cellular Concrete Fill

1. Submit manufacturer’s product data and specifications.

1.4 REPAIR OF DAMAGE

A. Any damage to existing facilities to remain, as caused by the Contractor's operations shall be repaired at no additional cost to the Owner.

B. Damaged items shall be repaired or replaced, at no additional cost to the Owner, with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this Contract.

1.5 PROTECTION OF EXISTING WORK

A. Before beginning any cutting, trenching or demolition work, the Contractor shall carefully review the work sequence and examine the Drawings and Specifications to determine the extent of the Work. The Contractor shall take all necessary precautions to prevent damage to existing facilities, which are to remain in place, and be responsible for any damages to existing facilities, which are caused by the operations. Damages to such work shall be repaired or replaced to its existing condition at no additional cost to the Owner. The Contractor shall carefully coordinate the work of this Section with all other work and shall provide shoring, bracing, and supports, as required. The Contractor shall insure that structural elements are not overloaded or compromised and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract. The Contractor shall remove all temporary protection

when the work is complete.

B. A jack hammer or sawcut shall be used at the beginning of each excavation and at all “back of sidewalk” limits in order to avoid damage to abutting properties and features which are to remain.

C. The Contractor shall carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the Contractor shall consult with the Owner prior to the placement of such equipment or material.

1.6 JOB CONDITIONS

A. The Owner assumes no responsibility for actual condition of the facilities to be removed, abandoned, or modified. The Contractor shall visit the site; inspect all facilities to get familiarized with all existing conditions and utilities.

B. The Owner may occupy portions of the utilities, structures, properties, or other facilities immediately adjacent to selective demolition area. Conduct selective demolition, modification, and abandonment so Owner's operations will not be disrupted. Provide no less than 24 hours notice to Owner of activities that will affect Owner's operations.

C. Owner assumes no responsibility for condition of the utilities, structures, properties, or other facilities to be selectively demolished.

D. If materials suspected of containing hazardous or asbestos materials are encountered, do not disturb; immediately notify Engineer.

E. Storage or sale of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition, modification, and abandonment operations.

1.7 QUALITY ASSURANCE

A. Comply with Section 01400 - QUALITY CONTROL

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Pre-Demolition, Modification, and Abandonment Conference: Conduct conference at Project site, which includes Owner and Engineer. Review methods and procedures related to selective demolition.

D. Review and finalize selective demolition, modification and abandonment schedule and verify availability of materials, labor, equipment, and facilities

needed to make progress and avoid delays.

1.8 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with material and installation requirements specified in individual Specification Sections.

2.2 MATERIALS OWNERSHIP

A. Coordinate with Engineer and Owner, who will make final determination as to whether an item is to be salvaged or removed. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials shall become Contractor's property and shall be removed from Project site.

2.3 REPAIR MATERIALS

A. Use repair materials identical to existing materials. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance equals or surpasses that of existing materials.

2.4 CELLULAR CONCRETE FILL

A. Cellular Concrete Fill shall be cast-in-place low-density cellular concrete with oven-dry density of 50 lb/ft^3 or less made with hydraulic cement, water and preformed foam for use in filling abandoned pipes and structures.

1. Cement shall meet the requirements of ASTM C 150, C 595 or C 1157.

2. Preformed Foam

a. Shall meet the requirements of ASTM C 869.
b. Shall be CMX CreteFoam or approved equal.

PART 3 - EXECUTION

3.1 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

3.2 PREPARATION FOR WORK

A. Verify that all active and inactive (temporarily not in use) sewer and drain services have been re-directed prior to abandonment. Perform CCTV inspection of gravity mains, building inspections and flow/dye testing to locate, observe and confirm that no known or unknown services remain connected. Any monetary losses or damage to facilities or property due to backups, flooding, or loss of use because of the abandonment of an active line shall be the sole responsibility of the Contractor.

B. Verify that utilities have been disconnected and capped, shut-off, or bulk headed. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition, modification and abandonment required. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate, and measure the nature and extent of conflict. Promptly submit a written report to Engineer.

D. Engage a professional engineer to survey condition of structures to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

F. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition, modification, and abandonment operations.

3.3 SITE ACCESS, TEMPORARY FACILITIES AND PROTECTION

A. Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used utilities, structures, properties, or facilities.

B. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

C. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

D. Protect existing site improvements, appurtenances, and landscaping to remain.

E. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

F. Temporary Facilities: Provide temporary barricades and other protection required for demolition security and to prevent injury to people and damage to adjacent utilities, structures, properties, and facilities to remain.

G. Provide protection to ensure safe passage of people around the area.

H. Temporary Shoring: Provide and maintain in accordance with Section 02160 - TEMPORARY EXCAVATION SUPPORT SYSTEMS.

I. Strengthen or add new supports when required during progress of selective demolition.

J. Existing landscaping materials, structures, pipes, and appurtenances, which are not to be removed/abandoned shall be protected and maintained as required by the Engineer and as specified.

3.4 POLLUTION CONTROL

A. Water sprinkling, temporary enclosures, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. Comply with government regulations pertaining to environmental protection. Water shall not be used when it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3.5 CLEANING

A. During and upon completion of work, the Contractor shall promptly remove

unused tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by work in a clean, approved condition.

B. All areas shall be cleaned of dust, dirt, and debris caused by demolition, modification, or abandonment and adjacent areas returned to conditions existing prior to start of work.

3.6 UTILITY SERVICES

A. Existing Utilities: Maintain services indicated to remain and protect them against damage during selective demolition, modification, and abandonment operations.

B. Do not interrupt existing utilities serving occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to authorities having jurisdiction.

C. Provide at least 72 hours notice to Owner if shutdown of service is required during changeover.

D. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utilities serving areas to be selectively demolished or abandoned.

E. If utility services are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary utilities that bypass area of selective demolition, relocation, or abandonment, and that maintain continuity of service to other parts of building.

3.7 DEMOLITION AND ABANDONMENT PROCEDURES

A. Disposal of all materials shall be performed in compliance with applicable local, state, and federal codes and requirements. Provide labor, equipment, and materials to perform work as specified and indicated.

B. The Contractor shall flush all pipe and structures to be removed or abandoned to remove solids and objectionable material prior to commencing demolition, modification, or abandonment.

C. When existing pipe is removed, the Contractor shall plug all resulting abandoned connections whether or not shown. Where removed piping is exposed, the remaining piping shall be fitted with a removable cap or plug, or bulk headed. Where existing piping, to include catch basin laterals, is to be abandoned, the Contractor shall cut back the abandoned pipe for a distance of 5 feet from any connecting structures to remain. Pipes to be abandoned in structures to be abandoned may be capped, plugged or bulk headed from inside the structure. All holes at the existing structures shall be repaired. Abandoned pipe smaller than 15 inches diameter shall be capped or plugged at both ends

prior to backfill. Abandoned pipe 15 inches diameter and larger shall be filled with Cellular Concrete Fill prior to being capped, plugged, or bulk headed and backfilling unless otherwise noted. Each pipe to be abandoned shall be filled with Cellular Concrete Fill from the up gradient end of the pipe reach wherever possible. The Cellular Concrete Fill shall completely fill each pipe reach and flow out the other end. The Contractor can aid the flow of the Cellular Concrete Fill in the pipe by providing a temporary structure at the access point to build up head or by pumping the Cellular Concrete Fill or by providing vibration in the pipe reach or access point.

D. Where existing drainage structures such as catch basins, drain manholes, sewer manholes, and combined sewer manholes are to be abandoned in place, the Contractor shall remove the frames, grates, and covers and cut the structures down a minimum of 4 feet below final grade. The Contractor shall put a minimum of four, 2-inch diameter drainage holes in the invert of each structure and then backfill the structure with control density fill or compacted sand as specified and as approved by the Engineer. Backfill around the structure shall be in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

E. Permanent plugs shall be constructed of Class B concrete, brick or other material approved by the engineer.

F. Fill excavations with solid fill resulting from earth removal operations and/or with select borrow material in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING. Final grade to be restored in kind unless otherwise noted.

G. Exercise precautions for fire prevention. Make fire extinguishers approved for Class A, B and C fires available at all times in areas where performing demolition or abandonment work with burning torches. Do not burn demolition debris on site.

3.8 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings, joints and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

2. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as pipe interiors, verify condition

and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

3. Maintain adequate ventilation when using cutting torches.

4. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

5. Dispose of demolished items and materials promptly.

6. Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

B. Existing Facilities: Comply with Owner's requirements for using and protecting utilities, structures, properties, and other facilities.

C. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery to Owner.

4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition, cleaned and reinstalled in their original locations after selective

demolition operations are complete.

3.9 REHABILITATION/MODIFICATION PROCEDURES

A. Certain areas of existing piping, conduits, and the like will be affected by work necessary to complete modifications under this Contract. The Contractor shall be responsible to rehabilitate those areas affected by his construction activities.

B. When new piping is installed in existing manholes, catch basins or other structures, the Contractor shall accurately position core-drilled openings in the concrete as shown or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory installation of a flexible connector to ensure water tightness around openings so formed.

C. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection shown. Any damage to the lining and coating of the existing piping shall be repaired by the Contractor.

D. At locations where existing piles are to be reused to replace the existing sewer or drain, the Contractor shall verify that the wood pile is not deteriorating. If wood piles scheduled for reuse are found to be in good condition, the piles shall be trimmed and capped with a concrete pile cap as indicated in the Contract Drawings. If wood piles scheduled to remain in place are found to be deteriorating, the Contractor shall notify the Engineer immediately.

3.10 DISPOSAL OF REMOVED/DEMOLISHED MATERIALS

A. The Contractor shall prepare and transport all demolition debris, materials, refuse, and abandoned equipment to an approved disposal site as part of the work under this section. All costs associated with the proper performance of this work shall be included in the appropriate Bid Items and at no additional cost to the Owner.

B. Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site. Demolition material shall be reused as fill to the extent possible. Removal of demolition debris, not utilized as fill, shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the Owner. Alternate routes shall be provided around closed or obstructed traffic ways.

C. Burning: Do not burn demolished materials.

D. Disposal: Transport demolished materials off Owner's property and legally dispose of them. See Sections 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL and 02080 – SOIL AND WASTE

MANAGEMENT as they relate to the transportation and disposal of non-hazardous and hazardous solid waste.

3.11 REPAIR OF DAMAGE

A. Any damage to existing facilities to remain, as caused by the Contractor's operations shall be repaired at no additional cost to the Owner. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this Contract.

B. Promptly repair damage to adjacent construction caused by selective demolition operations.

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

D. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.12 MASONRY PLUGS AND BULKHEADS

A. Shall be installed by a qualified mason having experience in the construction of temporary and permanent masonry plugs and bulkheads of the same general nature of those Specified and proposed.

END OF SECTION 02051

SECTION 02080

SOIL AND WASTE MANAGEMENT

PART 1 – GENERAL

1.1 QUALIFICATIONS

A. The Contractor shall be experienced and knowledgeable and have the trained and qualified personnel needed to conduct the work as specified herein. Contractor shall have demonstrated experience in excavation, handling, and management of soils, including characterization for off-site disposal.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. The following documents are appended to the technical specifications.

1. Memorandum -- Environmental Conditions Summary, Complete Streets Project, dated February 1, 2022.

1.3 OBJECTIVE and OVERVIEW

A. This Section includes furnishing all plant, labor, equipment, appliances, and materials, and performing all operations in connection with the handling, treating, stockpiling, transporting, and disposal and/or reuse of soil and associated fill and waste material resulting from the construction operations as specified.

B. This Section also includes requirements for handling spills of contaminated and/or hazardous materials.

C. The objective of soil management practices is to handle all soil and fill excavated during this contract in accordance with applicable state, federal and local regulations and bylaws and to implement off-site soil management in a cost-effective manner.

D. This Section includes protocol for handling and management of waste materials, including, but not limited to, construction debris, municipal waste, boulders, soil, fill, ash, rubble, and empty or crushed drums and/or drum parts. The Contractor shall provide the services of an Environmental Professional qualified to coordinate all soil/fill-handling activities with the Owner or Engineer and/or their representative.

E. In the course of the work, it may be necessary to excavate and handle potentially contaminated soil/fill. The soil/fill management practices specified herein apply to all soil/fill excavated during the course of this contract.

F. To the extent possible, the Contractor shall reuse geotechnically suitable excavated material prior to using imported backfill to reduce the volume of material to be disposed off-site. Imported backfill shall be used only as accepted by the Engineer.

G. Excavation and management of project soils and groundwater shall be conducted in accordance with:

1. A Project-Specific Utility-related Release Abatement Measure (URAM) Plan to be prepared by the Owner's Licensed Site Professional (LSP) and submitted to MassDEP by the City of Cambridge; and

2. "Environmental Conditions Summary, Complete Streets Project" Kleinfelder Memorandum, dated February 1, 2022 and attached to these specifications.

H. All work shall be conducted in compliance with the following Contractor-prepared plans. These plans may be combined as appropriate so long as all requirements of each Plan are incorporated and distinct.

1. Site-Specific Health and Safety Plan;
2. Soil Management Plan;
3. Equipment and Personnel Decontamination Plan;
4. Dust, Vapor and Odor Control Plan;
5. Air Monitoring and Quality Control Plan; and
6. Spill and Discharge Control Plan.

I. For work conducted on private and public properties outside of the Rights of Way (ROW) of public roadways, additional requirements for soil testing, reuse, storage, and backfill apply, as described in this section. Excavated soil shall not be removed from the individual property until all excavation and backfill has been completed on that property. Soil shall be stored, if necessary, on the property from which it came until backfill is completed on that property. The Contractor shall reuse excavated soils as backfill within the same property from which it originated. Under no circumstances shall surplus project soil be used as backfill on a property outside of the Right of Way unless the soil originated on that property. If surplus soil cannot be used on the same property, and is consistent with soil in the adjacent Right of Way, it may be used as backfill in the Right of Way within the project limits, subject to Engineer's Approval. If surplus soil cannot be used as backfill in the Right of Way, it shall, with the Engineer's approval, be combined with other surplus soils; in all instances it

shall be reused or disposed of in accordance with the requirements of this section.

J. For work conducted on properties outside of the public Rights of Way, the Contractor shall notify the Engineer if visual or olfactory evidence of contamination is observed in the soil on any property. The Contractor shall not collect samples for chemical testing from individual properties outside of the Right(s) of Way except as allowed by the Engineer.

1.4 DEFINITIONS

A. Area of Contamination: For the purpose of managing soil classified as RCRA characteristic or listed hazardous waste, the area of contamination is the contiguous area within which the waste has been identified.

B. Area of Excavation: For the purposes of reusing soil/fill on-site, the *area of excavation* is considered to be the approximate area in which the soil/fill was removed provided that area is consistent in soil strata, color, texture, geotechnical properties and has substantially similar visual and olfactory characteristics as accepted by the Engineer. Soil/fill returned to the *area of excavation* shall be placed approximately in the same horizontal and vertical location from which it originated.

C. Excavation: The removal of materials encountered to the elevation and width limits indicated in the Contract Drawings, Specifications, or as directed by the Engineer.

D. Fill (Historic Fill): Fill, also known as historic fill or miscellaneous fill, is defined as a mixture of soil and other materials which have been located in the area through man-made processes primarily for the purpose of grading, backfilling or filling in low areas. Materials commonly associated with historic fill includes, but are not limited to; coal, glass, brick, ash, wood fragments and other similar granular materials. Historic fill shall not include boulders, ledge, consolidated rock, asphalt pieces, concrete, railroad timbers, rail, cobblestones or other abandoned building materials that would preclude the disposal of the urban fill as daily cover at a landfill.

E. Hazardous Waste:

1. Defined in 310 CMR 40.0006; or

2. Defined in 40 CFR 261.3.

3. A waste, or combination of wastes, that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

a. Cause or significantly contribute to an increase in mortality or cause or significantly contribute to an increase in a serious irreversible or incapacitating reversible illness; or
b. Pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

F. Peat: A substance of vegetable origin, consisting of roots and fibers, moss, etc., in various stages of decomposition, and found as a kind of turf or bog. Peat shall be considered natural soil when it is encountered in small amounts (layers 1-foot (304.8 mm) or less in thickness) and when it is impractical to separate the peat from the natural soil or urban fill strata. Otherwise, peat shall be considered a distinctive stratum.

G. Soil Classification Categories: Unless specifically stated otherwise terms used in this specification are as defined in the MCP, 310 CMR 40.0006. The following definitions and soil classifications apply to these specifications:

1. (Class A) Any soil or fill material which has concentrations of chemicals < RCS-1 Reportable Concentrations established by 310 CMR 40.0300 and 40.1600.

Class A soils may be reused at the following types of facilities: Managed Fill Site (operating under an Administrative Consent Order (ACO) issued by MassDEP, unless otherwise approved by the owner); or a permitted landfill, provided that in all cases, the excavated soil analyte concentrations meet the acceptance criteria established by the facility and that disposal of soil at the receiving facility will not result in an exceedance of an RC applicable at the point of reuse/disposal and which would require notification of a release pursuant to 310 CMR 40.0300. Soils not exhibiting evidence of contamination or soils determined through laboratory chemical analysis to be Class A soils may also be reused in the area of excavation or elsewhere within Project limits as approved by the Owner's LSP.

Class A soil may be reused as common fill/ordinary borrow provided it also meets the physical requirements as specified herein and as specified in Section 02210 - Earth Excavation, Backfill, Fill and Grading. Class A soil may be used in gravel processing facilities provided the soil analytical data is comparable to materials being used by the facility and such use is approved by the Engineer.

Class A soil/fill which is reused or disposed of off-site shall be transported under a MassDEP Bureau of Air and Waste Material Shipping Record & Log (MSR). Management of Class A soils shall be conducted in conformance with the MassDEP Similar Soils Provision Guidance – WSC#-13-500 (2014).

2. (Class B) Contaminated: Any soil or fill material which contains oil or hazardous materials (OHM) at concentrations ≥ a release notification threshold established by 310 CMR 40.0300 and 40.1600.

   Soils with OHM ≥ RCS-1 resulting from exempt activities or meeting the definition of "background" per 310 CMR 40.006, may be managed as Class A at the direction of the Owner's LSP.

   Any soils exhibiting either petroleum or chemical odor or visual indications of oil or hazardous materials as accepted by the Engineer shall be handled as potentially contaminated soils. Potentially contaminated soils may be reused within the area of excavation without first performing laboratory analyses, with the approval of the Owner's LSP. Potentially contaminated soils shall not be mixed with soils not exhibiting either petroleum or chemical odor or visual indications of oil or hazardous materials. Any excavated soil/fill material which is not reused within the area of excavation, must be characterized prior to reuse.

   Following receipt of analytical results, Class B soil/fill shall be handled in accordance with the type and concentrations of OHM present in the soil/fill. Surplus soil/fill which may be contaminated shall be segregated by the Contractor. Soil/fill which has been staged and characterized can be reused within the area of excavation or elsewhere on site provided the material has been characterized by laboratory analysis and has equal or less contamination than the point where it is to be reused.

3. Class B soil which cannot be reused on site shall be reused off-site, recycled, or disposed of at a permitted facility. Subcategories of Class B, which establish off-site management requirements, are defined as follows:

   a. Class B-1: Soil and Fill that meet all applicable criteria (i.e., Massachusetts Department of Environmental Protection (MassDEP) Policy # COMM 97-001 - Reuse and Disposal of Contaminated Soil at Massachusetts Landfills Policy, and/or facility-specific permit requirements) for reuse as daily cover, intermediate cover, or pre-cap contouring material at in-state unlined landfills. Note: per COMM 97-001, sediments may not be re-used as Class B-1.
   b. Class B-2: Soil and Fill that meet all applicable criteria (i.e., COMM 97-001 and/or facility-specific permit requirements) for reuse as daily cover, intermediate cover, or pre-cap contouring material at in-state lined landfills.
   c. Class B-3: Soil and Fill that meet all applicable criteria for recycling at an asphalt batching plant and/or the specific licensing requirements for the proposed recycling facility.

d. Class B-4: Soil and Fill that contain concentrations of contaminants that exceed in-state, lined, and unlined landfill reuse criteria as well as asphalt batching acceptance criteria, but meet the criteria for regional thermal treatment facilities, and are not classified as a RCRA Hazardous Waste.

e. Class B-5: Soil and Fill that contain concentrations of contaminants that exceed in-state, lined and unlined landfill reuse criteria or which require removal to regional disposal facilities and are not classified as RCRA Hazardous Waste.

f. Class B-6: Soil and fill which does not meet one of the designations above due to excessive foreign materials and/or debris that are not classified as a hazardous waste.

4. (Class C) Hazardous Waste: A waste, or combination of wastes, that, because of its quantity, concentration, or physical, chemical, or infectious characteristics may cause or significantly contribute to an increase in mortality or cause or significantly contribute to an increase in a serious irreversible or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Also included within the definition of hazardous waste is hazardous waste as defined 310 CMR 40.0006 and 40.CFR 261.3. Hazardous waste, as defined in 40 CFR 261.3, is a solid waste that exhibits any of the characteristics of hazardous waste in excess of regulation levels presented in 40 CFR 261, subpart C and/or that is listed in 40 CFR 261, subpart D; that is a mixture of solid and hazardous waste; or that is derived from a listed waste.

   Soil having or suspected of having the characteristics of a hazardous waste or of containing a listed hazardous waste shall not be removed from the lateral limits of an excavation or staged at another location except at the direction of the Engineer. Subcategories of Class C shall be as follows:

   a. Class C-1: Soils classified as hazardous waste that can be treated on-site to eliminate the toxicity characteristic (e.g., for lead).

   b. Class C-2: Material determined to contain "listed" or "characteristic" hazardous waste constituents which cannot be treated on-site. Land disposal of hazardous soil is prohibited until the soil has been treated to meet Land Disposal Restrictions (LDR) standards pursuant to 40 CFR 268.48. This material must be transported to an out-of-state approved RCRA permitted disposal or treatment facility under a Uniform Hazardous Waste Manifest. Land disposal following achievement of the Uniform Treatment Standards (UTS) shall be at a RCRA landfill.

H. Special Waste: means any solid waste that is determined not to be a hazardous waste pursuant to 310 CMR 30.000 and that exists in such quantity or in such

chemical or physical state, or any combination thereof, so that particular management controls are required to prevent an adverse impact from the collection, transport, transfer, storage, processing, treatment or disposal of the solid waste. Asbestos and PCB-contaminated soils/fill (at regulated concentrations) are examples of special waste categories.

I. Soil (Natural Soils): Soil, otherwise known as natural soil, is defined as unconsolidated sand, gravel, silt and clay, and the organic material which has become part of the unconsolidated soil matrix.

J. Over Excavation: Consists of removal of materials beyond elevations and width limits indicated in the Contract Documents without direction of the Engineer. Over-excavation material handling, transportation and disposal, backfilling and compaction shall be at the Contractor's expense. Over-excavations shall be backfilled and compacted as specified for excavations of the same class, unless otherwise directed by the Engineer.

K. Unknown Materials: Any material, that is not readily identifiable as non-hazardous waste, and which has not been previously characterized or encountered during site investigation activities. The Unknown Material classification is to be used in the event that an unexpected, unusual material is encountered for which special handling procedures shall be required in order to handle the material safely. Such wastes include but are not limited to:

1. Unlabelled drums or containers containing material which is not readily identifiable as a non-hazardous substance.

2. Any material which varies significantly from material previously observed on site and which cannot be readily identified as non-hazardous.

3. Waste material of unusual color or odor or material with indications of hazardous levels (e.g. exceeding OSHA permissible exposure limits) of contaminants as evidenced on an organic vapor monitor or other similar instrument.

The Owner reserves the right to apply generator knowledge to classify and profile the material as a previously encountered waste or as a known waste. In the event that a material is encountered which the Contractor is uncertain as to its nature, the Owner or their representative shall assess the material with the Contractor and direct the Contractor as to the nature of the material being known or unknown.

1.5 WORK INCLUDED

A. Managing excavated soil and fill material, including disposal and/or reuse of excavated soil and fill material.

B. The Contractor's Environmental Professional shall characterize all excavated soil and fill material prior to off-site reuse or disposal; pre-excavation characterization may be conducted by the Contractor. Characterization requirements may vary depending on the site selected to receive soil suitable for reuse or the disposal facility permits and policies. The Contractor is responsible for final waste characterization.

C. At a minimum, all surplus soils shall be analyzed for the following parameters:

1. MCP 14 metals;
2. Volatile organic compounds (VOCs)(EPA Method 8260B);
3. Semi-volatile organic compounds (SVOCs)(EPA Method 8270);
4. Total petroleum hydrocarbons (TPH)(EPA Method 8100M or equivalent);
5. Polychlorinated biphenyls (PCBs) (EPA Method 8082); and,
6. pH, Ignitability, Reactive Sulfide, Reactive Cyanide, Specific Conductance.

D. The Owner shall not be responsible for costs associated with additional soil characterization.

E. Characterization of soil, fill, and unknown material for disposal/reuse purposes, including; field screening and soil management/segregation; temporary storage/staging; and laboratory analysis (as may be necessary for unknown materials and/or for compliance with receiving facility requirements).

All laboratory chemical analyses conducted shall utilize currently accepted U.S. EPA and applicable state agency analytical protocols and procedures. Laboratory chemical analysis reports shall meet MassDEP Compendium of Analytical Methods (CAM) requirements for analysis which have published CAM requirements. The MassDEP MCP Analytical Method Protocol Certification Form shall be provided by the Laboratory with all sample results. Toxicity Characteristic Leaching Procedure (TCLP) analysis shall be conducted for any analyte for which the RCRA "rule of twenty" is exceeded.

F. Management of contaminated groundwater: If groundwater potentially impacted by OHM, based on visual or olfactory evidence, is encountered in the course of the work and dewatering is required, discharge permits, modification of discharge permits, and/or groundwater treatment may be necessary depending upon the discharge method(s) and/or location(s) utilized by the Contractor. The Owner and Engineer shall be notified by the Contactor if groundwater potentially impacted by OHM is identified.

G. All work at the site must be performed in accordance with all applicable federal, state, and local regulations, permits and licenses, including, but not limited to:

1. The applicable parts of the Code of Federal Regulation (CFR) Title 40: Protection of Environment, pertaining to the Comprehensive Environmental Response and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA), RCRA, Toxic Substances Control Act (TSCA), and the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as regulated by the U.S. Environmental Protection Agency (U.S. EPA);

2. State regulations specified in the Massachusetts Contingency Plan (MCP) (310 CMR 40.0000), and Massachusetts General Law 21E - Massachusetts Oil and Hazardous Materials Release Prevention and Response Act, and applicable Massachusetts Department of Environmental Protection (MassDEP) guidelines and policies;

3. MassDEP Technical Update. Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil (2002);

4. Department of Transportation (DOT) regulations 49 CFR, and state transportation licenses and permits;

5. OSHA regulations (including, but not limited to, 29 CFR 1910.1000, 29 CFR 1926, and CFR 1910.120), 40-hour Occupational Safety and Health Administration (OSHA) training (plus 8-hour refresher training) and all other applicable state and federal regulations regarding health and safety requirements;

6. NIOSH/OSHA/USCG/EPA: "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" October 1985, DHHS (NIOSH). Publ. No. 85-115;

7. Department of Transportation training;

8. U.S. Army Corps of Engineers Section 404 Programmatic General Permit, Commonwealth of Massachusetts;

9. General Contractor's license;

10. National Pollutant Discharge Elimination System (NPDES) Notice of Intent (NOI) to discharge and associated Construction General Permits, Remediation General Permits, and/or Dewatering General Permits;

11. Regional and local Publicly Owned Treatment Works (POTW) pre-treatment and construction dewatering requirements and permits;

12. Excavation and/or grading permits;

13. Special use permits;

14. Special waste haulers certificate;

15. Massachusetts Wetlands Protection Act and associated Order of Conditions;

16. The Contractor's Soil Management Plan (SMP) and Health and Safety Plan to protect the workers and the public;

17. Massachusetts Division of Occupational Safety (DOS): The Removal, Containment or Encapsulation of Asbestos (453 CMR 6), including all clarifications, policy statements, etc.;

18. Massachusetts Department of Environmental Protection: 310 CMR 7.00, 7.09, 7.15 and all related amendments and policy statements;

19. MassDEP: Asbestos Cement Pipe Guidance Document (2011);

20. MassDEP Technical Update: Considerations for Managing Contaminated Soil: RCRA Land Disposal Restrictions and Contained-In Determinations, August 2010;

21. MassDEP Reuse and Disposal of Contaminated Soil at Massachusetts Landfills (COMM-97-001);

22. MassDEP Similar Soils Provision Guidance (WSC#-13-500) (2014); and,

23. MassDEP Interim Policy on the Re-Use of Soil for Large Reclamation Projects (COMM-15-01).

H. Implementation of the submitted HASP and other applicable monitoring and control plans includes establishing work zones (e.g., support zone, contamination reduction zone, exclusion zone), preparing a decontamination pad(s) and staging area(s), performing the appropriate environmental monitoring, training and medical monitoring of personnel, coordinating waste disposal and waste characterization as needed.

I. The Contractor shall develop, implement, maintain, supervise, and be responsible for all soil management practices during the course of this contract. The Contractor’s Environmental Professional shall be present during all field screening, segregating, handling, and characterization of all soils excavated in the course of completing this contract to ensure that soil is managed in accordance with applicable laws, regulations, and this Section.

Soil management activities shall include and be conducted as specified herein:

1. Providing and constructing a secure soil staging area sized to adequately segregate soils in accordance with the conditions specified without

impeding construction-related activities. The Contractor is to use existing information and obtain additional information as may be needed at no additional cost to the Owner to minimize the need for a staging area. If a staging area is required to characterize unknown or excess material for any reason, the Contractor is responsible for locating, selecting, preparing and securing the area. Contractor shall provide means of separating potentially contaminated material from the staging area ground surface to prevent the potential of cross-contamination. Separation method to be provided in accordance with 3.4(C).

2. Excavated soil that cannot be re-used on site shall either be loaded directly into containers for off-site reuse or disposal (provided the material has been adequately characterized and has been approved for acceptance at an off-site facility) or shall be staged at a location determined and secured by the Contractor pending sampling and analytical characterization by the Contractor's Environmental Professional prior to off-site reuse or disposal, with the exception of soil suspected of having the characteristics of a hazardous waste or of containing a listed hazardous waste. These soils shall not be removed from the Area of Contamination or staged at another location except at the direction of the Engineer. The Contractor is responsible for final soil characterization prior to transport and disposal. The Contractor is hereby made aware that for the purposes of disposal, final soil characterization is the responsibility of the Contractor and costs for securing a staging area and conducting waste characterization shall be incorporated into the Contractor's bid price for construction.

3. Soil that has been characterized as a Remediation Waste must be either live loaded, stockpiled on-Site or stockpiled on a property owned and/or controlled by the Owner. Stockpiling of known Remediation Waste at an alternative location shall be conducted only with the approval from the Owner and the Owner's LSP

4. The Contractor shall control and contain runoff of free liquids drained from stockpiled soil/fill. Free liquids shall be managed in accordance with applicable regulations.

5. Soil that has been chemically stabilized shall be confirmed through laboratory chemical analysis to be characteristically non-hazardous pursuant to RCRA prior to off-site shipment and disposal.

6. Soil/fill shall not be staged within 100 feet (30.5 meters) of a Reservoir or Area of Critical Environmental Concern.

7. Excavating unknown, previously uncharacterized material which may be classified as RCRA hazardous waste and disposing of it at an approved facility and/or on-site treatment of these materials to render it non-hazardous prior to and disposing of it at an approved facility.

8. Removing characterized on-site materials for off-site re-use or disposal.

9. Demobilizing the site, including, but not limited to, removing and disposing of construction-related equipment and materials used for personnel and equipment decontamination and related waste such as personal protective equipment (PPE), decontamination water/solids, temporary covers, and washwater storage tanks; disconnection of temporary utilities; and final clean-up to pre-construction conditions.

10. The Contractor shall manage unknown material separately and temporarily stage the material pending characterization.

J. All incidental, Contractor-generated waste (such as Personal Protective Equipment, decontamination wash water, etc.) resulting from the services hereunder are the property and responsibility of the Contractor and are to be disposed of by the Contractor under a Uniform Hazardous Waste Manifest and/or by a Massachusetts Bureau of Waste Site Cleanup Bill of Lading, as appropriate.

K. The Contractor is responsible for identifying potential hazards at the site and reviewing existing information.

1.6 RELATED WORK

A. Section 01025 – MEASUREMENT AND PAYMENT

B. Section 01108 – HEALTH AND SAFETY PROCEDURES

C. Section 01500 - TEMPORARY ENVIRONMENTAL CONTROLS

D. Section 02010 - SUBSURFACE INVESTIGATION

E. Section 02095 - TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

F. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

G. Section 02140 – DEWATERING

1.7 EXISTING CONDITIONS

A. Limited chemical characterization of soil has been conducted, the results of which are presented in the report referenced in Paragraph 1.2 of this section. The Contractor is obligated to review existing environmental assessment reports and manage the soil and groundwater in accordance with applicable state and federal regulations.

1. A total of 32 soil borings, designated as SB-1 through SB-28 and MW-101 through MW104, were advanced within the project area. A total of 24 soil samples were collected from these soil borings and submitted for laboratory chemical analysis. A grab sample from 20 locations was analyzed for VOCs. A composite sample generated from multiple intervals from the 20 locations was analyzed for SVOCs, PCBs, MCP 14 metals, TPH and general chemistry parameters. Select soil samples were also submitted for analysis of volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) by MassDEP methods.

2. The metals lead and barium, TPH, the PAHs benzo(a)pyrene, dibenzo(a,h)anthracene, naphthalene and phenanthrene, and EPH hydrocarbon fractions were all detected above the Reportable Concentration for Soil Category 1 (RCS-1).

3. Three soil samples were analyzed for TCLP lead due to the exceedance of the EPA's "twenty times rule" (SB-14 [3-6 feet], SB-15 [3-6 feet] and SB-28 [3-6 feet]). Results were less than the maximum concentration (5 milligrams per liter [mg/L]) for toxicity characteristic hazardous waste.

1.8 SUBMITTALS

A. The Contractor shall prepare a Work Plan that generally describes the work to be performed under Section 02080 Part 3 (Execution). The work plan shall include, but not be limited to detailing the submittal and implementation of the following:

1. Site-Specific Health and Safety;

2. Soil Management;

3. Dust, Vapor, and Odor Control;

4. Air Monitoring and Quality Control; and

5. Spill and Discharge Control.

The Work Plan shall be submitted to the Owner and Engineer for review and acceptance at least two weeks prior to beginning any intrusive work at the site.

B. The Contractor shall provide the qualifications of the Environmental Professional(s) to be assigned to this project. The Environmental Professional(s) shall be at a minimum certified, registered or licensed as an Environmental Professional or equivalent and hold a Bachelor of Science Degree in Environmental Science, Environmental Engineering, or Public Health or related degree and have sufficient experience in similar work to perform the responsibilities detailed herein. The Environmental Professional(s)

shall have demonstrated experience in management of RCRA hazardous waste soils and groundwater.

C. Soil Management: The Contractor shall prepare a Soil Management Plan (SMP) that outlines measures for soil and fill sampling, field screening, laboratory chemical analysis, treatment, and disposal/reuse. At a minimum, this plan shall address the following:

1. Methods, procedures, and equipment used for treating, excavating, dewatering, characterizing, segregating, reusing/backfilling, loading, and transportation of contaminated soil/fill materials encountered during excavation operations;

2. A list of all transporters and waste facilities, complete with license numbers, permit numbers or ACO numbers (as applicable), contact person, and address and telephone number that the Contractor utilizes for waste disposal. The Contractor shall provide copies of the permits/ACOs held by each disposal facility which the Contractor plans to use to dispose of non-hazardous solid waste; and if necessary, to dispose of hazardous waste (due to lead toxicity), PCB-impacted waste and/or asbestos-containing waste;

3. A summary of the history of compliance actions for each disposal/recycling facility proposed to be used by the Contractor. The compliance history shall include a comprehensive list of any state or federal citations, notices of non-compliance, consent decrees or violations relative to the management of waste (including remediation waste) at the facility. The Owner reserves the right to reject any facility on the basis of poor compliance history;

4. Procedures for securing the staging area, controlling dust and soil/fill migration, prevention of contamination of excavated soil by trucks used for asphalt transport, separation of stockpiled materials from the staging area ground surface, preventing damage to uncontaminated areas via contaminant migration and for decontaminating vehicles and personnel exiting the staging area;

5. The means and methods for decontaminating all equipment and personnel, including provisions for installing an equipment decontamination pad if required or specified;

6. Methods and procedures for identifying stockpiled material (e.g., labeling, marking containers) and procedures for identification and tracking;

7. Methods, procedures, and equipment used for obtaining the necessary information needed to satisfy the off-site reuse/disposal facility requirements specified herein and/or by the facility;

8. Methods, procedures, and equipment proposed for assessing and handling Unknown Materials. The SMP shall indicate which laboratory(ies) the Contractor shall utilize for chemical analysis soil, groundwater and unknown materials:

   a. An Unknown Materials information sheet shall be developed as part of the Contractor's SMP, upon which the Contractor shall record information such as container type, size, and condition; and, any identifying characteristics of the unknown material. The format of the information sheet shall be as accepted by the Owner and/or its representatives;

   b. The Contractor's plan for notifying the Owner and Engineer in the event that an unknown material as defined in this specification is encountered. The plan shall include the phone numbers and names of the Owner's representative(s) that the Contractor will contact in such an event.

9. Provisions for separation of incompatible materials;

10. Protocol for over-packing drums (if encountered);

11. Procedures for consolidating (i.e., bulking) compatible materials for disposal; and

12. Procedures for dewatering; testing, handling, treatment, and disposal/discharge of groundwater.

D. Soil Management/Tracking Documentation:

Prior to off-site disposal or reuse, the Contractor shall provide to the Engineer a letter from the disposal facility indicating that the facility has reviewed the available data relative to the soil/fill to be delivered and agrees that the soil/fill meets their acceptance criteria. The letter shall be signed by a duly authorized representative of the receiving facility.

Within the time constraints established in state and/or Federal laws and regulations, the Contractor shall submit to appropriate authority(ies), as applicable, Uniform Hazardous Waste Manifests and/or Bills of Lading for all soils and associated fill disposed or reused of off-site utilizing such documents. Copies of all manifests, Bills of Lading, and all other documents used to track and/or permit off-site transportation of soils shall be submitted to the Engineer within ten (10) days of shipment. The Contractor is responsible for preparation of all manifests, Material Shipping Records, and all other related documents completely, legibly, and accurately prior to submitting them to the Owner and/or its representative for generator and LSP signatures. Bills of Lading shall be prepared electronically by the Owner's LSP; the Contractor shall be

responsible for providing information necessary for completion of the BOL and LSP Opinion letter. The Contractor shall be responsible for paying for any and all fines associated with inaccurate, incorrect, or improperly completed manifests, Bills of Lading and all other related documents, including fines resulting from late or untimely submittals.

E. Spill and Discharge Control (SDC): The SDC program shall provide contingency measures and reporting responsibilities for potential uncontrolled spills and discharges of contaminated and/or hazardous materials, including, but not limited to, leachate, decontamination water, sewage, and other on-site waste materials. In addition to the above listed items, the SDC program shall specifically contain: procedures for containing dry and liquid spills; absorbent material available on site; storage of spilled materials; governmental reporting (i.e., notification) procedures; decontamination procedures; discharges of sanitary or combined sewers into storm drains either by flow handling/bypassing or accidental or unintentional discharge; and procedures for protecting wetlands and surrounding public and private property.

The Spill and Discharge Plan shall indicate the location and quantity of the materials to be staged on site and the basis for the quantities (i.e. indicate the vessel which will be on site containing the greatest volume of oil or hazardous materials). No fuel or oil tanks or drums may be temporarily staged on site unless they are stored within a secondary containment system. Fuel deliveries shall be performed in a designated area which has either secondary spill containment or an impervious surface with absorbent berms located around the point of fuel delivery. The Spill and Discharge Plan shall indicate the location of the fueling area and the nature of secondary containment which the Contractor intends on utilizing.

1. Notification Procedures: The Contractor shall prepare in advance of work activities a notification list, complete with phone numbers, addresses, and contact names for all parties to be notified in the event of a spill. This list shall include:

    a. Owner’s designated representatives;
    b. Owner;
    c. Fire Department;
    d. Engineer; and
    e. Massachusetts Department of Environmental Protection (as required per 310 CMR 40.0000).

    The Owner shall be notified immediately of an uncontrolled spill or discharge. If human health or the environment are potentially threatened, the Contractor shall take immediate action to abate the conditions and notify emergency personnel.

2. Spill Incident Report(s): In the event of an uncontrolled spill or discharge, a written report detailing each uncontrolled spill or

discharge shall include, at a minimum, the cause and resolution of incident, outside agencies involved, and date of occurrence. The report shall be submitted to the Owner within 48 hours of the incident. The Contractor shall document all spills on the as-built Drawings and submit the Drawings to the Owner at project completion. The Contractor shall be responsible for remediating any spills or releases of oil or hazardous materials as a result of the Contractor's activities. The site shall be remediated to pre-release conditions at no additional cost to the Owner.

F. Dust, Vapor and Odor Control (DVOC): The DVOC program shall include measures to control objectionable dust, vapors, and chemical or natural odors originating from the work area or soil/fill staging area. The DVOC Plan shall describe procedures to minimize the creation of dust, and the control of objectionable vapors and odors originating from the site. At a minimum, the DVOC program shall include air monitoring as specified in paragraph 3.6. The Contractor shall have materials on hand to implement control measures.

PART 2 – PRODUCTS

2.1 DUST AND VAPOR CONTROL

A. Air monitoring shall include total dust testing using MIE, Inc. Miniram PDM-3 Dust Monitors, or like instruments. Air monitoring shall include monitoring for total volatile organic vapors using a MiniRAE Photoionization Detector of like instrument.

2.2 SPILL CONTROL

A. At a minimum, the Contractor shall maintain on-site absorbent pads, booms and absorbent materials in sufficient quantity to address a release of fuel oil, hydraulic oil or other OHM that the Contractor intends to use or store on site, including fuel oil and hydraulic oil that is used within earth moving equipment. The quantity of spill containment materials maintained on site shall be sufficient to respond to a catastrophic release from the vessel containing the greatest quantity of oil or hazardous material on-site.

2.3 EQUIPMENT DECONTAMINATION PAD

A. The Contractor shall provide all materials and labor to complete an equipment decontamination pad. Liner materials and collection system shall be selected by the Contractor to perform as specified.

PART 3 – EXECUTION

3.1 GENERAL

A. All work in this section will be performed in accordance with the Contractor's Work Plan, SMP and Site-Specific HASP.

B. The primary concern of the Contractor in the excavating, handling, sampling, bulking, and on-site storage of soil/fill and/or drummed material (if encountered) will be to protect the health and safety of the site workers, the public, and the environment.

C. The Contractor shall keep a copy of the Health and Safety Plan (HASP) on site during all operations and shall conduct daily health and safety meetings. Failure to keep a copy of the HASP on-site, or any other breach of the Contractor's Plan, may be cause for stopping work at the cost of the Contractor. Delays caused by the Contractor's failure to comply with the health and safety regulations, or any health and safety plan shall not entitle the Contractor to recover any additional costs or time lost. The Contractor shall not be allowed to resume activities until corrective measures are accepted by the Engineer and/or their representative and implemented.

D. Medical surveillance records, OSHA 40-hour training forms, accident forms, and all other documentation requirements of the Contractor's safety and health program for personnel working on the site (who are subject to exposure to potentially contaminated soil) shall be up-to-date and kept on file at the site. The Contractor shall provide documentation of employee status upon request of the Engineer and/or their representative.

3.2 SOIL/FILL MANAGEMENT

A. Soil and fill material that is managed under a URAM Plan pursuant to the MCP, which is staged off-site, and which is not characteristically hazardous, may be re-used within fourteen (14) calendar days of excavation. Any material which is suitable for re-use as ordinary borrow, based on geotechnical results and could have been placed on site, but was not, due to Contractor delay (i.e. laboratory results were not available within ten (10) days following excavation) will be disposed in accordance with the applicable regulations by the Contractor at no cost to the Owner.

B. Soil and fill material that is managed under a URAM Plan pursuant to the MCP, which is determined at the staging area to be characteristically hazardous for lead may be treated (stabilized) within the “Area of Contamination” only and must be reused or disposed of within ninety (90) calendar days of excavation. No treatment may occur at the staging area if outside the “Area of Contamination”. If soils have been staged off-site prior to sampling and are subsequently determined to be characteristically hazardous for lead, no stabilization treatment may occur; these soils shall be managed as hazardous waste.

C. Class B and C excavated soils shall be completely covered with a minimum 10-mil thick layer of plastic tarp. Soils exhibiting evidence of potential contamination including but not limited to odors and/or staining shall be covered prior to characterization and off-site reuse or disposal. Stockpiled soils determined to be Class B or C, as described herein, shall be securely covered at the close of each day and continuously when not being added to or otherwise being handled by the Contractor. Stockpiles, including those of Class A soils, shall also be covered at times as directed by the Engineer.

D. Excavated soil shall not be removed from a private property until all excavation and backfilling has been completed on that property. Soil shall be stored, if necessary, on the property from which it was excavated until backfill is completed on that property. The Contractor shall reuse excavated soils as backfill within the same property from which it originated. Under no circumstances shall surplus project soil be used as backfill on a property outside of the Right of Way unless the soil originated on that property. If surplus soil is generated that cannot be used on the same property, and is consistent with soil in the adjacent Right of Way, it may be used as backfill in the Right of Way within the project limits, subject to the Engineer's approval. If surplus soil cannot be used as backfill in the Right of Way, it shall, with the Engineer's approval, be combined with other surplus soils and reused or disposed of in accordance with the requirements of this section. The Contractor shall not collect samples for chemical testing from individual public or private properties outside of the Right of Way except as allowed by the Engineer.

E. Excavated soil shall be managed such that it is not exposed to contamination following excavation. Equipment and supplies in contact with excavated soil shall be free of asphalt, petroleum products or other hazardous materials that could be transferred to soil. Vehicles used to transport asphalt shall not be used to transport soil except by permission of and following inspection by of the truck, by the Engineer.

3.3 SOIL/FILL CHARACTERIZATION

A. Soil and fill material shall be classified based on the criteria established in the accepted SMP and these Specifications.

B. Environmental Conditions Summary, Complete Streets Project, Cambridge, MA, performed by the Engineer during design, is appended to the specifications and includes a summary of analytical results.

C. The Contractor may either perform independent sampling and pre-characterization of soil/fill strata to be encountered during construction in advance of excavation such that excavated soil can be directly transported to an appropriate facility; or the Contractor shall make the necessary arrangements to secure a staging area(s) suitable for storing soil stockpiles pending analyses.

D. Soil shall be preliminarily segregated based on the Soil Classification Categories detailed in Sub-section 1.4, except as indicated below.

1. Potential Asbestos Containing Material (PACM): If soil/fill suspected of including asbestos-containing debris is encountered during excavation, the Contractor or the Contractor-hired Environmental Professional shall immediately contact the Engineer to discuss the nature and extent of the PACM and to assess potential hazards and appropriate handling procedures. Prior to handling and removing the PACM, MassDEP shall be notified and approval for handling and disposal obtained. Discovery and management of PACM shall be documented as required in the SMP. Evidence of PACM includes but is not limited to the presence of suspect asbestos-containing building debris such as broken or crushed asbestos-cement (transite) piping, vinyl floor tiling, tar-based pipe wrap, roofing paper or paper-like insulation materials. Following MassDEP approval, such soil/fill shall be managed in accordance with applicable regulations. Soils shall be analyzed for OHM to determine appropriate disposal requirements, as required by the proposed disposal facility.

2. Unknown Material. If unknown material is encountered during excavation, the Contractor or the Contractor-hired Environmental Professional shall immediately contact the Engineer to discuss the nature and extent of the unknown material and to assess potential hazards and appropriate handling procedures. Prior to handling and removing the unknown material from the excavation area, the Contractor and Owner and/or its representatives, shall visually assess the material and its potential hazards. Drums shall be assessed to determine whether they are leaking, bulging (evidence of reactive waste), crushed, or empty. Crushed, empty, and/or skeletal parts of drums shall be handled as solid waste, as specified. The Contractor shall record any identification or markings on the drummed material(s). Discovery and management of unknown materials shall be documented as required in the SMP.

E. Disposal Characterization: Waste characterization shall be the responsibility of the Contractor. The Contractor shall be responsible for determining the characterization requirements of each disposal facility in advance to facilitate timely disposal and to adequately estimate the disposal costs. The Contractor shall perform additional segregation based on disposal requirements. Disposal or reuse of the material shall depend on sampling and characterization analytical results.

Stockpiles within the staging area shall be sampled and characterized within a timely manner so as not to impede construction activities or preclude the reuse of soil/fill on site. If soil/fill cannot be reused on site due to the Contractor's delay in sampling material, the Contractor shall dispose of the soil/fill at no

additional cost to the Owner including the cost of imported fill material used in its place.

3.4 STAGING AREAS

A. Unless the staging area is comprised of an impervious surface material such as asphalt or concrete, the Contractor shall pre-characterize the surface soils (0-6") at the staging area(s) prior to staging any soils to document the existing conditions relative to contamination which may result from using the area to stage excess or unknown materials. A minimum of one composite surface soil sample, consisting of at least five grab samples, for every 2,500 square feet of staging area shall be collected by the Contractor prior to staging materials at the location. The samples will be submitted to a certified laboratory for analysis for:

1. MCP 14 metals;
2. VOCs (EPA Method 8260B);
3. SVOCs (EPA Method 8270);
4. TPH (EPA Method 8100M or equivalent); and
5. PCBs (EPA Method 8082).

B. At the completion of the work, the Contractor shall replicate the pre-staging sampling and analysis protocol to assess impacts to the area from use as a staging area.

C. Stockpiles located within the soil staging areas shall be placed on asphalt or concrete, or on a 20-mil HDPE liner/filter fabric and bermed to minimize the effects of contamination release. Each soil category shall be staged in separate areas with berms constructed a minimum of 2 feet above the existing grade with hay bales, concrete barriers, or functionally equivalent berm material. All wastes must be disposed off-site within ninety (90) days of excavation.

D. As described above and herein, excavated materials shall be completely covered with a minimum 10-mil thickness polyethylene tarp and secured with tires, ropes, anchors or equivalent material. The covered system shall be capable of resisting actual wind gusts at the site, with a minimum wind capacity of 40 miles per hour. The stockpile covers shall be installed and secured at the end of each working day and at all times when earthwork is not taking place on site. Stockpile covers shall be immediately recovered should wind forces expose any of the excavated materials. Stockpiles shall also be covered at times as directed by the Engineer.

E. Stockpiles are to be segregated based on a review of pre-characterization data and visual and olfactory conditions and field screening results obtained during excavation. Similar material may be stockpiled together. Each stockpile must be clearly separated from adjacent stockpiles.

F. Stockpiles shall be clearly designated by a sign post or marker which can be cross-referenced with samples collected from the pile for characterization purposes. The signs/markers are not to be moved, except by authorized personnel and not until the soil is ready to be either reused on site or loaded for off-site disposal.

G. Stockpiles shall be limited in size to approximately 500 cubic yards, unless approved by the Engineer. If, as a result of combining soil piles into larger volumes than 500 cubic yards, soil must be disposed of as a higher cost bid item than would otherwise be required, the Contractor shall be responsible for the additional cost.

H. Excavated soil shall not be added to a stockpile after it has been sampled for characterization.

I. Unknown, potentially hazardous soils/debris and drummed materials encountered during the project shall be located in a separate bermed location. The Contractor's Soil Management Plan shall provide construction details of the dimensions and protective measures proposed for the staging area(s). The construction details and protective measures are subject to the acceptance of the Owner and/or its representatives. The Contractor shall select the area to facilitate handling of the material and to minimize interference with other ongoing construction activities. The Owner or Engineer must agree with the location prior to construction.

3.5 EQUIPMENT AND PERSONNEL DECONTAMINATION

A. Equipment and personnel decontamination area(s), conforming with the Contractor's HASP and these Specifications, shall be constructed in such a manner to protect existing site surfaces, materials, and structures from contamination. Equipment decontamination areas shall be sized adequately to provide for the decontamination of the largest piece of equipment to be decontaminated. Filter fabric shall be placed over an impermeable liner to protect the liner from rips, punctures, or tears from traffic and heavy equipment.

B. The Contractor shall establish a site-specific decontamination protocol and decontamination areas for personnel and equipment utilized at the subject site. Personnel and equipment decontamination shall be conducted in compliance with the HASP.

C. The decontamination protocol shall include (i) the means, methods, and materials for the proposed decontamination procedures; (ii) the procedures employed to contain and store the wash or rinse liquids/sludges; (iii) procedures used to sample, analyze, and characterize the contaminated wash or rinse liquids/sludges; (iv) procedures to contain or clean contaminated equipment and PPE; and (v) the procedures for handling and disposing of solid wastes generated from site decontamination activities. All sample analysis or

sample compositing shall be completed by a certified laboratory. The Contractor shall be responsible for the cost of this analytical work. The Contractor shall submit a copy of the analytical results and laboratory certifications to the Owner for review prior to proceeding with disposal. The Contractor shall be responsible to properly manifest and dispose of all residual wastes generated from on-site activities in conformance with federal, state, and local environmental and transportation regulations. The Contractor shall be responsible for the manifests and procedures to be used to package and dispose of contaminated solid wastes, wash, or rinse liquids at an EPA or state-approved treatment or disposal facility. The Contractor shall be responsible for any releases from site or decontamination activities due to its work, and will remediate any release for which the Contractor is responsible to pre-existing conditions at the Contractor's expense.

D. Provisions for collecting decontamination water will be incorporated into the maintenance of the decontamination pad and will include placing an impermeable liner over a sloped surface such that water is directed, if necessary, into an area for subsequent pumping to 55-gallon drums or other appropriate tankage. Following completion of the work, the wash water shall be characterized by the Contractor and disposed off-site, in accordance with federal, state, and local regulations.

3.6 ENVIRONMENTAL FIELD MONITORING/DUST CONTROL

A. The Contractor's Site Health and Safety Officer shall keep accurate documentation of all air monitoring in accordance with the Contractor's Health and Safety Plan. Air monitoring data shall be made available to the Engineer or Owner upon request. At the direction of the Engineer, air monitoring may be limited to visual assessment for dust and odor monitoring; instrument monitoring may be required at any time by the Engineer, based on the results of visual and odor monitoring.

B. During excavation and construction at depths of greater than 2 feet below ground surface, the Contractor shall monitor the air quality at and surrounding the areas where construction activities involve soil handling such as excavation, re-location, staging, loading or grading of soil/waste materials. Air monitoring shall involve appropriate techniques capable of providing real-time indications of air contaminants to protect on-site personnel and the local population. If there are indications of contamination, the frequency of air monitoring shall be determined by the Contractor's Industrial Hygienist or competent environmental health professional. The Contractor's Site Health and Safety Officer and Superintendent shall be responsible for assuring that monitoring is conducted in an appropriate manner by personnel trained to operate the air monitoring equipment, record measurements, and compare to actions limits established by the Contractor's Health and Safety Plan, and that work practices, engineering controls and/or Personal Protective Equipment are proper for the conditions.

C. The air monitoring program is to be designed to protect public health and the environment from the potential generation of dust and odors and contaminant release during work. At a minimum, the air monitoring shall include daily monitoring and documentation of one upwind, and two downwind conditions during periods of activity on the site and when there is a potential for dust being generated on the site. The air monitoring information including air monitoring in the vicinity of all site activities shall also be utilized for establishing levels of personal protection measures in the Contractor's Site Specific Health and Safety Plan. The Contractor shall submit their air quality monitoring program for review prior to commencement of site activities.

D. Air monitoring shall be performed by the Contractor during all soil handling operations. In contaminated areas, detectors for organic contaminants and dust should be utilized to monitor on-site and off-site breathing zones and possible sources of potentially hazardous material (e.g. excavations, regrading, etc.). All personnel shall be made aware of the potential hazards and be informed of air monitoring information by the Contractor. Particular attention to air quality shall be made in the work area during earthwork activities to ensure that contaminants do not escape to the atmosphere and affect off-site population, on-site control, working conditions and personnel protection measures.

E. Ambient dust levels at the site shall be monitored by the Contractor prior to construction. During construction, real-time dust monitoring shall be conducted during any soil/fill handling activities. The monitoring shall consist of total dust testing using MIE, Inc. Miniram PDM-3 Dust Monitors, or like instruments. Dust shall be controlled during excavation of soil/fill material to limit potential spread of contaminants and potential exposure of contaminants to workers and the public. The total dust criteria at the site shall conform to the requirements of the HASP. Should fugitive dust quantities exceed 20 percent of the ambient level, the Contractor shall perform additional measures to reduce the total dust concentrations.

F. Nuisance dust levels shall be reduced by pre-wetting the surface soils and by establishing and maintaining clean access roads. The Contractor's Dust, Vapor, and Odor Control Plan shall describe the procedures and materials to minimize dust. At a minimum, the Contractor shall provide clean water, free from salt, oil, and other deleterious materials.

Areas of exposed earth to be excavated shall be lightly sprayed with water before excavation if there is potential for nuisance dust generation. Additional water spray may be utilized only when any indication of excessive dust is observed. To the extent feasible, the Contractor shall minimize the use of water within the limits of excavation.

G. All containers temporarily storing waste material shall be covered at all times except as necessary to place waste material into the container. The Contractor shall monitor the covers daily to ensure the covers are in place and effectively eliminating the generation of dust and make appropriate notes in the site log.

H. In the event that asbestos containing materials are encountered, dust control measures, which may include negative air containment, shall be instituted in accordance with all applicable local, state and federal laws and regulations.

3.7 VAPOR AND ODOR CONTROL

A. The Contractor shall provide the materials and labor to control objectionable vapors and odor in accordance with the Contractor's Vapor and Odor Control Plan. The Contractor shall limit the exposure area and shall cover the exposure area with synthetic reusable covers, lime, foam suppressants (containing no per- and polyfluoroalkyl substances (PFAS)), or other methods to reduce off-site odors to acceptable levels. The Contractor shall not use soil suitable for on-site reuse as cover to control vapor and odors.

3.8 BULKING

A. Following characterization and compatibility testing of waste material, the Contractor shall place compatible materials into common containers to reduce transport and disposal costs. In addition, materials that are improperly contained shall be transferred into the appropriate containers. Drums and containers used during this project shall meet the appropriate DOT, OSHA, and U.S. EPA regulations for the materials contained. The Contractor shall describe the bulking procedures in the Soil and Fill Management Plan.

3.9 BACKFILLING AND COMPACTION

A. Excavated areas shall be backfilled with appropriate backfill material (including excavated material suitable for reuse and, when necessary, imported off-site material). Imported backfill used in excavated areas shall have been analyzed and certified as free of contaminants and as specified in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING.

END OF SECTION 02080

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02095

TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

PART 1 – GENERAL

1.1 DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required to transport waste material off site, and dispose, reuse or recycle excess soil or waste materials at a licensed facility approved by the Owner.

B. All personnel involved in the transportation of waste from the site shall have the required Department of Transportation (DOT) and Occupational Safety and Health Administration (OSHA) training.

1.2 RELATED WORK

A. Section 01108 – HEALTH AND SAFETY PROCEDURES

B. Section 01500 – TEMPORARY ENVIRONMENTAL CONTROLS

C. Section 02010 – SUBSURFACE INVESTIGATION

D. Section 02051 – DEMOLITION, MODIFICATION, AND ABANDONMENT

E. Section 02080 – SOIL AND WASTE MANAGEMENT

F. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. A list of all transporters, destination/receiving sites and waste facilities, complete with license numbers and permit numbers (as appropriate), contact person, and address and telephone number that the Contractor utilizes for soil management and waste disposal.

2. Where appropriate the Contractor shall submit waste manifests for all waste disposed off-site to the appropriate authority, agency, facility, or person within the time constraints specified by state and federal regulations. Copies of all waste manifests and Bill of Lading documentation including weight slips and BOL summary sheets shall be provided to the Owner within ten (10) days. It is the responsibility of the Contractor to complete all Material Shipping Records (MSRs)

and waste manifests completely and accurately prior to submitting them to the Owner. For MassDEP Bills of Lading the Contractor shall provide the Owner's Licensed Site Professional (LSP) all information required for preparation of electronic Bills of Lading. The Contractor shall be responsible for preparation of Material Shipping Records. The Contractor shall be responsible for submitting to the Owner's LSP all information necessary for preparation of LSP opinion letters to disposal facilities and coordinating disposal documentation with all parties. The Owner's LSP and the Owner shall sign any MassDEP Bill of Lading forms where required only after the Contractor has provided the information required for preparation of electronic MassDEP forms. The Contractor shall reimburse the Owner for any and all fines associated with inaccurate, incorrect, or improperly completed waste manifests, including fines resulting from late or untimely submittals.

3. Disclose a summary of the history of compliance for each disposal/recycling facility proposed to be used by the Contractor. The compliance history shall include a comprehensive list of any state or federal citations, notices of non-compliance, consent decrees or violations relative to the management of waste (including remediation waste) at the facility. The Owner reserves the right to reject any facility on the basis of poor compliance history.

4. Prior to transporting any soils or fill material to a disposal facility the Contractor shall submit a letter from the disposal facility indicating that the facility has reviewed the available data and the generator's profile of the material and the facility agrees that it meets the facility's acceptance criteria.

5. Within fifteen (15) business days following off-site disposal of soil or fill materials at a disposal facility the Contractor shall submit Material Shipping Record or MCP Bill of Lading load log sheets signed by the facility.

6. Following disposal of all the soil represented by a Material Shipping Record or Bill of Lading, the Contractor shall submit that Material Shipping Record "Acknowledgment of Receipt by Receiving Facility" or Contractor shall arrange for receiving facility to electronically sign that Bill of Lading "Attestation of Disposal", as applicable, within sixty (60) days of shipment.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide completed Bills of Lading, Material Shipping Records, manifests, certificates of disposal, weight slips and all other documentation relative to disposal, reuse or recycling of soil and waste material.

PART 3 – EXECUTION

3.1 GENERAL

A. The Contractor shall reuse, recycle or dispose of all excess soil and wastes resulting from excavation activities in accordance with federal, state and local regulations and these specifications. Transport shall be by a permitted and licensed waste transporter. The Contractor shall be responsible for supplying the proper manifests to be approved and signed by a representative of the Owner.

B. Prior to disposal, it shall be the responsibility of the Contractor to maintain segregated waste stockpiles in conformance with all applicable federal, state, and local waste disposal regulations and as specified in Section 02080 - SOIL AND WASTE MANAGEMENT.

C. The Contractor shall be responsible for preparing and keeping in proper order all waste manifests, Bills of Lading and Material Shipping Records, and shall designate one person who shall be made available to sign all transportation documentation. The Engineer shall be responsible for obtaining the Owner's signature and all other signatures required for the proper completion of the manifests. The Contractor shall allow a minimum of five working days from the date of the submittal for any documents requiring the signature of the Owner and/or the LSP. The manifests shall document the handling of the waste from the time it is generated until the time it is properly disposed.

D. The Contractor shall be responsible for obtaining all federal, state, and local permits and variances to allow transport of materials on public roadways.

E. The Contractor shall be responsible to inform the Owner if hazardous waste disposal will not be performed within 90 days of hazardous waste characterization. This notification shall take place a minimum of 30 days prior to the 90-day deadline. No hazardous waste stockpiled at the site shall remain on site more than 60 days after it is characterized.

F. The Contractor shall obtain certificates of disposal for all disposed waste.

G. Transportation of solid wastes shall be in compliance with any relevant federal, state and local special waste requirements, and such as to assure that waste material is not released during transit.

3.2 SOLID WASTES

A. Transporters of solid wastes that include, but are not limited to, contaminated soil/fill (including oil-contaminated soil/fill), construction and demolition debris, non-hazardous laboratory wastes, bottles, tires, metal parts, tree stumps, brush, and grass cuttings will utilize trucks or dumpsters specifically designed to ensure that material, dust, or liquid is not released in transit. No truck shall be allowed to exit the site until all free liquids are drained from soil/fill or other solid waste being transported off-site. Material shall be covered at all times. The vehicle in which the waste is transported shall be driven directly to the intended destination without any stops or detours in between, except those necessary in response to road conditions, vehicle service needs, or emergencies. Discharge or release of material during transport shall be immediately reported to the Owner. Transporters shall clean up any discharge that occurs in transit, at the Contractor's expense.

B. The disposal site shall be permitted by the state in which the facility is located to receive and dispose of solid waste, and shall be approved for use by the Owner. The Contractor shall provide copies of the disposal facility's operating permit.

C. Manifesting of solid waste shall be required and shall include vehicle identification; date of loading and disposal; tonnage, as measured at the disposal site; and signature of the Owner and/or its representative, transporter, and disposal facility's representative. Transportation of the wastes shall be accompanied by the appropriate manifests, as required in the Code of Massachusetts Regulations (CMR) 310 CMR 40.0030, such as a Material Shipping Record, MassDEP Bill of Lading, or by a Uniform Hazardous Waste Manifest. Where paper documents are utilized, the original shall be returned to the Owner, and/or their representative, within ten (10) working days of disposal.

D. All solid waste shall be disposed in accordance with all applicable federal, state and local laws and regulations, as well as all other state laws through which the waste material is being transported.

E. Transport of soils in which asbestos containing materials have come to be located shall be transported and disposed of in accordance with Section 02080 – SOIL AND WASTE MANAGEMENT and all applicable local, state and federal laws and regulations.

3.3 HAZARDOUS WASTES

A. Transporters of hazardous wastes shall be in conformance with Code of Federal Regulations (CFR) 40 CFR, Part 263, all other federal laws and regulations, 310 CMR 30.400, and all other state laws through whose boundaries the waste material is being transported. The transporter shall provide copies of its EPA identification number, Massachusetts transporter's license, and proof of driver training in transporting hazardous waste.

B. The disposal site shall be in conformance with 40 CFR, Part 264 and relevant laws of the state in which the facility is located. The Contractor shall provide copies of the disposal facility's EPA and state treatment and disposal permit.

C. Manifesting of hazardous wastes shall be in conformance with 40 CFR, Part 264, Subpart E and 310 CMR 30.405.

3.4 DUST CONTROL

A. Dust control measures shall be implemented during loading and transport of waste material from the site in accordance with the contractor's Dust Control Plan, as specified in Section 02080 – SOIL AND WASTE MANAGEMENT.

END OF SECTION 02095

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02100

SITE PREPARATION AND TREE PRUNING

PART 1 – GENERAL

1.1 SUMMARY

A. The work to be done under this section consists of instituting and maintaining positive measures to protect and maintain public and private shade trees within and adjacent to the limits of work as detailed on the Drawings and as directed by the Owner's Representative.

B. This work includes proactive measures prior to, during and after construction to ensure the short- and long-term health of existing trees to remain on site and to prevent damage due to construction operations.

C. Tree Protection should be assumed for existing trees to remain within the project limit of work where proposed construction activity is to occur beneath the canopy and within the drip lines of existing trees to remain. Tree protection shall remain in place throughout the duration of the construction project but may be temporarily relocated to allow for work in select areas in close proximity to the trees to occur as approved by the Owner's Representative. Tree protection shall be promptly restored following work operations. The measures described herein are anticipated to be required and will be verified based on actual field conditions. Provisions under this item include: tree protection fencing measures to minimize disturbance to existing trees and their root systems; canopy and root system review and evaluation; canopy and root pruning in areas of proposed disturbance; and post-pruning care including mulching and watering of root zones.

D. Work in this section includes the following:

1. Tree Protection
2. Preparation of a Tree Protection and Maintenance Plan and Work Schedule
3. Hiring of a Certified Arborist for the Duration of the Construction Activity
4. Developing a Plant Health Care Program
5. Tree Pruning
6. Tree Removal
7. Stump Removal
8. Subsurface Root Exploration

1.2 RELATED WORK

A. Division 1 – General Requirements

B. Section 01570 – Maintenance and Protection of Traffic

C. Section 02210 – Earth Excavation, Backfill, Fill and Grading

D. Section 02524 - Curbs, Walks and Driveways

E. Section 02900 – Landscaping

1.3 GENERAL REQUIREMENTS

A. Tree, stump and shrub removal: Remove City and private trees as specifically designated on the Plans, as listed in the Specification, and as directed by the Owner's Representative. Trees to be removed shall be verified with the Owner's Representative prior to undertaking any work under this Contract. Trees shall be completely removed, including stumps, and legally disposed of offsite. Existing tree pits shall be restored to existing conditions or as per the Contract Documents.

B. Pruning: The Contractor shall prune City and private trees within the limit of work before and after construction under the direction of a Massachusetts Certified Arborist and only as directed by Owner's Representative. The pruning shall result in adequate vertical clearance in the parking lanes to reroute vehicle and truck traffic to the curbs lines, unless otherwise limited by the City Arborist. The Contractor shall also be aware that tree branch removal limitations will likely restrict full use of parking lanes for temporary lane shifts.

C. Provide protection of existing trees and vegetation not designated for removal within the limits of work and along truck routes outside the limit of work. Temporarily stump or stockpile as applicable topsoil, shrubs, and vegetation within the limits of work that will interfere with construction and as required.

D. Conduct site clearing and pruning operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities only as directed by the Owner's Representative. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Owner's Representative. Pruning operations shall include the specific pruning requests identified in this Specification.

E. Contractor is required to comply with the City of Cambridge Department of Public Works, Division of Urban Forestry regulation "Tree Protection during Construction". This regulation contains specific measures and remedies should the Contractor fail to abide the City's requirements.

F. Public trees are protected by Massachusetts State Law, Chapter 87. Section 12 states that a fine of up to five hundred dollars, ($500.00) per incident of damage to public shade trees can be levied. Each branch broken or improperly pruned, each improper wounding of the trunks of the trees, and

each root improperly pruned shall constitute an infraction. Section 12 further provides that anyone who negligently or willfully damages a tree will be liable to the City for all damages.

G. The Contractor shall exercise special care when excavating near trees. When major roots are in the way, the Contractor shall go under or between them. In no case shall the Contractor disturb the root structure of the trees without direction from the City Arborist. Expose roots shall be covered promptly. Excavation of all tree wells shall be done entirely by hand.

H. The Contractor shall take the utmost care to avoid unauthorized, unnecessary or improper wounding of City or private shade trees. Prior to construction, the Contractor shall provide a Tree Protection and Maintenance Plan and Work Schedule. A Massachusetts or International Certified Arborist shall be sub-contracted by the Contractor to provide a protection and maintenance plan and perform specified work. All plans and schedules shall be subject to review and approval by the City Tree Warden. Infraction of Massachusetts State Law Chapter 87 or failure to provide a protection plan and work schedule will result in fines or the immediate cancellation of the contract.

I. The Contractor shall engage a board-certified arborist with a **minimum of five (5) years of experience** including experience with supersonic air tools such as the "airspade" for the project.

J. The work shall consist of the provision of all labor, materials, equipment, and transportation required to complete the pruning as required by the Owner's Representative in strict accordance with the conditions and specifications of these Contract Documents. The work shall include, but is not necessarily limited to, the following:

1. Attending initial site visit and assessment with City representatives
2. Securing necessary permits and approvals before commencement of work
3. Posting work areas for parking restrictions
4. Securing police details, if necessary
5. Marking work zones for traffic and pedestrian control
6. Providing a schedule of work for City review and approval
7. Meeting with City staff on a periodic basis (up to 5 meetings)
8. Visual assessment of each tree to be pruned including the assessment of the need for airspading and/or tree root pruning
9. Determination of pruning objectives
10. Making pruning cuts and wound care
11. Wood waste and debris consolidation & disposal
12. Site cleanup

1.4 QUALITY ASSURANCE

A. Tree Protection measures to be performed by Massachusetts Certified Arborist with a minimum of five years of experience and as reviewed and approved by the Owner's Representative and City Tree Warden.

1.5 SUBMITTALS

A. Certification: Submit the Certification of the arborist to be performing the work.

B. Tree Protection and Maintenance Plan, Plant Health Care Program and Work Schedule: submit for review and approval by the Owner's Representative and City Tree Warden at least two (2) weeks prior to beginning initial work on a project street.

C. Product Data: Submit most recent printed information from manufacturers for:

1. Tree Watering Bags
2. Slow Release Fertilizer

D. Samples: Submit samples of:

1. Tree Trunk Wrapping
2. Tree Protection Fencing
3. Wood Chips
4. Tree Watering Bags

E. Shop Drawing/Field Mock-Up: Submit for review and approval by the Owner's Representative and City Tree Warden:

1. Tree Box. Owner's Representative to approve first tree box constructed prior to Contractor completing remaining boxes.

PART 2 – PRODUCTS

2.1 TREE BOX

A. Tree Box shall be constructed from 2 in. x 4 in. lumber creating a box around the border of the tree pit with 2 in. x 4 in. lumber standing straight up at the corners and wrapped with orange snow fence. Fasteners as per detail.

2.2 TREE TRUNK WRAPPING PROTECTION LUMBER

A. Tree Trunk Wrapping Protection Lumber shall consist of 2 in. x 4 in. and 8 ft. height lumber wired together in close spacing with 16 gauge galvanized steel wire to form a protective enclosure around tree trunks.

2.3 TREE PROTECTION FENCING

A. Tree Protection Fencing shall be new 4 ft. height orange snow fence.

B. Stakes shall be 2” diameter black painted galvanized steel pipe or 2in. x 4in. stained lumber stock as approved by the Owner's Representative.

2.4 WOOD CHIPS

A. Wood Chips shall conform to provisions of Wood Chip Mulch under Materials Section M6.04.3 of the MassDOT Standard Specifications.

2.5 WATER

A. Water shall be furnished by Contractor, suitable for irrigation and free from ingredients harmful to plant life. Hose and other watering equipment required for work shall be furnished by Contractor.

2.6 TREE WATERING BAGS

A. Tree Watering Bags shall be 20 gallon, slow-release drip irrigation bags, made of UV treated polyethylene. Color: green.

PART 3 – EXECUTION

3.1 GENERAL

A. Remove trees, shrubs, grass and other vegetation, improvements, or obstructions that interfere with installation of new construction and as required. Removal includes digging out stumps in their entirety and grubbing roots to at least 2.5 feet below existing grades shown on the Drawings.

B. Prior to start of work, Contractor shall conduct project-wide pruning of existing trees and shrubs within the right-of-way.

3.2 SPECIAL REQUIREMENTS

A. The Contractor is required to conform to the requirements of the City of Cambridge Department of Public Works, Division of Urban Forestry regulation “Tree Protection During Construction”. This regulation contains specific measures and remedies should the Contractor fail to abide the City’s requirements.

B. For definitions and pruning standards, the Contractor is required to adhere to the requirements of ANSI A300, American National Standard for Tree Care Operations “Tree, Shrub and Other Woody Plant Maintenance Standard Practices”.

3.3 TREE, STUMP AND SHRUB REMOVAL

A. Work to be done under this item shall conform to the relevant provisions of Section 101 Clearing and Grubbing of the MassDOT Standard Specifications.

B. Trees to be removed shall be verified with the Owner's Representative prior to undertaking any work under this Contract. Trees shall be completely removed, including stumps, and legally disposed of offsite. Existing tree pits shall be restored as sidewalk under the appropriate sidewalk item.

3.4 SITE REVIEW OF EVALUATION OF TREES AND POTENTIAL CONSTRUCTION RELATED IMPACTS TO ROOT SYSTEMS

A. Prior to mobilization and construction operations, Contractor, Arborist, Owner's Representative and City Tree Warden shall conduct a site review of the existing trees to remain in relation to proposed limits of construction operations, confirm the limits of tree protection fencing, and confirm which trees are to receive other types of Tree Protection including those designated as "Special Mature Trees". Contractor to document the trees and strategy to receive type of Tree Protection and submit for Owner's Representative's approval.

3.5 PROTECTION OF EXISTING TREES AND IMPROVEMENTS

A. Provide protection necessary to prevent damage to existing trees and improvements indicated to remain in place inside or outside of the limit of work. Existing trees and shrubbery to remain shall be protected from injury. Except as otherwise approved, cutting and trimming of existing tree limbs and roots will not be permitted. Existing trees to remain which can potentially be damaged by construction operations shall be protected. Trees having a caliper under 20" dbh shall be wrapped with tree protection lumber. "Special Mature Trees", those trees with a caliper over 20" dbh, shall be wrapped with tree protection lumber and protected with a tree box. Protection shall be maintained until completion of the work of the Contractor. Tree protection requirements are described in City of Cambridge Department of Public Works, Division of Urban Forestry regulation "Tree Protection During Construction".

B. Protect trees and improvements on adjoining properties and within City right-of-way. Restore improvements damaged by Contractor's clearing and construction activities to their original condition, at no additional expense to the City. Remove and replace trees damaged by Contractor's clearing and construction activities at no additional expense to the City.

C. Protect existing trees and other vegetation indicated to remain in place or outside of the clearing/grading limit lines.

3.6 TREE PROTECTION FENCING

A. Contractor shall erect the tree protection fence before site preparation or other construction activity commences. For each tree to be protected, set posts and fencing at minimum to the limit of the existing non-paved area, i.e. existing tree pit opening, and to the drip line in cases where pedestrian and vehicular movements will not conflict with an expanded fence location. Individual tree protection fencing, trunk protection, branch protection, and wood chips shall be determined on a case by case basis at the start of the project and shall be maintained throughout the duration of the contract until removal is approved by the Owner's Representative.

B. During the course of the project, adjustments or temporary relocations to the fence locations might be required to facilitate the work. Adjustments shall be made at no additional cost to the City.

C. Erect the protective fence so that it is securely in place and resistant to seasonal climatic forces, adjacent pedestrian movement, and work operations to ensure root and tree protection.

D. Periodically inspect, repair and maintain protective fences during the course of construction operations. During periods of construction stoppages, including but not limited to delays and over-wintering, periodically inspect, repair and maintain protective fences. Of particular concern is compaction by vehicles once the existing pavement has been removed, exposing roots to damage and by drying out.

E. Owner's Representative reserves the right to require Contractor to provide additional or more secure tree protection devices if it is determined that the existing trees are not being properly protected or if the vegetation is threatened with damage through the construction operations.

F. Protect existing trees and other vegetation to remain in place. Do not burn, cut, break, skin, or bruise trunk, roots, or branches. Do not fasten ropes, cables, or guys to any existing trees unless specifically authorized by the Owner's Representative.

G. If the Owner's Representative determines that trees are not being protected to the standards herein, Owner's Representative may order construction activity to stop immediately and to remain stopped until the non-compliant condition or practice is corrected. The Contractor shall comply with this provision at no additional cost to the City. This provision in no way affects the Contractor’s obligation to complete the work of this contract by the date specified.

3.7 TEMPORARY ACCESS

A. Temporary access within plant protection areas is permitted to perform construction operations as approved by the Owner's Representative. Work

within tree protection areas shall be performed by hand or with small equipment that will not damage or threaten damage to trees. Restore tree protection at the end of each day's operation.

3.8 TREE PROTECTION AND AIR SPADING OF ROOTS FOR SPECIAL MATURE TREES

A. The Contractor shall stake out the following in relation to "Existing mature trees" as identified as being greater than 20" dbh or as identified in the field by the City Arborist at the start of the project. This should be done prior to initiating excavation and should be reviewed together in the field by the City's representatives, the Contractor, Contractor's arborist, and Owner's Representative. This includes:

1. limits of utility trenching
2. limits of sidewalks and proposed tree pit openings
3. limits of proposed construction fences,
4. alignment of proposed limits of excavation.

B. After areas of potential negative impact are reviewed and confirmed in the field, the Contractor's arborist shall perform subsurface root exploration and evaluate root distribution in the area of the final cut lines.

C. As a guideline, the minimum final cut line distance from trunk of tree shall be established by taking the tree's diameter at breast height in inches and converting it to feet, (For example, 12" caliper tree translates into a 12' offset from the edge of the trunk to the final cut line.) Site constraints may dictate that the final cut line is closer to the trunk than guidelines will allow. Do not perform subsurface exploration near the trunk or within the drip line without authorization from the Owner's Representative.

D. The Contractor's arborist shall perform subsurface exploration in areas of negative impact adjacent to the final cut line using an air spade to cut windows in the soil to a depth of 10" or greater to expose the root systems without damaging them.

E. Based on the proposed alignment of the new utilities, pavement, curbs, formwork, etc. in relation to "Existing mature trees" the Contractor's arborist with the Owner's Representative's review and approval, will define the final cut lines depending on the density and distribution of the root systems. The final cut line will be created by the supersonic air tool such as "airspade".

F. The Contractor's arborist shall redirect root systems within the final cut line area and shall prune roots that extend beyond the final cut line with pruning tools. The Contractor and arborist shall minimize exposure of tree root systems during the exploration and pruning/construction activities over exposed roots, support edge of excavation and mulch to a depth approved by the Owner's Representative. The Contractor shall saturate burlap and mulch

with water and maintain the burlap in a damp condition during daylight hours as to not allow roots to dry out. If tree roots will be exposed for a period of time longer than 1 week, the contractor shall install 2" depth of wood chip mulch.

G. Once final cuts are completed by the Contractor's arborist with airspade and pruning tools, no mechanical excavation shall be allowed beyond the final cut line around the existing tree to remain.

H. The Contractor shall install forms for sidewalks or install curbs, etc. in locations shown on the Drawings at the limits of excavation. If possible existing tree roots to remain can be extended below pavement areas or planting surfaces, or within pavement sand based structural soils or other similar landscape zones that are not in conflict with the final pavements. Planting soils shall be hand placed over these areas as shown on drawings and as described in specifications.

3.9 GENERAL HORTICULTURAL TREE AND ROOT RELATIONSHIPS

A. The majority of a tree's roots are located in the upper few inches of topsoil. For this reason, trees are vulnerable to immediate and long-term damage. Immediate damage to roots is caused by grading, use of vehicles and tools, and excess pedestrian traffic above the roots. Long-term damage is caused by the compaction of the soil above the roots by use of vehicles, storage of materials, and excess pedestrian traffic.

B. Protection of a tree therefore includes the protection of the roots of the tree as well as its trunk, branches, and leaves. Roots are best protected by fencing off as large an area as possible around each tree, so that no driving, parking, walking, or storage of materials takes place where it may cause damage.

C. The roots of a tree often extend far into the surrounding landscape, including areas well beyond the outer perimeter of the tree's canopy / drip line. For this reason, operations should be confined to the smallest possible area.

D. As a practical minimum, however, every effort shall be made to protect the area beneath the canopy of the tree, also known as the area inside the "drip line." This area is sometimes referred to as the "root zone."

E. Soil is most vulnerable to compaction, and roots to damage, when the soil is wet.

3.10 ROOT PROTECTION

A. Roots that cannot be avoided during construction for all other trees to remain shall be carefully and cleanly cut. Only hand methods for grubbing roots will be accepted inside drip lines of trees to be left standing. All pruning of any roots greater than 2" must be completed under the supervision of the City

Arborist. Root pruning shall include application of root treatment or fertilizer as required. In order to minimize impacts to roots, Contractor shall uncover roots with air spade for all Special Mature Trees as identified under Section 3.8 of this specification. Additionally, the City Arborist may determine that certain significant roots of trees under 20" in diameter may also require the use of an air spade.

B. Trucks and heavy equipment shall not pass over or park on roots of public shade trees; nor shall construction materials, debris, or excavated material be stored within drip line of trees or within tree pits. For occasional or one time access over roots, ½-inch plywood overlapped may be used. Permeable materials such as gravel or wood chips shall be placed over root systems of trees which are not covered by hardscape and over which trucks and heavy equipment must travel during construction operations, when such travel is unavoidable, to prevent soil compaction and root damage. Material shall be replaced as needed.

C. During sidewalk construction adjacent to trees, suitable soil shall be maintained within tree wells. Moist soil or mulch shall also be maintained around surface roots outside of tree wells which may become exposed during construction. Such covering shall be placed as soon as possible after roots are exposed. If roots are going to be exposed for more than one hour, cover roots with damp burlap. Burlap shall be kept moist until most soil and mulch can be used for permanent cover.

D. Tunneling shall be the preferred method of excavation adjacent to tree roots to avoid root pruning. If root pruning is unavoidable, a certified arborist shall be onsite to execute or oversee the operation with sufficiently sharpened hand tools and in such a fashion as to have minimum negative impact on tree health and safety.

3.11 EXCAVATION WITHIN DRIP LINE

A. Where excavation for new construction is required within drip line of trees, tie branches out of the way, hand clear and excavate to minimize damage to root systems and place wood chips to a depth of six inches (6") on the ground to protect the root systems.

B. Use narrow-tine spading forks and comb soil to expose roots. Relocate roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits to bend and relocate them without breaking. No roots greater than two (2) inches in diameter shall be cut from trees to remain without prior approval of the Owner's Representative. Provide protection for roots over one inch (1”) diameter cut during construction operations. Prune roots that are either cut or broken with a smooth, clean cut.

3.12 ROOT PRUNING

A. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of structures. Cut roots with sharp pruning instruments; do not break or chop; cutting of roots with machinery is expressly prohibited. When roots that must be cut are encountered, work shall cease until roots have been properly cut.

3.13 ROOT SYSTEM EXPOSURE AND SUPPORT

A. Provide saturated burlap or temporary earth to cover tree roots exposed by construction. Do not allow exposed roots to dry out before placing permanent backfill. Water and maintain roots in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.14 PRUNING SAFETY STANDARDS

A. Tree pruning and airspading shall be performed only by certified arborists or arborist trainees who, through related training or on-the-job experience, or both, are familiar with the practices and hazards of arboriculture and the equipment used in such operations.

B. The Contractor's certified arborist must be present at all times while tree pruning is performed.

C. Tree pruning operations shall comply with the American National Standard for Tree Care Operations—Safety Requirements (ANSI Z133.1), as approved by the American National Standards Institute, and published by the National Arborists Association. Operations shall also comply with applicable Occupational Health and Safety Administration (OSHA) standards.

3.15 PRUNING OBJECTIVES

The pruning operation shall focus on the following types of pruning:

A. Cleaning. Cleaning shall consist of selective pruning to remove one or more of the following parts—dead, diseased, and/or broken branches. All deadwood that is two (2) inches or greater in diameter shall be removed. Branches with splits, large cavities or any defect that may result in failure shall be reduced, or removed to the trunk if reduction is not feasible.

B. Thinning. Thinning shall consist of selective pruning to reduce density of live branches. Thinning shall result in an even distribution of branches on individual limbs and throughout the crown.

C. Raising. Raising shall consist of selective pruning to provide vertical clearance. The intent of crown raising for this project will be the removal of all branches extending lower than fourteen (14) feet above a public roadway, eight (8) feet above a public sidewalk, and nine (9) feet above separated

bicycle lanes on Harvard Street. This includes trees endangered by traffic re-routing as the result of construction operations, as well as trees over existing roadways and sidewalks which do not presently meet these height requirements. However, the level of pruning of each tree will be determined at the site walk with the Contractor, Contractor's arborist, Owner's Representative and City arborist. Additionally, any cuts to lateral branches over 4" as well as any questionable cuts will require the approval of the City arborist.

D. Reducing. Reduction shall consist of selective pruning to decrease height and/or spread. Consideration shall be given to the ability of a tree species to tolerate this type of pruning. All branches obstructing park signs, street signs, traffic signs, traffic lights, and park or street lighting shall be removed. Branches shall be pruned away from all houses and buildings a minimum of five (5) feet, or more if appropriate to the tree shape and structure.

E. Specialty (Young) Trees. For young yet established trees, branches that are rubbing or poorly attached shall be removed. A central leader or leaders as appropriate to the species should be developed. A strong, properly spaced scaffold branch structure should be selected. For newly planted trees, pruning shall be limited to cleaning.

1. During the First Three Years After Planting: A central leader or leaders (as most appropriate for the species and specimen) shall be developed by removing competing leaders and removing vigorously growing branches that compete with the selected leader(s). A strong scaffold branch structure shall be developed by selecting the primary scaffold branches. To improve the scaffold structure, branches that are crossing, have included bark or interfere with the scaffold branches shall be removed. Scaffold branches shall be properly spaced. For deciduous shade trees that will reach or exceed 40 ft (12.2 m) in height at maturity, the recommended spacing is approximately 18 in (457.2 mm). For smaller species, 6 to 8 in. (152.4 mm to 203.2 mm) would be adequate.

2. Between Four and Six Years After Planting: The development of a good, structurally sound scaffold branch system should be continued by selective thinning of or on branches and removing dead, interfering, split and broken branches. Large-growing branches with narrow angles of attachment shall be removed from the trunk and canopy. The crown shall be raised for pedestrian clearance and vehicular clearance.

3.16 PRUNING PRACTICES

A. The Contractor’s certified arborist shall visually inspect each tree before commencing work.

B. If a condition is observed requiring attention, the condition should be reported to the City within 24 hours. Such conditions may include structural weakness, rot or decay that cannot be corrected by cleaning, and dead trees.

C. Equipment and work practices that damage living tissue and bark beyond the scope of work shall be avoided. Climbing spurs shall not be used when climbing and pruning trees. Spurs may be used to reach an injured climber or when removing a tree.

D. Pruning tools (e.g. chain saws, pole saws, hand saws, pole pruners, etc.) shall be sharp and regularly sharpened and maintained throughout the Contract Term.

E. Not more than 25% of the foliage of an individual tree should be removed within an annual growing season. The percentage and distribution of foliage to be removed shall vary according to the tree species, age, health and site, in accordance with the types of pruning identified above.

F. Not more than 25% of the foliage of a branch or limb shall be removed when it is cut back to a lateral. The lateral shall be large enough to assume apical dominance.

G. Heading shall be permitted only by the expressed permission of the City, when needed to reach a defined objective.

H. Topping and lion tailing shall be considered unacceptable pruning practices.

I. All pruning cuts shall be made in accordance with the American National Standard for Tree Care Operations—Standard Practices (ANSI A300 Part 1), as approved by the American National Standards Institute, and published by the National Arborists Association (revised 2001). All terminology included in these Technical Specifications shall be defined by ANSI A300 Part 1.

J. When tracing wounds, only loose, damaged tissue should be removed. No other wound treatments shall be used.

K. On mature trees the maximum diameter of any undesirable branch (dead, broken, rubbing, structurally unsound) that may be left shall not exceed 2 in. (50.8 mm).

L. Pruning cuts shall be clean and smooth with the bark at the edge of the cut firmly attached to the wood.

M. Large or heavy branches that cannot be thrown clear shall be lowered on ropes to present injury to the tree and other property.

N. Rope injury to trees from leading out heavy wood shall be avoided by using a cambium guard or installing a false crotch.

3.17 UTILITY CONSTRUCTION NEAR TREES

A. Route utilities away from existing trees. Review re-routing with Owner's Representative. Do not proceed without written direction. Minimize the cutting of tree roots, and when cutting is unavoidable, cut cleanly with a power saw and not an excavating machine.

3.18 ACTIVITIES PROHIBITED WITHIN DRIP LINE

A. Do not store and stockpile construction materials and/or excavated materials, park vehicles, drive vehicles, remove soils, and stockpile soils within the drip line of trees, including trees located on adjacent properties which overhang the site unless otherwise indicated in Contract Drawings. Excavation within these areas shall be subject to special care as described below in “Excavation within Drip line”.

3.19 EQUIPMENT

A. The following equipment and vehicles shall be available on-site for use. All gas- powered equipment and vehicles must be five years old or less and in good condition as determined by the Owner's Representative.

1. Two (2) aerial lift trucks with an articulating boom that have a working height of not less than sixty (60) feet with Contractor’s name painted on each side.
2. Two (2) chipper dump trucks with a minimum capacity of nine (9) cubic yards, with Contractor’s name painted on each side.
3. Two (2) wood chippers with a capacity for 16” diameter limbs.
4. All relevant traffic control devices as prescribed by the Manual of Uniform Traffic Control Devices (MUTCD) of the U.S. Department of Transportation.
5. Supersonic air tools such as the “airspade” for use on designated trees with root conflicts as designated by Owner's Representative.

3.20 PLANT HEALTH CARE PROGRAM

A. Prior to mobilization and construction operations, Contractor's arborist to document and submit a strategy for maintaining the health of existing trees within the project limits including strategies for watering and fertilizing as outlined below.

B. Watering: Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

C. Drainage: Do not permit water to stand around the base of plants within the drip line during construction operations except during that period of

inundating flooding which would, in its natural course, cover the base of trees. Provide temporary drainage where required to avoid ponding during construction operations.

D. Fertilizing: After pruning operations are completed, fertilize trees to increase vigor with a complete, slow release nitrogen, phosphorus, potassium (1:1:1 or 2:1:1) liquid injected fertilizer. Where liquid injected fertilizer is not practical, and when approved by Owner's Representative, drill holes 6" to 10" deep and place granular fertilizer at frequent spacing.

3.21 DAMAGE DUE TO CONSTRUCTION OPERATIONS

A. Contractor shall be responsible for the health of the existing trees in the immediate vicinity of construction. Trees damaged by construction operations which, as determined by the Owner's Representative, can be remedied by corrective pruning measures shall be addressed immediately.

B. Owner's Representative shall engage an independent qualified Arborist to inspect the damaged trees and to make a determination on damage, sustainability, and remediation procedures.

C. The Contractor shall strictly adhere to the independent Arborist’s recommendations.

D. Broken limbs shall be pruned according to industry standards.

E. Wounds shall not be painted.

F. The total cost of tree repair, including the cost of the independent Arborist, shall be borne by the Contractor.

3.22 TREE REPLACEMENT DUE TO DAMAGE

A. If the independent Arborist determines that the damaged tree cannot be repaired and restored to full-growth status, the Contractor shall replace the damaged tree(s) and pay liquidated damages as noted below.

B. The size of the replacement tree shall equal ½” caliper for every 1” caliper inch of the damaged tree (size of the damaged tree shall be measured, the new tree shall be based on nursery measurements). The species of the replacement tree shall be determined by the Owner's Representative and the City.

C. In addition to providing a new tree replacement, Contractor shall pay City $250.00 for every caliper inch of the damaged tree (the size of the damaged tree shall be as shown on the Drawings).

D. An example of the conditions stated above: A 20” caliper tree was damaged and determined to need replacement. To remedy this situation, the Contractor would purchase and install a 10” caliper tree and pay the Owner $5,000.

E. The total cost of tree replacement, including the cost of the tree and stump removal and the independent Arborist, shall be borne by the Contractor.

3.23 TEMPORARY REMOVAL OF SHRUBS AND TOPSOIL

A. Topsoil, shrubs, and vegetation to be temporarily removed shall be carefully removed from overall areas to be excavated, and over all other areas to be disturbed as a result of the Contractor's operations in the performance of the Contract work. The topsoil shall be transported and deposited in storage piles convenient to the areas which are subsequently to receive the application of topsoil, separate from other excavated materials, and in approved locations. The topsoil shall be stockpiled free of roots, stones and other undesirable material. The Contractor shall take all necessary precautions to prevent other excavated material or other objectionable material from becoming intermixed with the topsoil, either before or after the stripping and stockpiling operations. Shrubs and other vegetation shall be balled and burlaped and then transported and stored until they can be replaced after construction has been completed in that area. The shrubs and vegetation must be watered and maintained to remain healthy while being temporarily stored. Any shrubs and vegetation that do not remain healthy during storage shall be replaced by the Contractor at no additional cost to the City.

3.24 DISPOSAL OF WASTE MATERIALS

A. Remove waste materials and unsuitable topsoil from project area and dispose of off site in a legal manner. Waste materials shall include but not be limited to timber, brush, refuse, stumps, roots, vines, debris and other objectionable matter. Removal includes raking and sweeping after completion of clearing and pruning operations.

B. Tree branches shall be removed in such a manner so as not to cause damage to other parts of the tree, or to surrounding people and property. Where necessary, ropes or other equipment shall be used to lower large branches to the ground.

C. All severed limbs shall be chipped, hauled away from the site, and disposed of in a legal manner. All wood waste, sawdust, leaves, and associated organic debris shall be collected from both public ways and adjacent private property, hauled away from the site, and disposed of in a legal manner.

D. Site cleanup shall follow as closely as possible to the pruning operation.

3.25 POST-CONSTRUCTION CLEANUP

A. After construction is complete, but prior to preparation and seeding of lawn area and planting, remove and properly dispose of the following off site: wood chips, temporary fencing, branch protection, tree boxes and trunk protection, and other materials.

END OF SECTION 02100

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02140

DEWATERING

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Design, furnish, operate, maintain, and remove temporary dewatering systems to control groundwater and surface water to maintain stable, undisturbed subgrades, and allow work to be performed under dry and stable conditions and comply with permit and other regulatory requirements. Work to be done as part of dewatering includes, but is not limited to:

a. Obtain necessary state, local and Federal discharge permits.

b. Lower the groundwater level within excavations to below the bottom of the excavation.

c. Lower hydrostatic pressure.

d. Prevent surface and storm water from entering the excavation during construction.

e. Limit settlement of utilities and adjacent structures.

f. Implement erosion and sedimentation control measures for disposing of discharge water.

g. Provide treatment system to treat all water removed from excavations as required by discharge permits, except water that is re-infiltrated to the ground on site in a manner that does not result in negative on- or off-site impacts.

h. Provide observation well and geotechnical implementation as specified and indicated or as otherwise required by the Engineer.

i. Provide an Environmental Site Professional/Dewatering Specialist/Field Representative (hereinafter referred to as the Dewatering Professional) who will be responsible for dewatering, re-infiltration, treatment and discharge of dewatering flows as specified and in compliance with all applicable permits and regulations.

j. Common dewatering methods include, but are not limited to, sump pumping, deep wells, well points, vacuum well points or any combinations thereof.

2. Water removed from excavations shall be re-infiltrated to the ground if feasible. If re-infiltration is not feasible, treated water shall be discharged to the Massachusetts Water Resources Authority (MWRA) sewer system in accordance with the appropriate permit(s) and regulations. In no case shall dewatering flows be directly or indirectly released to surface waters or storm drains prior to settling of suspended solids and appropriate additional treatment. The Contractor is responsible for obtaining necessary permits. The City shall pay for the permit, however, the Contractor will be responsible for any costs associated with water sampling.

1.2 RELATED SECTIONS

A. Section 01300 – SUBMITTALS

B. Section 02010 – SUBSURFACE INVESTIGATION

C. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

D. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

1.3 SUBMITTALS

A. Shop Drawing: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Qualification of both the Contractor's dewatering specialist or firm's qualifications (installation) and the Dewatering Professional (all other responsibilities) a minimum of four (4) weeks prior to execution of any dewatering. The submittal shall include, but not be limited to:

a. Qualifications of specialist or firm's Registered Professional Engineer as specified below.

b. Qualifications of the Dewatering Professional who shall oversee the installation, operation and maintenance of the dewatering system.

2. Submit a dewatering plan including design calculations at least four (4) weeks prior to start of any dewatering operation. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain

responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

a. Dewatering plan and details stamped and signed by a Massachusetts Registered Professional Engineer that conform to the requirements of the dewatering permit(s), and all other applicable regulations and permits including, but not limited to, requirements for equipment, monitoring, sampling and reporting.

b. Submit a generalized plan of actions at least two (2) weeks before operation of the groundwater control system to be implemented in the event that the Threshold and Limiting values for groundwater lowering have been reached.

c. Certificate of Design for calculations.

d. A list of equipment including, but not limited to, pumps, prime movers, and standby equipment.

e. A description of the proposed method of dewatering; water re-infiltration; containment; treatment and discharge; and installation, monitoring, maintenance, and system removal procedures.

f. A groundwater monitoring plan shall be developed by the Professional Engineer retained by the Contractor that designs the dewatering system. The monitoring plan shall address groundwater control within the excavations and address settlements of utilities and adjacent structures.

g. A description of erosion/sedimentation control measures, and methods of disposal of pumped water.

h. List of all applicable laws, regulations, rules, and codes to which dewatering design conforms.

3. Data for the required discharge reports shall be collected by the Contractor's Dewatering Professional. It shall consist of periodic sampling and analysis of system influents, midfluents and/or effluents and discharge quantities and other requirements of the relevant permits. The Contractor's Dewatering Professional shall also coordinate analysis of samples at an appropriately certified analytical laboratory and shall comply with all permit reporting requirements.

4. A modified dewatering plan within 24 hours, if open pumping from sumps and ditches results in boils, loss of fines or softening of the

ground.

1.4 AVAILABLE SUBSURACE INFORMATION

A. Subsurface exploration data are provided as referenced in Section 02010 – SUBSURFACE INVESTIGATIONS.

1.5 QUALITY ASSURANCE

A. Employ the services of a Dewatering Professional and a Massachusetts Registered Professional Engineer having the following qualifications:

1. The Massachusetts Registered Professional Civil Engineer shall have completed the design of at least five (5) successful dewatering projects of equal size and complexity and with equal systems within the last five (5) years consisting of deep wells, well points, vacuum well points, and sump pumping for heavy Civil projects of similar size, type, and complexity in urban areas with the appropriate temporary support of excavation systems proposed by the Contractor including, but not limited to, trench boxes, soldier pile and lagging, timber sheeting support and secant pile support of excavation systems.

2. The dewatering systems installer supervisor shall have a minimum of five (5) years experience in installation of well points, deep wells, recharge systems, or equal systems.

3. The Dewatering Professional responsible for day to day operation of the system shall have the following minimum qualifications:

a. Completion of at least five (5) successful dewatering projects of equal size and complexity with equal systems within the last five (5) years consisting of system operation and troubleshooting, collection of readings, maintenance of logs and other required documents, collection of samples, coordination of analysis of samples, and compliance with reporting requirements during pumping for heavy Civil projects of similar size, type, and complexity in urban areas.

b. Valid certification from the Massachusetts Department of Environmental Protection (DEP) to operate the proposed treatment system.

B. If subgrade soils are disturbed or become unstable due to dewatering operation or an inadequate dewatering system, notify the Engineer, stabilize the subgrade, and modify system to perform as specified at no additional cost to the Owner.

C. Notify the Engineer immediately if any settlement or movement is detected on

any adjacent structures. If the settlement or movement is deemed by the Engineer to be related to the dewatering, take actions to protect the adjacent structures and submit a modified dewatering plan to the Engineer within 24-hours. Implement the modified plan and repair any damage incurred to the adjacent structures at no additional cost to the Owner.

D. If oil and/or other hazardous materials are encountered after dewatering begins, immediately notify the Engineer.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Provide groundwater monitoring wells in accordance with the submitted dewatering plan or as specified.

B. Provide casings, well screens, piping, fittings, pumps, power and other items required for dewatering system.

C. Provide sand and gravel filter around the well screen. Wrapping geotextile fabric directly around the well screen shall not be allowed.

D. When deep wells, well points, or vacuum well points are used, provide pumping units capable of maintaining high vacuum and handling large volumes of air and water at the same time.

E. Provide and store auxiliary dewatering equipment, consisting of pumps and hoses on the site in the event of breakdown, at least one (1) pump for every five (5) used.

F. Provide dewatering equipment, including an appropriately sized settling tank, and maintain erosion/sedimentation control devices as indicated or specified and in accordance with the dewatering plan.

G. Provide temporary pipes, hoses, flumes, or channels for the transport of discharge water to the discharge location.

H. Provide cement grout having a water cement ratio of 1 to 1 by volume.

PART 3 – EXECUTION

3.1 GENERAL

A. Execution of any earth excavation, installing earth retention systems, and dewatering shall not commence until the related submittals have been reviewed by the Engineer with all Engineer's comments satisfactorily addressed, the

geotechnical instrumentation has been installed and baselines established and submitted to the Engineer, and the Dewatering Professional is on site and has begun the duties specified herein.

B. Furnish, install, operate, and maintain dewatering, re-infiltration, treatment and discharge systems as indicated or specified and in accordance with the dewatering plan. As no dewatering flows shall be discharged to surface waters either directly or indirectly without appropriate settling, at a minimum, the Contractor shall provide a settling tank, such that if pumping rates exceed discharge rates, sufficient storage capacity is available. Delays due to insufficient storage capacity will be at no additional cost to the Owner. The Contractor is responsible to evaluate available data and determine the necessary storage capacity so as to not impede construction activities.

C. Carry out dewatering program in such a manner as to prevent undermining or disturbing foundations of existing structures or of work ongoing or previously completed.

D. Do not excavate until the dewatering system is operational.

E. Unless otherwise specified, continue dewatering uninterrupted until all structures, pipes, and appurtenances below groundwater level have been completed such that they will not be floated or otherwise damaged by an increase in groundwater elevation.

F. Discontinue open pumping from sumps and ditches, if such pumping is resulting in boils, loss of fines, softening of the ground, or instability of the slopes. Modify dewatering plan and submit to the Engineer at no additional cost to the Owner.

G. Where subgrade materials are disturbed or become unstable due to dewatering operations, remove and replace the materials in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING at no additional cost to the Owner.

3.2 DEWATERING DISCHARGE

A. Water to be infiltrated need not be treated. Contractor shall provide infiltration that complies with relevant local, state and federal regulations.

B. Transport pumped or drained water to discharge location in compliance with applicable permits and without interference to other work; damage to or contamination of pavement, other surfaces, or property; erosion; or siltation.

C. Provide separately controlled pumping lines.

D. Immediately notify the Engineer if groundwater is encountered that is suspected to be contaminated with substances other than those for which the

treatment system has been designed. Do not pump water found to be contaminated with oil or other hazardous material to the discharge locations without prior treatment and permits.

3.3 COMPLIANCE WITH DEWATERING AND RELATED PERMITS AND REGULATIONS

A. Discharging groundwater and allowing for natural infiltration may not be a viable option for controlling groundwater in the project area. Should dewatering activities be required where the Contractor needs to discharge groundwater to a location other than the point of origin, then the Contractor shall be prepared to store, treat and discharge the water in accordance with applicable permits and regulations. Periodic sampling, as may be required to demonstrate treatment effectiveness and compliance with discharge and/or pretreatment standards specified in any local, state, or federal discharge permit required shall be the responsibility of the Contractor and its Dewatering Professional. Water that cannot be infiltrated is anticipated to be discharged to the existing City of Cambridge Storm Drain system. The Contractor shall be responsible for seeking coverage under the appropriate MWRA Temporary Construction Site Dewatering Permit. At a minimum, the Contractor shall be prepared to comply with the permit influent/effluent testing requirements. The Dewatering Plan shall include a description of procedures and information related to the collection of readings, maintenance of logs and other required documents. At a minimum, the dewatering plan shall describe compliance with relevant provisions of the MWRA Temporary Construction Site Dewatering Permit obtained by the Contractor.

B. The Contractor, through its Dewatering Professional:

1. Shall furnish all labor, equipment and materials necessary to obtain accurate representative samples of the groundwater and for analysis for the set of analytical parameters specified above and as required by local, state and federal permits and regulations.

2. Shall coordinate sampling activities with the Engineer. The engineer reserves the right to sample treated and untreated dewatering flows at any time.

3. Shall take readings from the treatment system in accordance with the dewatering plan.

4. Shall collect an initial sample of untreated and treated groundwater at the beginning of dewatering activities within the construction area.

5. Shall prepare and keep in proper order all records required by regulatory authorities and permits.

6. Shall maintain logs and other records in accordance with the

Specifications, regulatory agency and permit requirements, and the Dewatering Plan.

7. Shall coordinate analysis of samples by an appropriately certified analytical laboratory in accordance with the Specifications, regulatory agency and permit requirements, and the Dewatering Plan, and ensure that laboratory detection limits meet permit requirements.

8. Shall comply with reporting requirements in a timely manner and in the format required by the relevant permit. Reporting in compliance with permit requirements includes, but is not limited to, notification to the appropriate regulators and the Owner and Engineer prior to discharge; submittal of laboratory analytical reports for each sampling event; submittal of reports for each reporting period during which no discharge occurs; notification of non-compliant discharges; notification of termination of discharge; and response to permit-related questions posed by regulators or the Owner and Engineer.

    a. Water will be discharged under a MWRA Temporary Construction Site Dewatering Permit, as applicable. The Contractor shall submit notifications and reports to the entities identified in the permit. Comply with pre-discharge notification, discharge reporting, notification of no discharge, and termination of discharge notification requirements; and respond to inquiries or correspondence from agencies regarding permit issues.

    b. If water will be discharged under a local permit, submit notifications and reports as required in the permit.

    c. For monthly or less frequent reporting deadlines, provide the Engineer with copies of all reports fourteen (14) days prior to the reporting deadline, and submit reports to the appropriate agency(ies) at the same. Provide copies of other dewatering documents to the Engineer immediately.

9. Install and maintain erosion/sedimentation control devices at the point of discharge as indicated or specified and in accordance with the dewatering plan.

10. The Contractor shall obtain all federal, state, county, and local permits and variances to allow transport of materials on public roadways, should such transport be necessary.

11. The Contractor shall dispose of all wastes resulting from construction dewatering activities in accordance with local, federal and state regulations.

12. The Contractor is solely responsible for the implementation of the permit requirements, and is solely responsible for any punitive action resulting from any violation of the permit. The actual permit issued by MWRA shall become part of this Contract by either addendum or by change order. If the actual permit is included by change order, no additional costs for implementing the permit will be considered by the Owner, when the actual permit is issued.

3.4 REMOVAL

A. Do not remove dewatering system without written approval from the Engineer.

B. Backfill and compact sumps or ditches with crushed stone wrapped with geotextile fabric in accordance with the Remedial Contract.

C. All dewatering wells shall be abandoned upon completion of the work, and completely backfilled with cement grout.

END OF SECTION 02140

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02160

TEMPORARY EXCAVATION SUPPORT SYSTEMS

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Design, furnish, install, and remove temporary excavation support systems as required to provide worker protection, maintain lateral support, prevent loss of ground, limit soil movements to the allowable limits indicated, and protect from damage existing and proposed improvements including, but not limited to, pipelines, utilities, structures, roadways, and other facilities.

2. The location, configuration, design, construction and maintenance of the excavation support walls and internal bracing shall be the sole responsibility of the Contractor.

3. The temporary excavation support system to be used on this project may include singular or multiple stages comprised of internally braced timber or steel sheeting, soldier piles and timber lagging or trench box. Temporary excavation support system is, at a minimum, required at excavation locations within 25 feet of building walls. Within 25 feet of existing building walls, the soldier piles and timber or steel sheeting shall be drilled or hydraulically pushed in place. No vibratory or impact hammers will be used to install the excavation support system within this area. At excavation locations along the alignment outside 25 feet of existing building walls, other approved methods of excavation support system installation may be determined as acceptable after submittals by the Contractor have been submitted and reviewed, for informational purposes only, by the Engineer.

4. Wherever the word "sheeting" is used in this section or on the Contract Drawings, it shall be in reference to steel soldier piles and timber lagging or steel and timber sheeting support systems.

5. Construction of the temporary excavation support system shall not disturb the existing structures or the completed proposed structures. The Contractor, at no additional cost to the Owner, shall repair damage to such structures.

6. The Contractor shall bear the entire cost and responsibility of correcting any failure, damages, subsidence, upheaval or cave-ins as a result of improper installation, maintenance or design of the temporary

excavation support systems. The Contractor shall pay for all claims, costs and damages that arise as a result of the work performed at no additional cost to the Owner.

7. Monitoring movement of the lateral support systems by optical survey techniques is required by an independent geotechnical monitoring consultant until installation and backfilling is complete. Additional survey monitoring of the lateral support system may be required if movement (lateral or vertical) is measured following backfilling to the existing grade.

8. If, in the Engineer's judgment, the performance of the excavation support system is unacceptable, the Owner may instruct the Contractor to stop work and implement remedial measures to arrest further movements or restore groundwater levels to pre-construction levels. The Contractor shall take immediate steps to implement the remedial measures designed by the Contractor and reviewed by the Engineer. The costs for these measures shall be at no additional cost to the Owner.

9. Temporary excavation support systems shall be designed and installed in accordance with OSHA excavation safety standards.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS.

1. Submit the following qualifications at least three weeks prior to the construction:

a. Qualifications of Contractor's temporary excavation support system designer as specified below.

b. Qualifications of Contractor's temporary excavation support system installer as specified below.

2. Submit a temporary excavation support plan stamped and signed by a Professional Civil Engineer Registered in the Commonwealth of Massachusetts at least two weeks prior to start of the construction. Submit design calculations for review that will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include the following items as a minimum:

a. Drilled or hydraulically pushed in place excavation support system, details, location, layout, depths, extent of different

types of support relative to existing features and the permanent structures to be constructed, and methods and sequence of installation and removal.

b. Certificate of Design

c. Requirements of dewatering during the construction.

d. Minimum lateral distance from the edge of the excavation support system for use for vehicles, construction equipment, and stockpiled construction and excavated materials.

e. List of equipment used for installing the excavation support systems.

3. Submit a Construction Contingency Plan specifying the methods and procedures to maintain excavation support system stability if the allowable movement of the adjacent ground and adjacent structures is exceeded.

4. Estimates of the lateral and vertical displacements of the excavation lateral support systems under applied loads at critical stages.

1.3 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Conform to the requirements of the OSHA Standards and Interpretations: "Part 1926 Subpart P - Excavation, Trenching, and Shoring", and all other applicable laws, regulations, rules, and codes.

C. All welding shall be performed in accordance with AWS D1.1.

D. Prepare design, including calculations and drawings, under a Professional Civil Engineer registered in the Commonwealth of Massachusetts and having the following qualifications:

1. Not less than five years' experience in the design of soldier pile and lagging and steel or timber sheeting temporary excavation support systems of at least 10 feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed not less than five successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of comparable type, size, and complexity as this project within the last five years.

E. Temporary Excavation Support System Installer's Qualifications:

1. Not less than five years' experience in the installation of soldier pile and lagging and steel or timber sheeting temporary excavation support systems of at least 10 feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed not less than five successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of comparable type, size, and complexity as this project within the last five years.

F. Install all temporary excavation support system under the supervision of a supervisor having the following qualifications:

1. Not less than five years' experience in installation of soldier pile and lagging and steel or timber sheeting temporary excavation support systems of at least 10 feet deep in urban areas of comparable type, size, and complexity as this project.

2. Completed at least five successful soldier pile and lagging and steel or timber sheeting temporary excavation support system projects of comparable type, size, and complexity as this project within the last five years.

1.4 DESIGN CRITERIA

A. Design of temporary excavation support systems shall meet the following minimum requirements:

1. Support systems shall be designed for earth pressures, hydrostatic pressure, equipment, traffic, temporary stockpiles, construction loads, and other surcharge loads.

2. Design internal bracing to provide sufficient reaction to maintain stability.

3. Limit movement of ground adjacent to the excavation support system to be within the allowable ground deformation as specified.

4. Design the embedment depth below bottom of excavation to minimize lateral and vertical earth movements and provide bottom stability. Toe of braced temporary excavation support systems shall not be less than 5 feet below the bottom of the excavation.

5. Design temporary excavation support system shall withstand an additional 3 feet of excavation below proposed bottom of excavation

without redesign except for the addition of lagging and/or bracing.

6. Maximum width of pipe trench excavation shall be as indicated on the Drawings.

7. Permanent structure walls shall not be directly cast against excavation support walls.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT and as specified.

B. Store sheeting and bracing materials to prevent sagging, which would produce permanent deformation. Keep concentrated loads, which occur, during stacking or lifting below the level, which would produce permanent deformation of the material.

1.6 PROJECT/SITE CONDITIONS

A. Subsurface exploration data are provided as referenced in Section 02010 – SUBSURFACE INVESTIGATIONS.

B. The Contractor shall notify the Engineer immediately if obstructions are determined to conflict with the location of the excavation support system. Cobbles and boulders within dense well-bonded soils or other competent naturally deposited soils will not be considered obstructions.

C. The Contractor shall protect adjacent structures above ground and buried from damage associated with lateral support of excavation operations and other operations. Damage due to lateral excavation support operations or other Contractor activities shall be repaired immediately by the Contractor at their own expense.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Structural Steel

1. All soldier piles, wales, rakers, struts, wedges, plates, waterstop and accessory steel shapes shall conform to ASTM A36.

B. Timber Lagging

1. Structural grade having a nominal thickness of 3 inches and a minimum allowable working stress of 1100 psi.

C. Timber Sheeting

1. Structural grade having a nominal thickness of 4 inches and a minimum allowable working stress of 1100 psi.

D. Other Materials

1. Tamping tools adapted for backfilling voids after removal of the excavation support system.

2. Provide specific trench box sizes for each pipe and utility excavation with structural capacity of retaining soil types as described in OSHA's 29 CFR Part 1926 Subpart P.

PART 3 – EXECUTION

3.1 GENERAL

A. Installation of the temporary excavation support system shall not commence until the Engineer has reviewed the related earth excavation and dewatering submittals with all Engineers' comments satisfactorily addressed.

B. Install excavation support system in accordance with the Contractor's temporary excavation support plan.

C. Carry out program of temporary excavation support in such a manner as to prevent undermining or disturbing foundations of existing structures of work ongoing or previously completed.

D. Perform preparatory work to discover, protect, maintain and restore, or remove utilities, foundations or other facilities located in close proximity of the proposed excavation lateral support system.

E. Conduct pre-excavation as necessary to remove obstructions and identify exiting utilities along the alignment of the excavation lateral support system which will interfere with installation in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

F. The Contractor shall provide fully equipped rig(s) and appropriate tools in full-time operation at the site during the work, and shall mobilize additional equipment, if necessary, to complete the work on schedule.

G. Excavation shall not proceed more than 2 ft below the bracing level, anywhere within the excavation support limits, until the entire level of bracing is completely installed, including prestressing.

H. Notify utility owners if existing utilities interfere with the temporary excavation support system. Modify the existing utility with the utility owner's permission or have the utility owner make the modifications at no additional cost to Owner.

3.2 SOLDIER PILES AND TIMBER LAGGING

A. Install steel soldier piles before starting excavation. Install soldier piles by drilling or hydraulically pushing to the design tip elevation. Driving by impact or vibratory hammers shall not be allowed. Drilled methods shall prevent loss of ground around the hole. Each soldier pile shall be installed in its drilled hole within 2 hours after drilling is completed to the required depth.

B. The Contractor shall have equipment on-site able to advance the drilled hole, for installation of the soldier piles, through sand below the water table, through concrete, and through large boulders and other obstructions which may be encountered.

C. Space soldier piles at intervals indicated on the Shop Drawings. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

D. Within the same day of seating the soldier piles in the drilled holes, encase the piles crushed stone or other acceptable granular material.

E. Prior to completion of the final backfilling operations, soldier piles shall be completely removed.

F. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. As installation progresses, backpack the voids between the excavation face with sand and on-site soils to establish a tight contact. Pack louver openings between lagging with hay or other porous material to allow free drainage of groundwater without loss of retained soil or backpacking. In no case shall the louvered openings be allowed to exceed 1-inch.

G. Beginning at the top of the soldier piles, the maximum permissible height of unlagged face of excavation shall not exceed 2-feet in all soil types encountered at the site. If water is flowing from the face of the excavation, or if soil to be retained moves toward the excavation, the maximum height of unlagged face shall not exceed 8-inches.

H. If unstable ground is encountered, take suitable measures (grouting behind the lagging or other approved method) to retain the material in place and prevent loss of ground or movements, which may cause damage to adjacent structures or utilities.

3.3 INSTALLATION – STEEL OR TIMBER SHEETING

A. Length Markings: Before installation is started each steel or timber section shall be marked so that the depth of the tip can be readily determined. This shall be accomplished by a method that is approved by the Engineer.

B. Sheeting shall be installed by means of hydraulically pushing each sheet piling to the required design depth. No impact or vibratory hammers will be allowed for installation of steel or timber sheeting on this project. The Contractor shall take all precautions against excessive vibrations in all areas. The Contractor shall be solely responsible for any damages caused directly or indirectly to structures, sewer and other utilities, and shall repair any such damage occurring due to their operations to the requirements of the Owner.

C. All sheeting shall be protected from damage during installation and shall be removed after backfill is within 5' of finish grade.

D. All sheeting shall be hydraulically pushed to its full depth ahead of the excavation so as to avoid the loss of material from behind the sheeting; where voids occur outside of the sheeting, they shall be filled immediately with structural fill and thoroughly compacted.

E. Requirements for the sheeting include the following:

1. Install sheeting in the plumb position.

2. Install sheeting such that the piling is in direct contact with the material to be retained.

3. Install sheeting to the depths indicated on approved Shop Drawings.

4. Methods and equipment used in pushing, setting, cutting and splicing shall conform to approved Shop Drawings.

5. Use templates or other temporary alignment facilities to maintain piles plumb and on line.

6. Control vibrations and noise associated with installation.

7. Pre-excavate as necessary to remove existing structures along alignment of the sheeting.

8. Sheeting shall be positioned within 3 inches of the design plan location along its length from top down to bottom of excavation grade. Design plan locations are to be established by the Contractor's Professional Engineer and submitted to the Engineer for review.

F. The Contractor shall provide all inspection equipment to determine whether the sheeting has been started in their planned location, are vertical, and are within

the allowable tolerance for position after installation.

3.4 INTERNAL LATERAL WALL BRACING (WALES AND STRUTS)

A. Use wales and struts as necessary to provide support of the excavation lateral support walls as required. Include web stiffeners, plates, brackets, or angles as required to prevent rotation, crippling or buckling of connections and points of bearing between structural steel members. Allow for eccentricities due to fabrication and assembly. Consider effects of temperature changes.

B. Install and maintain all support members in continuous tight contact with each other and with the wall being supported.

C. Coordinate locations of all bracing and components thereof for temporary lateral excavation support with locations of permanent structures.

D. Control rate of excavation and installation of support members to minimize movement of adjacent ground surface.

E. Excavation shall proceed in accordance with the detailed sequence submitted by the Contractor and reviewed by the Engineer. It shall be the responsibility of the Contractor to schedule and sequence the work accordingly.

3.5 MONITORING

A. As required by the Engineer.

END OF SECTION 02160

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02210

EARTH EXCAVATION, BACKFILL, FILL AND GRADING

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. The Work shall consist of excavation of all materials removed within the limits of the Contract in accordance with the Specifications and in close conformity with the lines, grades, thickness and cross sections shown on the plans or established by the Engineer.

2. The Contractor shall comply with all applicable laws, rules, ordinances, and general regulations of the Federal Government, the Commonwealth of Massachusetts, the City of Cambridge, the Cambridge Department of Public Works, DEP, EPA, OSHA, and other regulatory agencies having jurisdiction over the Work.

3. Provide materials for backfilling excavations as indicated and specified.

4. Subbase thickness shall be as shown on the drawings or as specified herein. These depths may also be revised by the Engineer to reflect project needs and scheduling of anticipated work by other contractors. No adjustment to the bid unit price shall be made for quantity changes resulting from these directives.

5. Grade surfaces to meet finished grades indicated. Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

6. Test pits per the Drawings, or described in the Specifications, and as directed or agreed upon by the Engineer.

1.2 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit an Excavation, Backfilling, Grading and Compaction plan at least two weeks prior to start of any earth moving activities. The review will be only for the information of the Owner and third parties for an overall understanding of the project relating to access, maintenance of existing facilities and proper utilization of the site. The

Contractor shall remain responsible for the adequacy and safety of the means, methods and sequencing of construction. The plan shall include, but not be limited to the following items:

a. Detailed sequence of work.

b. General description of construction methods.

c. Numbers, types, and sizes of equipment proposed to perform excavation, backfilling, grading and compaction.

d. Details of dust control measures.

e. Proposed locations of stockpiled excavation and/or backfill materials.

f. Proposed surplus excavated material off-site disposal areas and required permits.

g. Erosion and sedimentation control measures, which will prevent erosion and sedimentation during the earth moving and soil stockpile activities.

2. Backfill Materials: Submit grain size analysis and performed in accordance with ASTM D422 and compaction moisture density curve (ASTM D1557) for each proposed source of backfill, imported material and on-site material to be reused, for review by the Engineer at least one week prior to use of the material. The grain size analysis shall indicate that the backfill material conforms to the gradation requirements specified.

a. In addition, a certification statement and analytical results shall accompany each physical sample of earth materials to be imported onto the site, including but not limited to crushed stone, loam, bedding sand, gravel sub-base, common fill and structural backfill. At a minimum the certification shall state the point of origin and that the material is free of contaminants. The certification shall include representative sample analysis from each point of origin of backfill to be used on the site. The sample(s) shall be analyzed by a certified laboratory for total metals (MCP 14 Metals), volatile organic compounds (EPA Method 8260), semi-volatile organic compounds (EPA Method 8270), petroleum hydrocarbons (EPA Method 8100), and Total PCBs and pesticides (EPA Method 8081 and 8082). On-site soils defined as suitable for reuse in this Section and in Section 02080 – SOIL AND WASTE MANAGEMENT can be used as backfill without providing the certification required above.

b. All sampling of soils for chemical testing shall be performed by a person experienced in sample collection and shall be either: 1) a Licensed Site Professional registered in the Commonwealth of Massachusetts; 2) a Professional Engineer registered in the Commonwealth of Massachusetts; 3) a professional Geologist registered in the Commonwealth of Massachusetts; 4) a certified groundwater/environmental professional; or 5) an authorized representative of the one of the persons listed above. Samples of each material shall be submitted to a chemical analytical laboratory, certified by the Massachusetts Department of Environmental Protection.

c. Submit additional samples and geotechnical and analytical test data and certifications for every 1000 cubic yards (every 500 cubic yards for moisture density curves) of material imported or reused on-site or anytime consistency of material changes in the opinion of the Engineer. Submit associated chemical laboratory data on the imported materials throughout the course of the Work, if requested by the Engineer, to evaluate the consistency of the source or process, at no additional cost to the Owner.

d. Controlled Density Fill Mix Design: Prior to beginning the work the Contractor shall submit for review, controlled density fill mix designs which shall show the proportions and gradations of all materials proposed for each class and type of controlled density fill specified herein.

e. Filter Fabric: Submit shop drawings and product data sheets.

3. During Construction, submit written confirmation of fill lift thickness, in-place soil moisture content, and percentage of compaction to the Engineer before placing the next lift or constructing foundations.

4. Submit Qualifications of the Contractor's Independent Testing Laboratory as specified in Paragraph 1.5.K, three weeks prior to the execution of any earth excavation, backfilling, filling, or compaction process.

5. Blasting shall not be permitted.

6. 5-gallon buckets of the soil types shall be submitted to the Engineer for review.

B. Test Pit Logs

1. Prepare and submit a log of the existing conditions observed. Each test pit log shall be submitted as its own document. The following

information shall be indicated on the log at a minimum:

a. Plan sketch indicating size, material, quantity, function, ownership and direction of flow for each structure and utility. Include a north arrow and approximate STA number.

b. Swing ties indicating the horizontal location of each structure, utility and duct bank. Where horizontal alignment is found to vary, swing ties shall be recorded at appropriate intervals.

c. Top and bottom elevations of each structure and utility, and the dimensions of any encasement. Where vertical elevations are found to vary, elevations shall be recorded at appropriate intervals.

d. Where test pits are conducted to establish a vertical corridor for a proposed pipeline through conflicting utilities, include a profile sketch indicating the vertical separation between utilities.

2. Submit photographs that document wide-angle and close-up views of the existing conditions observed.

1.3 DEFINITIONS

A. Acceptable Material: Material which does not contain organic silt or organic clay; peat; vegetation; wood or roots; stones or rock fragments over 6-inch in diameter; porous biodegradable matter; loose or soft fill; excavated pavement; ice or frozen material; or refuse. Stones or rock fragments shall not exceed 40 percent by weight of the backfill material. Clay or silt content shall not exceed 25 percent by weight of the backfill material.

B. Unacceptable Materials: Materials that do not comply with the requirements for the acceptable material or which cannot be compacted to the specified or indicated density.

C. Percentage of compaction is defined as the ratio of the field dry density, as determined by ASTM D1556 or ASTM D6938 to the maximum dry density determined by ASTM D1557, multiplied by 100.

D. Proof Roll: Compaction to a firm and unyielding condition with a minimum of four passes of a vibratory steel drum roller. Vibratory plate compactors shall be used in small areas where a vibratory steel drum roller cannot be used.

E. Rock Excavation:

1. Rock excavation in trenches and pits includes removal and disposal of materials and obstructions encountered which cannot be excavated with

a 1.0 cubic yard (heaped) capacity, 42-inch wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rated at not less than 90HP flywheel power and 30,000 lb. drawbar pull. Trenches in excess of 10 foot 0-inches in width and pits in excess of 30 feet 0-inches in either length or width are classified as open excavation.

2. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered which 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 No. 977K, or equivalent track-mounted loader, rated at not less than 170HP flywheel power and developing 40,000 lb. break-out force (measured in accordance with SAE J732C).

3. Determination of rock excavation classification will be made by the Engineer. Typical of materials classified as rock are boulders 1.0 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits. Intermittent drilling, blasting or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by Engineer. If the area to be excavated is preblasted prior to the excavation of overburden soils, the Engineer shall be notified at least two days in advance to allow observation of the preblast drilling by the Engineer in order to classify the excavation. Visual observation of the completed excavation may be made by the Engineer to modify the excavation classifications. Removal of rock excavation prior to classification by the Engineer shall be considered as earth excavation unless accepted by the Engineer in writing. Such excavation will be paid on the basis of contract unit rates for this classification.

1.4 REGULATIONS

A. The Contractor shall be solely responsible for making all excavations in a safe manner. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P) and State requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

B. Comply with all applicable laws, rules, ordinances, and general regulations of the Federal Government, the Commonwealth of Massachusetts, the City of Cambridge, the Cambridge Department of Public Works, the Cambridge Water Department, DEP, EPA, OSHA, and other regulatory agencies having jurisdiction over the Work.

1.5 QUALITY ASSURANCE

A. Dewatering and Groundwater Control: Provide and maintain as specified in Section 02140 - DEWATERING.

B. Excavations shall be performed in the dry, and kept free from standing water, snow and ice during construction.

C. Temporary Excavation Support Systems: Provide and maintain as specified in Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS.

D. Do not excavate or fill until the Engineer has reviewed all the required submittals.

E. Formulate excavation, backfilling, and filling schedule and procedures to eliminate possibility of undermining or disturbing foundations of partially and completed structures, pipelines and embankments or existing structures and pipelines.

F. Cut pavement and all surface materials to the top of the existing fill material with a saw to prevent damage to remaining pavement without extra compensation. Surface materials may include concrete slabs, cobblestones, rails and other miscellaneous materials. Where pavement is removed in large pieces, dispose of pieces before proceeding with excavation.

G. Dig test pits considered separate to the normal excavation as required to locate underground utilities, obstructions or water table.

H. If material for foundation or pavement support is found to be unacceptable, as defined in these Specifications, at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, remove such material to the required width and depth as required by the Engineer and replace it with crushed stone.

I. During progress of work, conduct earth-moving operations and maintain work site so as to minimize the creation and dispersion of dust.

J. Bedding and backfill material shall not be placed in water. Water shall not be allowed to rise upon or flow over the bedding and backfill material.

K. Employ an independent testing company to perform field and laboratory testing. The independent testing laboratory shall have the following qualifications:

1. Be accredited by the American Associates of State Highway and Transportation Officials (AASHTO) Accreditation Program;

2. Have three years experience in sampling, testing and analysis of soil and aggregates, and monitoring field compaction operations;

3. Able to provide three references from previous work.

1.6 PROJECT/SITE CONDITIONS

A. Subsurface investigation data are available as referenced in Section 02010 – SUBSURFACE INVESTIGATION.

1.7 MATERIAL TESTING

A. Moisture Density - One per source, except for crushed stone. Repeat the moisture density test for every 500 cubic yard of material used, and whenever visual inspection indicates a change in material gradation as required shall be as determined by the Engineer.

B. Gradation Analysis - A minimum of one per source, for each moisture density test, for every 100 cubic yards of material used, and whenever visual inspection indicates a change in material gradation. For on-site fill soil, the Engineer shall determine frequency of tests required.

C. Construction Tolerances: Construct finished surfaces to plus or minus 0.5 inches of the elevations indicated. Provide the Engineer with adequate survey information to verify compliance with above tolerances.

1.8 FIELD TESTING

A. Field Testing and Inspections: By Contractor’s independent testing company, acceptable to the Engineer, at Contractor's expense as specified. Location of tests shall be mutually acceptable to testing laboratory and the Engineer or as required by the Engineer. In the event compacted material does not meet specified in-place density, recompact material and retest this area until specified results are obtained at no additional cost to the Owner.

B. Methods of Field Testing: In-Place Density: ASTM D1556, ASTM D2167, or ASTM D2922; In-Place Moisture Content: ASTM D3017, ASTM D4944, or ASTM D4959; Material Testing Frequency: The following testing frequencies are minimum required for all fill materials.

C. Field In-Place Density and Moisture Content - Crushed stone shall be compacted as specified and indicated. For other backfill and fill materials, minimum test frequency shall be as follows, and no less than two tests per lift:

1. Trenches under structures, foundation preparation, or roadways subbase: Every 150 linear ft. per lift.

2. Trenches in areas without structures or roadways: Every 200 linear ft. per lift

3. Under Structure: Every 300 sq. ft. per lift.

4. Adjacent to Structure Exteriors: Every 300 sq. ft. per lift.

PART 2 – PRODUCTS

2.1 SAND BORROW

A. Sand borrow shall consist of clean, inert, hard, durable grains of quartz or other hard durable rock free from clay and loam or other deleterious or organic material.

B. The sand borrow shall conform to Massachusetts Department of Transportation (MassDOT) Specification Designation, M1.04.1, and the following gradation:

Sieve Size	Percent Passing by Weight
½-inch (12.7mm)	100
3/8-inch (9.525mm)	85-100
No. 4	60-100
No. 16	35-80
No. 50	10-55
No. 200	2-10

2.2 COMMON FILL AND ON-SITE MATERIAL GEOTECHNICALLY SUITABLE FOR REUSE ON-SITE AS BACKFILL:

A. Common fill and on-site material geotechnically suitable for reuse on-site as backfill shall consist of sand and gravel consisting of hard durable particles, and free from trash, ice and snow, tree stumps, roots and other organic matter.

B. Common fill and on-site material geotechnically suitable for reuse on-site as backfill shall be used from the top of the sand borrow or crushed stone layer up to the bottom of the gravel subbase or landscaping layer.

C. Common fill and on-site material geotechnically suitable for reuse on-site as backfill shall conform to the following gradation requirements:

Sieve Size	Percent Finer by Weight
6-inch (152.4mm)	100
No. 4	30-80
No. 40	30-50
No. 200	0-25

2.3 CRUSHED STONE

A. As per MassDOT Standard Specifications for Highway and Bridges, as amended, M2.01.0, crushed stone shall consist of durable crushed rock or durable crushed gravel stone, angular in shape and free from structural defects, comparatively free of chemical decay, and free of any foreign material including, but not limited to ice and snow, sand, silt, clay, loam, or other deleterious or organic material.

B. Open-graded clean washed ¾" crushed stone for biocell applications shall be double washed and completely free of fines.

C. Crushed stone shall be wrapped in filter fabric where indicated or required by the Engineer.

D. The crushed stone shall be uniformly blended and shall conform to MassDOT Specification Designation, M2.01, and the following gradation requirements:

Sieve Size	Percent Passing by Weight M2.01.4 3/4 inch Crushed Stone	Percent Passing by Weight M2.01.6 3/8 inch Crushed Stone (Porous concrete screeding course)
1-inch (25.4 mm)	100	---
3/4-inch (19.05 mm)	90-100	---
5/8-inch (15.875 mm)	---	---
½-inch (12.7 mm)	10-50	100
3/8-inch (9.5 mm)	0-20	85-100
No. 4	0-5	20-50
No. 8	---	0-15
No. 16	---	0-5

2.4 DENSE GRADED CRUSHED STONE FOR SUBBASE

A. As per MassDOT Standard Specifications for Highway and Bridges, as amended, M2.01.7, dense graded crushed stone shall consist of hard, durable fragments of stone. Dense graded crushed stone shall be angular in shape and free from structural defects, comparatively free of chemical decay, and free of any foreign material including, but not limited to ice and snow, sand, silt, clay, plastic, loam, or other deleterious or organic material.

B. The dense graded crushed stone shall be uniformly blended and shall conform to MassDOT Specification Designation, M2.01.7, and the following gradation requirements:

Sieve Size	Percent Passing by Weight M2.01.7 Dense Graded Crushed Stone
2-inch (50 mm)	100

Sieve Size	Percent Passing by Weight M2.01.7 Dense Graded Crushed Stone
1.5-inch (37.5 mm)	70-100
3/4-inch (19.0 mm)	50-85
No. 4 (4.75 mm)	30-55
No. 50	8-24
No. 200	3-10

2.5 CONTROLLED DENSITY FILL (CDF)

A. Controlled density fill shall consist of a cementitious hard excavatable mixture of aggregate, Portland Cement conforming to ASTM C-150, Type II, and air entraining admixtures. Controlled density fill may have coarse and fine aggregate consisting of well graded crushed stone.

B. Controlled density fill shall be a maximum of 100 psi, consist of no fly ash and shall have clean water free from oils, acid, and organic matter.

C. Controlled density fill shall be of the type specified in MassDOT Standard Specifications for Highway and Bridges, as amended, M4.08 Manual Excavatable.

D. Controlled density fill shall be used as trench backfill material in areas inaccessible to compaction equipment such as below existing utilities and in narrow excavations for structures or as directed by the Engineer.

E. Controlled density fill shall also be used to fill abandoned utilities and around the excavation support systems as directed by the Engineer.

2.6 FILTER FABRIC

A. Filter Fabric shall consist of a nonwoven fabric made from polypropylene or polyethylene filaments or yarns.

B. Filter Fabric shall be inert to organic chemicals commonly encountered in the soil.

C. Edges and ends of filter fabric shall overlap a minimum of two feet.

D. Filter Fabric used as a drainage medium shall conform to MassDOT Specification Designation, M9.50.0 and the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Grab Strength	Lbs	ASTM D-4632	80
Grab Elongation	Percent	ASTM D-4632	15
Sewn Seam Strength	Lbs	ASTM D-4632	70
Puncture Strength	Lbs	ASTM D-4833	25
Trapezoid Tear Strength	Lbs	ASTM D-4533	25
Mullen Burst Strength	Psi	ASTM D-3786	130

E. Filter Fabric used as a separation medium shall conform to MassDOT Specification Designation, M9.50.0 and the following recommended property tests:

Property	Unit	Test Method	Minimum Value
Grab Strength	Lbs	ASTM D-4632	180
Grab Elongation	Percent	ASTM D-4632	15
Sewn Seam Strength	Lbs	ASTM D-4632	160
Puncture Strength	Lbs	ASTM D-4833	70
Trapezoid Tear Strength	Lbs	ASTM D-4533	70
Mullen Burst Strength	Psi	ASTM D-3786	210

2.7 GRAVEL SUBBASE

A. Gravel Subbase shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings and deleterious materials.

B. Gravel Subbase shall be graded in accordance with MassDOT specification section M1.03.0 Type d as indicated below:

Sieve Size	Percent Passing by Weight
1-1/2-inch	100
1/2-inch	50-85
No. 4	40-75
No. 50	8-28
No. 200	0-10

Processed Gravel for Subbase shall be graded in accordance with MassDOT specification section M1.03.1 as indicated below:

Sieve Size	Percent Passing by Weight
3-inch	100
1-1/2-inch	70-100
3/4-inch	50-85
No. 4	30-60
No. 200	0-10

PART 3 – EXECUTION

3.1 GENERAL

A. Do not excavate or fill until the Engineer has reviewed all the required submittals.

3.2 SITE MAINTENANCE

A. Roadway and Site Leveling: Grade roadway and site as to maintain them in a level unrutted condition and to eliminate puddling of surface and subsurface water.

3.3 SUBGRADE PREPARATION AND PROTECTION

A. As directed by the Engineer, over-excavate any unacceptable materials below the subgrade, and replace with compacted Gravel Borrow.

B. Utilize excavating equipment equipped with a toothless or smooth edged, excavating bucket to expose the pipe trench subgrade to minimize disturbance of the bearing surface.

C. Proof roll the exposed subgrade below pipes and structures prior to backfilling and filling operation, or placing crushed stone or sand borrow.

D. Proof roll to a firm and unyielding condition with a minimum of 4 passes of a vibratory plate compactor or double drum roller the exposed subgrade prior to backfilling and filling operation or placing soil-supported pipeline.

E. In areas where the bottom of the excavation is in silt and clay, and is below the groundwater table, a working mat and drainage layer of 12 inches of compacted crushed stone wrapped in filter fabric shall be placed.

3.4 TRENCH EXCAVATION

A. For pipe installation in a cradle or within bedding, excavate trench by machinery to, or just below designated subgrade. If material remaining at bottom of trench is disturbed, recompaction shall be required.

B. When pipe is to be laid directly on bottom of trench, do not excavate lower part of trenches by machinery to subgrade. Remove remainder of material to be excavated by use of hand tools just before placing of pipe. Form a flat or shaped bottom, true to grade, so pipe will have a uniform and continuous bearing. Support on firm and undisturbed material between joints, except for limited areas where use of pipe slings have disturbed bottom.

C. Excavate trenches to depths so as to permit pipe to be laid at elevations, slopes, or depths of cover indicated on drawings, and at uniform slopes between indicated elevations.

D. Make trenches as narrow as practicable and do not widen by scraping or loosening materials from the sides. Make every effort to maintain sides of trenches firm and undisturbed until backfilling has been placed and compacted.

E. Excavate trenches with approximately vertical sides between springline of pipe and elevation 1 ft. above top of pipe.

3.5 EXCAVATION NEAR EXISTING STRUCTURES

A. Discontinue digging by machinery when excavation approaches pipes, conduits, or other underground structures. Continue excavation by use of hand tools. Include such manual excavation in work to be done when incidental to normal excavation and under items involving normal excavation.

B. Excavate test pits when determination of exact location of pipe utilities or other underground structures is necessary for doing work properly.

1. Conduct test pits in accordance with Specification.

2. Record all information required under Part 1.2.B - Test Pit Logs of this Specification Section.

3. Perform an instrument survey of all horizontal and vertical alignments.

4. Photograph the existing conditions observed. Mark any utilities, structures or encasement that is difficult to discern with orange paint prior to photographing.

C. Execution of any earth excavation shall not commence until the related dewatering, soil and fill management, excavation support systems, and required backfill and fill materials submittals are reviewed by the Engineer and all Engineers' comments addressed.

D. Carry out program of excavation, dewatering, and excavation support systems to eliminate possibility of undermining or disturbing foundations of existing structures or utilities of the work previously completed under this contract.

E. Excavate to widths that give suitable room for constructing structures or laying and jointing piping.

F. Do not plow, scrape or dig by machinery near to finished subgrade in a manner that would result in disturbance of subgrade.

G. Excavate to lines and grades indicated in an orderly and continuous program.

H. Establish limits of excavation to allow adequate working space for installing forms and for safety of personnel.

I. Excavate to elevations indicated, or deeper, as required by the Engineer, to remove unacceptable subgrade material.

J. Exercise care to preserve material below and beyond the lines of excavations.

K. Boulders, rock fragments, and concrete less than one cubic yard encountered during excavation shall not be included for payment as rock.

3.6 REMOVAL OF SUBSURFACE OBSTRUCTIONS

A. Remove indicated or approved subsurface structures and related obstructions to complete the work.

B. Promptly notify the Engineer when any unexpected subsurface facilities are encountered during excavation such as utility lines and appurtenances, walls and foundations.

3.7 UNAUTHORIZED EXCAVATION

A. When the bottom of any excavation is excavated beyond limits indicated or specified, backfill with crushed stone wrapped with non-woven geotextile fabric. No additional payment will be made for the excavation of backfill or unauthorized excavation.

3.8 SEPARATION OF EXCAVATED MATERIAL FOR REUSE

A. Carefully remove acceptable material from excavated areas and store separately for further use as backfill material or for disposal or immediately reuse at the area of excavation as backfill.

B. Reuse surplus acceptable excavated materials for backfill as indicated and in accordance with Section 02080 – SOIL AND FILL MANAGEMENT; deposit neatly and grade.

3.9 COMPACTION EQUIPMENT

A. The compaction equipment shall be selected by the Contractor, and shall be capable of consistently achieving the specified compaction requirements. The selected compaction equipment shall meet the following minimum requirements:

1. Manually operated vibratory plate compactors weighing no less than 200 pounds with vibration frequency no less than 1600 cycles per minute.

2. Vibratory steel drum roller weighing at least 12,000 pounds.

3. Water jetting and puddling will not be allowed.

3.10 COMPACTION REQUIREMENTS

A. The degree of compaction is expressed as a percentage of the maximum dry density at optimum moisture content as determined by ASTM Test D1557, Procedure C. The compaction requirements are as follows:

Area	**ASTM Density Degree of Compaction**
Natural subgrade	Proof roll
Crushed stone	As specified herein
Sand Borrow	95%
Gravel or Dense Graded Crushed Stone subbase	95%
General backfill with CDF adjacent to structures	As specified herein
Trench backfill (on-site fill) - below pavements - below landscaped areas	 95% 90%
Other areas	90%

B. Moisture Control: Fill that is too wet for proper compaction shall be desiccated, harrowed, or otherwise dried to a proper moisture content to allow compaction to the required density. If fill cannot be dried within 24 hours of placement, it shall be removed and replaced with drier fill at no additional cost to the Owner.

C. Fill that is too dry for proper compaction shall receive water uniformly applied over the surface of the loose layer. Sufficient water shall be added to allow compaction to the required density.

D. Unfavorable Conditions: In no case shall fill be placed in standing water, over

organic silt or peat or material that is frozen. No fill material shall be placed, spread or rolled during unfavorable weather conditions. When work is interrupted by heavy rains, fill operations shall not be resumed until the moisture content and the density of the previously placed fill are as specified.

E. In freezing weather, a layer of fill shall not be left in an uncompacted state at the close of the day's operations. Prior to terminating work for the day, the final layer of compacted fill shall be rolled with a smooth wheeled roller to eliminate ridges of soil left by compaction equipment.

F. Compaction Control: In-place density tests shall be made at the Contractor's expense in accordance with ASTM D1556, D2922 or D2167 as the work progresses, to determine the degree of compaction being attained by the Contractor. Any corrective work required as a result of such tests, such as additional compaction, or a decrease in the thickness of layers, shall be performed by the Contractor at no additional expense to the Owner.

G. The Engineer's duties do not include supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Engineer nor any observation and testing performed by him shall excuse the Contractor from defects discovered in his work at that time or subsequent to the testing.

H. Placement: All fill shall be placed in horizontal layers. Fill shall not be placed following the natural contours of the ground. Fill shall be placed starting in the lowest areas working up to finish grades in horizontal layers in the manner specified herein. Each layer of fill should be benched into the existing slope in order to avoid the formation of a shear plane.

I. Surfaces: After backfilling trenches and excavations, the Contractor shall maintain the surfaces of backfill area in good condition so as to present a smooth surface at all times level with adjacent surfaces. The Contractor shall repair any subsequent settling over backfilled area immediately, in a manner satisfactory to the Engineer, and such maintenance shall be provided by the Contractor for the life of this Contract, at no additional expense to the Owner.

J. The finished subgrade of the fills and filled excavations upon which topsoil is to be placed, or pavements are to be constructed, shall not be disturbed by traffic of other operations and shall be maintained in a satisfactory condition until the finished courses are placed. The storage or stockpiling of materials on finished subgrade will not be permitted.

3.11 BACKFILL MATERIAL SELECTION

A. Backfill Material Selection: Unless otherwise specified or required, material used for filling and backfilling shall meet the requirements specified under Backfill materials. In general, the material used for backfilling trench

excavations within the zone above structures and 6 inches above pipe crowns shall be material removed from the excavation provided that the reuse of these materials result in the required trench compaction and meets the gradation requirements specified for on-site fill. In areas where the bottom of the excavation is in silt and clay, and is below the groundwater table, a working mat and drainage layer of 12 inches of compacted crushed stone wrapped in filter fabric shall be placed.

B. Place backfill to a maximum loose lift thickness of 9 inches except where used as pipe bedding. Maintain backfill material with a uniform moisture content, with no visible wet or dry streaking, between plus 2 percent and minus 3 percent of optimum moisture content. The final filled soil mass shall be as uniform as possible in lift thickness, moisture content, and effort required to compact soil mass.

3.12 STRUCTURE AND TRENCH BACKFILL

A. The trenches shall be backfilled as soon as practicable with the material specified herein. All trench backfilling shall be done with special care, in the following manner and as required by the Engineer.

B. Backfill material for pipe bedding shall be placed in the trench, uniformly on both sides of the pipe, for the entire width of the trench as indicated on the drawings. Sand borrow bedding shall be placed by hand shovels, in layers not more than 4-inches thick in loose depth, and each layer shall be thoroughly and evenly compacted by tamping on each side of the pipe to provide uniform support around the pipe, free from voids. Crushed stone bedding material shall be placed in layers not more than 6-inches thick in loose measure, and compacted with at least 4 passes using a vibratory plate or roller compactor.

C. The balance of trench backfill around structures or where compaction equipment cannot be utilized due to space limitations or other reasons shall be CDF material from the crushed stone layer at the bottom of the structure to the common fill layer at the top of the structure. CDF SHALL NOT BE USED AROUND ANY GAS MAINS OR GAS SERVICES, AND SHALL NOT BE USED AROUND WATER PIPING, VALVES, OR APPURTENANCES WITHOUT WRITTEN AUTHORIZATION FROM THE CAMBRIDGE WATER DEPARTMENT. The common fill material shall be spread in layers not exceeding 9-inches in loose depth and each layer thoroughly compacted by mechanical methods and shall contain no rock, stones or boulders larger than 6-inches in their greatest dimension. The balance of the trench with no structures shall be common fill material placed in 9-inch think lifts and compacted up to the bottom of the gravel subbase layer.

D. All trench backfill under, and service lateral trench backfill within 3 feet of the large diameter (>18-inches) water transmission mains shall be reviewed with the Engineer and Cambridge Water Department prior to backfill. Backfill shall be placed in appropriately sized lifts and on both sides of the transmission main

simultaneously to ensure that all loads applied to the main by the backfill are properly balanced and that they do not exceed the safe load carrying capacity of the main at any time.

E. All trench backfilling shall be done with special care and must be carefully placed so as not to disturb the work at any time if necessary, timber grillage or other suitable method shall be used to break the fall of material. The moisture content of the backfill material shall be such that proper compaction will be obtained. Backfill shall be made to grades required to establish the proper subgrade for the placement of topsoil or pavement base courses.

F. In backfilling trenches, each layer of backfill material shall be moistened and compacted to a density as specified herein, and in such a manner as to permit the rolling and compaction of the filled trench or excavation with the adjoining earth to provide the required bearing value.

G. Any trenches or excavations improperly backfilled or where settlement occurs shall be reopened, to the depth required for proper compaction, then refilled and compacted with the surface restored to the required grade and condition, at no additional expense to the Owner.

H. During filling and backfilling operations, pipelines will be checked by the Engineer to determine whether any displacement of the pipe has occurred. If the observation of the pipelines shows poor alignment, displaced pipe or any other defects they shall be remedied to meet Engineer and Owner requirements at no additional cost to the Owner.

3.13 BACKFILLING AGAINST STRUCTURES

A. Backfilling against masonry or concrete shall not be done until permitted by the Engineer. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been satisfactorily completed, the Contractor, as required by the Engineer, shall make special leakage tests of the structures. After the satisfactory completion of leakage tests and the satisfactory completion of any other required work in connection with the structures, the backfilling around the structures shall proceed using CDF Material provided the CDF material is not used around gas main or gas services, and not used around water piping, valves, and appurtenances without written approval by Cambridge Water Department.

B. Symmetrical backfill loading shall be maintained. Special care shall be taken to prevent any wedging action or eccentric loading upon or against the structures.

C. In compacting and other operations, the Contractor shall conduct his operations

in a manner to prevent damage to structures due to passage of heavy equipment over, or adjacent to, structures, and any damage thereto shall be remedied by the Contractor at no additional expense to the Owner.

3.14 CDF QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Slump: ASTM C143; one test at point of discharge for each day's placement; additional tests when CDF consistency seems to have changed.

B. Compression Test Specimen: ASTM C31; one set of four (4) standard cylinders for each compression strength test, plus additional sets for each 100 cu yds more than the first 50 cu yds placed in any one day unless otherwise required.

C. Compressive Strength Tests: ASTM C39; one set for each day's pour plus additional sets for each 100 cu. yds more than the first 50 cu. yds placed in any one day; two specimens tested at 28 days, and two specimens tested at 90 days.

D. Test results will be reported in writing to Engineer, Ready-Mix Producer, and Contractor within 24 hours after tests. Reports of compressive strength tests shall contain the project identification name and number, date of placement, name of testing service, fill type and class, location of fill batch along route, design compressive strength limits at 28 days and 90 days, fill mix proportions and materials, compressive breaking strength, and type of break for both 28 day tests and 90 day tests.

3.15 CARE AND RESTORATION OF PROPERTY

A. Do not use or operate tractors, bulldozers, or other power-operated equipment on paved surfaces when their treads or wheels of which are so shaped as to cut or otherwise damage such surfaces. Restore surfaces damaged by the Contractor's operations to a condition at least equal to that in which they were found immediately before work commenced. Use suitable materials and methods for such restoration.

3.16 POLLUTION CONTROL

A. During progress of work, conduct earth-moving operations and maintain work site so as to minimize the creation and dispersion of dust.

B. Separation of Excavated Material for Reuse: Remove only existing pavement and all other surface materials, which may include concrete slabs, cobblestones, rail ties, by saw cutting that is necessary for prosecution of work.

END OF SECTION 02210

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02252

MANHOLES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of precast concrete sanitary sewer manholes and storm drain manholes, complete and in place, within the limits and to the lines and grades indicated.

2. Furnishing and installing precast leaching risers, complete and in place, for inclusion in sump manhole assemblies where indicated. Contractor is responsible to coordinate with precast manufacturer to custom design and fabricate leaching risers to meet the Engineer's design intent.

1.2 RELATED TECHNICAL SECTION

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02590 – BRICK MASONRY

D. Section 02604 – CATCH BASINS

E. Section 03300 – CONCRETE

F. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Prior to preparation of Submittals, perform test pits for sump manholes and storm drain manholes that connect to catch basin laterals, and propose any changes in the elevation and/or type of pipe and structures, in accordance with Section 02604 – CATCH BASINS.

B. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Complete shop drawings for all precast manhole sections, cast iron frames and covers and appurtenances.

2. Prior to fabrication, submit clock drawings showing details of precast monolithic base sections; risers; eccentric cone and flat slab manhole tops; pipe openings; joints and gaskets; and construction details,

tolerances, and other information as required by the Owner.

3. Submit certified statement of structural limitations for any openings hole cored in the field, such as setback distances from pre-cast openings and jointing with other sections.

3. Submit manufacturer's recommended installation procedures for informational purposes.

4. Submit concrete strength testing as specified herein.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

C. Engineer reserves the right to direct the Contractor to use blank base and riser sections in lieu of sections with pre-cast holes, should unknown site conflicts require field cutting of concrete for the connection of laterals.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

B. Removed manhole fixtures must not be reused and shall be salvaged and delivered to the City of Cambridge Public Works storage yard unless directed by the Owner to dispose off site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Precast Bases, Risers, and Tops:

1. Except as otherwise indicated, precast reinforced concrete manhole bases and risers shall be 48 inches diameter with top sections of types indicated or as directed.

2. Manhole sections shall conform to the requirements of ASTM C478, latest revision, except as modified herein and/or on the drawings.

3. Each manhole section shall be constructed with a bell-and-spigot or tongue-in-groove joint.

4. The manhole sections shall be manufactured by the centrifugal, roller suspension or vertical cast process; workmanship and methods shall be in accordance with the best practices of modern shops for this type of work.

5. The height and diameter of manhole bases shall be as required to accommodate size of pipe used, as approved. The manhole risers shall be available in 2, 3, and 4-foot lengths.

6. Manhole tops of the eccentric cone type shall be 3 or 4 foot lengths, with opening at top matching size of casting nominal diameter, unless otherwise noted as shown in the details.

7. Manholes larger than 4 feet in diameter at the base shall be reduced in diameter to 4 feet at the top riser section unless noted otherwise on the plans.

8. Manhole tops of the flat slab type, where space restrictions exist or where directed, shall not be less than 8 inches thick and reinforced as indicated, and shall have an opening having a minimum inside diameter of 24 inches.

9. Manhole bases and risers shall have the wall thicknesses as stated in the Drawings; cone type units shall taper to a minimum wall thickness of 8-inches at top.

10. Leaching risers shall be fabricated per the dimensions indicated on the Drawing Details. Should the Contractor propose perforations larger than indicated, the Contractor shall provide an alternate infiltration stone as directed by the Engineer at no additional cost to the Owner.

11. The assembled height of pre-cast base, riser and top sections shall allow for the standard cast iron frame height, plus grade adjustment indicated on the drawing details, to meet the finish grade indicated on the roadway plans, unless otherwise directed by the ENGINEER.

12. Steel reinforcement within the walls of pre-cast base and risers shall be designed to accommodate a 16-inch opening hole cored in the field at any position within the wall with exception of structural setbacks from pre-cast openings and joints to other sections.

13. All exterior concrete surfaces shall be coated with bituminous dampproofing as per Section 07160 – BITUMINOUS DAMPPROOFING.

B. Concrete:

1. Cement shall be moderate heat-of-hydration Portland cement conforming to ASTM C150, latest revision, Type II. Absorption,

determined by absorption test described in ASTM C478, latest revision, shall not exceed 8 percent of dry weight.

2. The concrete for precast manhole sections shall have an average strength of not less than 4,000 psi at 28 days. Strength shall be determined by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the manhole sections, cores cut from the manhole sections, or by other approved methods. Not less than two concrete strength tests shall be made for each 100 linear feet of manhole sections and the test results submitted to the Owner. Testing may be conducted at the manufacturer's plant or at an approved testing laboratory and shall be the responsibility of the Contractor, at no additional expense to the Owner.

C. Frames and Covers:

1. All frames shall have a minimum clear opening of 24 inches. Standard frame height shall be 8 inch. Compact 4-inch high frames shall be used only where indicated on the drawings or directed by the ENGINEER.

2. Iron castings shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow-holes and other defects affecting the strength and value for the service intended. The finished coating shall be tough and tenacious when cold and not brittle or with any tendency to scale off under seasonable temperature changes.

3. Frames and Covers shall be Cast Iron, conforming to ASTM A48, Class 35B and as follows:

   a. Castings to be free from scale, lumps, blisters and sandholes.

   b. Machine contact surfaces to prevent rocking.

   c. Thoroughly clean and conduct hammer inspection.

4. Two pickholes cast 180° apart shall be closed loops to facilitate removing cover allowing manhole pick to “hook” the loops.

5. Frames and covers shall be City standard by East Jordan Iron Works Models 2111AGS (cover), 2114Z (8-inch frame) and 2264Z (4-inch frame) unless otherwise indicated. Covers shall have custom casting with “THE WORKS, CAMBRIDGE DEPARTMENT OF PUBLIC” logo.

   a. Where offline sump manholes are indicated to have ADA-compliant grates, round grates by EJ Group (2110 Series 0MA211000045) shall be used instead of covers.

6. Frames and covers shall be capable of withstanding AASHTO H-20 loading unless otherwise indicated or specified.

7. The Contractor shall furnish all manhole frames and covers conforming to the details shown on the drawings, or as herein specified. Frames and covers shall be of cast iron with diamond cover surface design. Manhole covers shall be machined to fit securely and evenly on the frame.

8. Covers for all structures shall have the word “SEWER”, “DRAIN” or other appropriate designation cast upon them.

D. Jointing:

1. Precast machine-made solid segments shall conform to ASTM C139.

2. Ends of each length of manhole riser, the bottom end of manhole tops of the cone type, base slabs, and the tops of monolithic bases shall be provided with bell-and-spigot or tongue-and-groove ends of concrete formed on machined rings to insure accurate joint surfaces.

3. Jointing shall be O-ring gaskets or butyl rubber molded sealants. All joints shall be provided so as to be watertight under all conditions of service. The ends of base, riser, and cone sections to be jointed using neoprene "O-ring" type joints shall be designed to enclose the gasket on four surfaces when the joint is in its final position.

E. Gaskets:

1. Gaskets for sealing joints using the "O-ring" type gaskets shall conform to ASTM C443, latest revision, and shall be of rubber of a special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five years experience in the manufacture of neoprene gaskets for pipe joints, or shall be vulcanized butyl rubber sealants meeting or exceeding Federal Specifications SS-S-210.

2. Each gasket shall be a continuous ring of round solid cross-section having smooth surfaces free from blisters, porosity and other imperfections. The joint sealing gasket shall be of a composition and texture which shall be resistant to sewage, industrial wastes including gasoline, oils and groundwater, and which will endure permanently under the conditions likely to be imposed by this use. The tensile strength shall be at least 1,200 psi. The elongation shall be such that 2-inch gauge marks shall stretch to not less than 9 inches. The compression set (constant deflection) shall not exceed 25 percent of the original gauge length. The tensile strength after accelerated aging shall be not less than 80 percent of the original strength.

3. The butyl rubber sealant shall have a self adhesive nature and shall have a diameter of 1 inch and shall be furnished in coils. The sealant shall meet the following properties:

DESCRIPTION	SEALANT PROPERTY
Base	Vulcanized Butyl Rubber
Percent of Solids	100%
Shore "A" Durameter:	
- Initial	10
- Aged	20
Adhesion to Clean Surfaces	Excellent
Temperature Range:	
- Application	-20° F to 120° F
- Service	-65° F to 200° F
Water Absorption after 14 days immersion:	Less than 5%
Chemical Resistance after 7 days immersion in 5% Potassium Hydroxide and 5% Hydrochloride Acid	Excellent
Resistance to Water and Organic Solvents	Excellent
Resistance to Shock, Heat, and Cold	Excellent
Color	Black
Shelf Life	Excellent
Elongation	
- Initial	30%
- 2 weeks at 190° F, drying	250%
- 2 weeks in water	300%
Weather Resistance	Excellent
Moisture Diffusion Resistance	Excellent
Specific Gravity	1:18
Flash Point	None
Fire Point	Over 620° F

F. Grout for Sealing Joints:

1. Grout for sealing mortar-type joints or grouting field made pipe openings, shall be a non-shrink grout which shall be a factory-mixed ready-to-use product containing especially prepared aggregate, cement and sand and other components which will produce a mortar or grout with properties to counteract shrinkage, increase density, withstand impact, improve workability, produce watertight joints, and which will be suitable for jointing around pipes entering manholes.

G. Mortar for Brickwork:

1. Per Section 02590 – BRICK MASONRY

H. Brick

1. Per Section 02590 – BRICK MASONRY

I. Bituminous Dampproofing

1. Per Section 07160 – BITUMINOUS DAMPPROOFING

J. Flexible Seals

1. Flexible manhole seals shall be:

a. New Lok Joint Flexible Sleeve by Interpace,

b. A-Lok Manhole Sleeve by L & L Concrete Products,

c. Press Wedge II by Pre-Seal Basket Corporation,

d. or approved equal.

2. Field applied seals shall be similar to a style typified by Kor-N-Seal boot or an approved equal.

3. Manhole sleeves, gaskets and sealants shall be furnished complete with lubricants, stainless steel stops, inserts, clamps, etc.

PART 3 – EXECUTION

3.1 PROCUREMENT:

A. In addition to riser sections identified in the pre-cast manufacturer's clock drawings, procure an additional one each of every nominal height of 4-ft diameter base and riser section for use as blanks when field conditions warrant hole coring of openings for pipe connections. Replenish sections when used to maintain suitable inventory of blanks throughout construction.

3.2 HANDLING:

A. Manhole sections shall not be shipped for at least five days after manufacture.

B. All manhole sections which have been damaged after delivery, and manhole sections installed in the work which are found to be damaged will be rejected and shall be removed and replaced by the Contractor with new, sound and approved material, at no additional expense to the Owner. At the time of inspection, the surfaces of the sections shall be dense and close-textured. Cores shall serve as a basis for rejection of manhole sections if poor bond or reinforcement is exposed.

C. Each manhole section shall be handled into its position in the trench only in such manner and by such means as recommended by the manufacturer of the

manhole sections, and as approved. Provide all necessary slings, straps and other devices for the safe and satisfactory handling and support of the manhole sections during lifting, installation and final positioning of the sections. Lifting holes may be permitted provided suitable rubber or concrete stopper or other approved devices are provided for plugging and sealing the holes and watertight, all as approved.

3.3 INSPECTION

A. All manhole sections will be inspected upon delivery; manhole sections which do not conform to specification requirements will be rejected and shall be removed immediately from the site by the Contractor at no additional cost to the Owner. The Contractor shall furnish all labor and facilities necessary to assist the Owner in inspecting the material.

B. The quality of all materials, processes of manufacture, and the finished manhole sections shall be subject to inspection and approval of the Owner. Such inspection may be made at the place of manufacture and/or on the site, and the manhole sections shall be subject to rejection at any time because of failure to meet any of the specification requirements, even though sample manhole sections may have been accepted as satisfactory.

3.4 INSTALLATION

A. Manhole sections shall be installed level and plumb and set on 12 inches compacted crushed stone or gravel base as indicated on the Drawings.

B. Manhole sections shall be installed using approved type neoprene "O-Ring" type gasket or butyl rubber sealants for sealing joints of manhole sections; jointing shall be performed in accordance with the pipe manufacturer's recommendations, and as approved.

C. Water shall not be permitted to rise over newly made joints until after inspection as to their acceptability. All jointing shall be done in a manner to insure watertight joints.

D. All holes in sections used for handling shall be thoroughly plugged with non-shrink grout.

E. The manhole frames shall be set with tops conforming accurately to the grade of the pavement or finished ground surface or as indicated on the drawings utilizing brick and mortar or reinforced precast concrete rings. Frames shall be set in a full bed of mortar so that the space between the top of the brick and mortar and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to a height of 4-inches above the flange. Exterior surfaces of brick masonry shall be plastered with 1/2 inch of cement mortar.

F. Opening in precast manhole sections to extent indicated on the drawings to receive entering pipes shall preferably be made at the place of the manufacturer. Care shall be taken to assure that the openings are made to permit setting of the entering pipe at its proper elevation. Where opening cannot be pre-determined, they shall be hole cored in the field.

1. Pipe openings shall be sized to accommodate the specific make/model of flexible seal furnished by the Contractor or annular space to be mortared.

2. When openings are hole cored in the field, the openings for entering pipes shall be of a size to provide a uniform annular space between the outside of pipe wall and the opening in the manhole section.

a. Hole cored openings shall be circular, not square and shall be made by the appropriate coring operation. Damaged sections will be rejected and shall be replaced at no additional expense to the Owner.

b. After hole coring, clean the cut face of concrete with compressed air and remove rust formation from cut steel with cloth rag and suitable cleaner.

3. The annular space for pipes requiring mortar connections (RCP pipe) shall be 3/4 inch, and after the pipe is in position the annular space shall be solidly filled with non-shrink mortar.

a. For cored openings, prior to non-shrink mortar apply a corrosion inhibiting bonding primer to the cut face of concrete and steel reinforcement (Sika Armatec 110 EpoCem, or equal). Contractor shall control for the rated ambient conditions at the time of application.

4. The annular space for pipes requiring flexible connections (DI, PVC and FRP pipe) shall be made in accordance with the Drawing details.

a. For cored openings, prior to inserting flexible connections apply a suitable primer and waterproofing membrane for harsh service to the cut face of concrete and steel reinforcement (Conseal CS-80 & CS-1800, or equal). Contractor shall control for the rated ambient conditions at the time of application.

G. Manhole inverts shall be brick masonry for sewer or concrete for drain and shall have a cross-section shaped to conform to connecting pipes; changes in size shall be made gradually and evenly. Concrete and brick masonry for manhole inverts shall conform to Section 03300 – CONCRETE and Section 02590 – BRICK MASONRY, constructed as indicated and as specified.

3.5 BACKFILLING

A. Conduct backfill operations of open cut trenches closely following laying, jointing, and bedding of pipe, and after initial inspection and testing are completed, all in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING.

3.6 INSPECTION AND TESTING

A. Acceptance of precast reinforced concrete manhole sections will be made on the basis of plant tests, material tests, and inspection of the completed product, in accordance with the requirements of ASTM C478, latest revision, with the following modifications.

B. Manhole sections shall not be shipped for at least five days after manufacture when cured by subjecting them to thoroughly saturated steam at a temperature between 100 and 150° F for a period of not less than 8 hours, or when necessary, for such additional time as may be required to enable the manhole sections to meet specification requirements.

C. Leakage Tests

1. Refer to Article 51 – "Leakage Tests" in Section 00825A – SPECIAL CONDITIONS.

2. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

3.7 CLEANING

A. All excess material including dirt, loose concrete, bricks, grit, stones and any other material, shall be removed from all manholes prior to final review by the Engineer. A final cleaning shall be performed, to include complete removal of all accumulated debris and fluids from each catch basin, upon complete project completion.

END OF SECTION 02252-

SECTION 02500

PAVING AND SURFACING

PART 1 – GENERAL

1.1 DESCRIPTION

A. Furnish and install paving on all roadway areas as indicated and specified.

B. Pavement and surfacing shall be constructed in courses as shown on the plans and as required in accordance with these specifications and in close conformity with the lines, grades, compacted thickness, and cross sections shown on the plans, or as directed by the Engineer. Course thickness shall not exceed 3".

C. The Contractor shall take all reasonable measures to assure proper drainage on the final surface of the roadway. Pavement that does not drain properly due to poor workmanship shall not be accepted by the Owner and shall be replaced by the Contractor at no additional cost to the Owner.

D. Where required by the Engineer, the roadway surface shall be repaired by the infrared method. The repairs shall include the cleaning of the area, infrared heating, the addition of recycling agent and additional hot mix asphalt as required, raking to grade, compacting, and the addition of rejuvenating sealer with sand cover. The work shall be done in accordance with these Specifications and/or as required by the Engineer.

E. Installation of intermediate course for final roadway paving shall not proceed prior to testing and acceptance of new water main, CCTV and testing of new subsurface infrastructure, or other confirmation required by the Engineer and City.

1.2 RELATED WORK

A. Section 00900 – COST AJUSTMENTS

B. Section 01200 – GENERAL REQUIREMENTS FOR UTILITY WORK

C. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

D. Section 02524 – CURBS, WALKS AND DRIVEWAYS

E. Section 02577 – PAVEMENT MARKINGS

F. Section 03300 – CONCRETE

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Reference is made herein to the MassDOT Highway Division, Standard Specifications for Highways and Bridges, latest edition, and all addendums/supplemental specs hereinafter referred to as the "Standard Specifications." All references to method of measurement, basis of payment, and payment items in the Standard Specifications are hereby deleted. References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with the General Conditions of Contract and Section 01300 – SUBMITTALS:

1. Product Data: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with, or exceeds, specified requirements.

2. Design Data: Submit design mix for asphalt base, binder and surface course.

1.5 GRADE CONTROL

A. Establish and maintain required lines and elevations. Where elevations are not shown, the contractor shall follow existing roadway profile and cross slopes in a manner that does not produce puddling upon completion of pavement restoration.

B. On shared streets (Worcester Street, Suffolk Street, Pine Street and Ashburton Place), construction tolerance at final roadway surface shall be 0.25” vertical per 10’ horizontal, shall not produce puddling and results in ADA compliant slopes as designed upon completion of pavement restoration.

1.6 QUALITY CONTROL

A. Provide in accordance with Section 01400 and as specified.

B. The Engineer may require the Contractor to remove at their own expense, any defective mix not conforming to the specified job mix formula within the stipulated tolerances. Samples of the actual mixture in use will be taken as many times daily as necessary and the mixtures shall be maintained uniform for the project. The Engineer may suspend further approval for use of the Plant mixtures if the mixtures do not conform to the specified requirements.

C. Do not place materials when underlying surface is muddy, frozen, or has frost, snow, or water thereon.

1.7 SEQUENCING AND SCHEDULING

A. All roadway excavated areas shall be paved daily or as otherwise directed with temporary trench pavement as specified. Paving on a daily basis will be required unless permission not to do so is received from the applicable permit agency and Owner. Contractor shall pave any uneven surfaces at the end of each week. Temporary pavement shall be maintained a minimum of 90 days in local streets. The temporary pavement shall be repaired as necessary to maintain the surface of the pavement until replaced by permanent pavement.

B. The Contractor shall provide temporary markings on the temporary pavements where existing markings are removed, at no additional cost to the Owner.

C. Use of steel plates require the Contractor to notify the Owner's Public Works Department prior to use. If approved, steel plates shall be recessed into the roadway and welded as required.

1.8 GUARANTEE

A. During the one-year guarantee period, the Contractor shall maintain the surfacing and shall promptly fill with similar material in compliance with the Specifications, any depressions, holes or other deterioration that may occur so as to keep the surfacing in a safe and satisfactory condition for traffic.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Subbase

1. Materials including preparation of subgrades shall meet the requirements of the applicable sections of the Specifications, including Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2. The trench subbase shall be used in the upper 1-foot of trench backfill material immediately below pavements and graded in accordance with MassDOT Highway Division "Standard Specifications" and applicable subsections of Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Hot Mix Asphalt Pavement – Base Course

1. Asphalt Base Course and Asphalt Tack Coat shall conform to the applicable subsections of Section 450, Hot Mix Asphalt Pavement, of the MassDOT "Standard Specifications".

C. Hot Mix Asphalt Pavement – Intermediate Course

1. Asphalt Intermediate Course shall conform to the applicable subsections of Section 450, Hot Mix Asphalt Pavement, of the MassDOT "Standard Specifications".

D. Hot Mix Asphalt Pavement – Surface Course

1. Asphalt Surface Course shall conform to the applicable subsections of Section 450, Hot Mix Asphalt Pavement, of the MassDOT "Standard Specifications."

E. Tack Coat

1. Tack coat shall conform to Section M3.03.0 Asphalt Emulsions of the MassDOT "Standard Specifications".

F. Hot Poured Rubberized Asphalt Sealer

1. Hot Poured Rubberized Asphalt Sealer shall conform to the applicable subsections of Section 480 Pavement Crack Sealing of the MassDOT "Standard Specifications".

G. Cement Concrete Roadway

1. Cement Concrete Roadway shall conform to the applicable subsections of Section 476 Cement Concrete Pavement of the MassDOT "Standard Specifications".

2. Reinforcement shall be 6"x6" welded wire mesh meeting the applicable requirements of Section 03300 – CONCRETE.

PART 3 – EXECUTION

3.1 GENERAL

A. Pavement depths shall be as shown on the drawings or as specified herein. These depths may be revised by the Engineer to reflect project needs and scheduling of anticipated work by other contractors. No adjustment to the bid unit price shall be made for quantity changes resulting from these directives.

3.2 TRANSPORTATION AND DELIVERY OF MIXTURES

A. The mixtures shall be transported from the plant to the work in vehicles previously cleaned of all foreign materials. During transportation of the mixture from the plant to the spreader on the work, each load shall be covered at all times, without exception, with canvas or other suitable material of sufficient size and thickness to furnish complete protection. The mixture shall not be transported such a distance that segregation of the ingredients takes place or that any crust is formed on the surface, bottom or sides of said mixture which will not crumble or flatten out when the mixture is dumped or shall otherwise be deleterious to the mixture in place on the roadway.

B. The vehicles for transporting shall be cleaned between uses of transportation of asphalt and soil.

C. The vehicles for transporting the mixture shall be tight and inside of the bodies shall be evenly and lightly coated with suitable thin oil or approved soap solution, but no excess of lubricant shall be allowed to accumulate in low spots in the body.

D. During paving operations, the Contractor shall provide continuous radio communication between the plant and the project to ensure immediate response due to breakdowns, emergencies such as accidents, and to ensure the best quality results possible.

E. When necessary, proper insulation of the vehicles transporting the mixture shall be made to ensure that the mixture is delivered for placing at the proper temperature.

F. The dispatching of trucks from the plant shall be so arranged that all material which is to be delivered at or on the road surface during any day may be placed and shall have received final compaction before nightfall of the same day; unless artificial light, satisfactory to the Engineer is provided.

G. The temperature of the mixture, within a tolerance plus or minus 15°, when delivered at the project site will be governed by the temperature of the base upon which the mix is placed as follows:

Base Temp °F on Which Mix is Placed	MAT THICKNESS					
	1/2”	3/4”	1”	1-1/2”	2”	3” or Greater
35-40				305	295	280
40-50			310	300	285	275
50-60		310	300	295	280	270
60-70	310	300	290	285	275	265
70-80	300	290	285	280	270	265
80-90	290	280	275	270	265	260
90+	290	275	270	265	260	255

3.3 SUBGRADE PREPARATION AND PROTECTION

A. Bring subgrade to required grade as necessary, including dynamic compaction, prior to placing subbase material.

B. As required by the Engineer, over-excavate on-site fill material and any unacceptable materials below the subgrade. Utilize excavating equipment equipped with a toothless or smooth edged, excavating bucket to expose the on-site fill material and unacceptable materials to avoid disturbance of the bearing surface.

C. Proof roll all subgrade prior to placing gravel.

D. Prepare subgrade in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

E. Stabilize grades in accordance with Section 02210 so that loaded construction vehicles do not cause rutting or displacement when depositing materials.

3.4 PLACEMENT OF SUBBASE

A. Do not begin placement of subbase and paving work until deficient subgrade areas have been corrected and are properly prepared and ready to receive paving.

B. Subbase under roadway shall be installed and compacted as covered in the Contract Drawings and in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. The subbase to be placed under pavement shall be a minimum thickness as indicated on the Contract Documents after compaction. Subbase shall be evenly spread and thoroughly compacted in accordance with the Contract Documents. In areas where the existing bituminous concrete, concrete slabs, RR tracks/ties, or other surface materials are removed but no trenching is performed, the area shall be proof rolled without additional excavation of underlying soils. The restoration will be a dense graded crushed stone and HMA pavement section that will bring the roadway surface back to the pre-existing grades or proposed grades.

D. The subbase shall be spread in layers with thickness indicated on the Contract Documents. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by ASTM D1557 at optimum moisture content.

E. Complete subbase preparation, including dynamic compaction, for full width before placing surfacing materials.

3.5 HOT MIX ASPHALT BASE AND INTERMEDIATE COURSE

A. Weather Limitations

1. Apply prime and tack coats when ambient temperature is above 50 deg.F (10 deg.C), and when temperature has not been below 35 deg.F (1 deg.C) for 12 hours immediately prior to application. Do not apply when subbase is wet or contains an excess of moisture.

2. Base and intermediate course pavement for temporary pavement may be placed when air temperature is above 30 deg.F (-1 deg.C) and rising.

B. Placement

1. Base and intermediate course shall be spread and compacted to a finished thickness indicated on the Contract Drawings, or as directed by the Engineer. Maximum thickness shall be 3" per layer. A smooth even surface shall be produced.

2. Base and intermediate course placement for temporary paving and trench paving shall be performed on a daily basis or as otherwise approved by the Owner and Engineer. Cold Patch for temporary pavement shall not be allowed with the exception of an emergency or to cover steel road plate edges per the direction of the Engineer or Owner.

3. Base and intermediate course placed as temporary paving shall be maintained at all times until removed prior to final paving.

3.6 HOT MIX ASPHALT SURFACE COURSE

A. Weather Limitations

1. Construct asphalt surface course when atmospheric temperature is above 40 deg.F (4 deg.C) and when base is dry.

B. Placement

1. Surface course shall be spread and compacted, to the width required in the Contract Documents and to a finished thickness indicated in the Contract Documents. A smooth, even surface shall be produced. Full width overlays shall be installed after the street has been cold planed or as approved by the Owner and Engineer. Compact and finish pavement to provide a smooth transition between new and existing surfaces.

a. Prior to placement of the surface course, the entire surface which the surface course is to be placed shall be broom cleaned and tack coated.

b. Apply tack coat at a rate of 0.05 to 0.10 gallons per square yard over the base and intermediate courses. Apply material to penetrate and seal, but not flood, surface. Cure and dry as long as necessary to attain penetration and evaporation of volatile.

C. Placing Mix

1. Place hot mix asphalt mixture on prepared surface, spread and strike-off. Spread mixture at minimum temperature of 225 deg.F (107 deg.C). Place inaccessible and small areas by hand. Place each course to required grade, cross-section, and compacted thickness. Protect all adjacent construction from staining with mix or damage by mechanical equipment. Clean, repair or replace any construction stained or damaged at no additional cost to the Owner.

2. Place pavement in strips not less than 2-feet wide, unless otherwise acceptable to Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base and intermediate course for a section before placing surface course.

3. The Contractor shall supply an approved Dial Type Asphalt Thermometer (Range 10º C to 260º C) for each paving machine in operation on the project. The thermometer shall remain the property of the Contractor upon completion of the project.

D. Rolling

1. Begin rolling when mixture will bear roller weight without excessive displacement. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.

2. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.

3. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.

4. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density. Final rolling of the pavement shall be performed by a steel wheel roller weighing not less than 285 pounds per inch width of tread at a mix temperature and time sufficient to allow for final smoothing of the surface and thorough compaction.

5. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut-out such areas and fill with fresh, hot mix asphalt. Compact by rolling to match the surrounding surface density and smoothness.

6. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked by wheel traffic. Repair damages or other irregularities to satisfaction of Engineer, at no additional cost to the Owner, before final acceptance by the Engineer.

7. The Contractor shall furnish and install paving to provide transition or aprons for driveway and walkways impacted by new pavement installation.

E. Existing Pavement/Joints

1. The edges of existing pavement, which are to remain, shall be saw cut to even, straight edges. This includes road and trench edges. Any joints at junction of old and new pavements shall be sealed and covered with sand.

2. Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density and smoothness as other sections of asphalt course. Clean contact surfaces and apply tack coat.

F. Compaction

1. The asphalt mixture shall be compacted to at least 95% of the density achieved on the laboratory testing of the design mix for the project. Density will be checked by the Nuclear Density Gage Method, ASTM D2950. Testing shall be completed by Contractor at no expense to Owner for every 200 square yards of surface area placed.

G. Field Quality Control

1. Thickness: Test in-place asphalt courses for compliance with requirements for thickness. Repair or remove and replace unacceptable paving as required by Engineer, and at no additional cost to the Owner. In-place compacted thickness will not be acceptable if exceeding following allowable variation from required thickness:

a. Base or Intermediate Course: 1/4-inch, plus or minus.

b. Surface Course: 1/4-inch, plus or minus.

H. Crack Sealing

1. Crack sealing shall be performed where required by the Engineer with modified asphalts (e.g. hot poured rubberized asphalt sealer). Prior to sealing a crack all compressible material shall be removed by high-pressure air or routing. If grass or vegetation is present in the crack the Contractor shall inject a liquid herbicide to prevent future growth. For small hairline cracks, an asphalt slurry mixture type SS-1, SS-1h shall be squeegeed over the surface and forced in the cracks. The slurry shall be maintained at a significant fluidity to be able to flow into the hairline cracks. Sealing of cracks shall be considered to be complete upon review and approval by the Engineer.

I. Liquid Asphalt Emulsion

1. Liquid Asphalt Emulsion shall be applied prior to installation of asphalt as incidental to all Final pavement pay items. Emulsion shall be AC-20 conforming to AASHTO M226 and shall be applied at a temperature over 100 degrees F by an emulsion truck.

2. The emulsion truck shall have pneumatic tires of such width and number that the load produced on the surface shall not exceed 672 lbs/in of tire width, and it shall be designed, equipped, and operated so that at an even heat the emulsion may be applied uniformly on variable widths of surface at a readily controlled rate of 1/20 gal/square yard or as required by the Engineer.

3. The emulsion shall be applied within a pressure range of 25 psi to 75 psi. Distributor equipment shall include a tachometer, pressure gauges, volume-measuring devices, and a thermometer for reading the temperature of tank contents. The distributor shall be self-powered and shall be equipped with a power unit for the pump and full circulation spray bars adjustable laterally and vertically.

3.7 RAISING AND ADJUSTING CASTINGS

A. Prior to base course or surface course paving, all existing or recently installed City or Owner owned catch basin and manhole castings and curb and valve boxes shall be raised, if necessary, to the proper grade by the Contractor. The Contractor shall replace all gate valve boxes which are adjusted with boxes meeting the municipality standards unless the City or Owner agrees that the salvaged box is acceptable for reuse.

1. With Owner and Engineer approval, Contractor may remove castings ahead of base course paving. Castings shall then be excavated and raised to base grade on an interim basis within 2 weeks of base paving. Contractor shall locate and provide documentation of all casting locations

to the Engineer prior to removal.

B. Castings owned by private utilities shall be raised by the responsible utility. The Contractor shall be responsible for coordinating this work. Castings owned by private utilities shall not be removed or buried at any point without written consent by the responsible utility. The Contractor is responsible for locating all private utility castings prior to paving operations and confirming all castings are accessible immediately following paving operations.

C. The method of adjusting catch basin and manhole castings shall be as follows: Cut around catch basin or manhole castings a minimum of 24 inches from casting. Excavate and, if required, rebuild up to 12 inches of masonry below the bottom of the casting. Backfill with suitable material and compact to bottom of casting. Place high, early strength cement concrete to approximately 1½ inches below the raised casting grade. Masonry work shall conform to Section 02252 - MANHOLES and Section 02590 – BRICK MASONRY.

D. The method of raising curb and valve boxes shall be as follows: Cut around valve box a minimum of 12 inches from valve box. Excavate as required and raise the valve box. Pour high early strength cement concrete to approximately 1½ inches below the top of the valve box.

E. Castings which need to be raised or adjusted to complete final surface course full-width paving shall be done immediately prior to paving.

3.8 EXCAVATION BY COLD PLANING

A. The Contractor shall cold plane 2 inches as transitions onto the adjoining streets, and to the limits as established on the Plans. Cold planning shall be done after all excavation affecting the area is complete and prior to final paving.

B. The Cold Planer shall be equipped with an elevating device capable of loading planed material directly into dump trucks while operative. The Cold Planer shall further have all necessary safety devices such as reflectors, headlights, taillights, flashing lights, and back-up signals so as to operate safely in traffic, both in the day or at night. The Cold Planer shall be designed and built for planing flexible pavements and possess the ability to plane cement concrete patches when encountered in bituminous pavement. The Cold Planer shall be self-propelled and have the means for planing without tearing or gouging the underlying surface. The Cold Planer shall be adjustable as to crown and depth and shall meet the standards of the Air Quality Act for noise and air pollution.

C. Variable lacing patterns shall be provided to permit a rough grooved surface as directed. A 2-inch cut is required in one (1) pass. The minimum width of pavement planed in each pass shall be 6-feet, except in areas to be trimmed and edged.

D. The milled or planed surface shall conform generally to the existing grade and

cross slope. The surface shall not be torn, gouged, shoved, broken or excessively grooved. It shall be free of imperfections in workmanship that prevent resurfacing after this operation. Excess material shall be swept and removed so that the surface is acceptable to traffic.

3.9 HOT MIX ASPHALT INFRARED PAVEMENT SEALING

A. Area to be repaired shall be swept clean to remove loose and foreign materials.

B. An approved infrared heater shall be positioned over the area to be repaired for a period of time required to soften the existing pavement to a depth of two or more inches. Oxidation of the pavement caused by improper heating techniques shall be avoided. If this condition occurs, the oxidized pavement material shall be considered a defective material and shall be disposed of and replaced.

C. The softened area shall have a minimum cutback of one foot on all sides of the excavation. The area shall then be scarified and sprayed with a liquid asphalt emulsion approved by the engineer and raked to a workable condition.

D. For trenches longer than 20 linear feet with jogs within 50 feet of each other, the contractor shall have a minimum cutback of one foot. The cutback shall be cut in a straight line consistent and equidistant from the opposite outside extremity of the one-foot cutback trench line.

E. For street crossings, no jogs are allowed. A one-foot cutback on each side from the widest section of the crossing, and uniform width throughout is required.

F. Any additional hot mix asphalt required, shall be obtained from an Engineer approved solid metallic heated asphalt storage unit. No hot mix asphalt, with a temperature of under 200 degrees F, shall be used.

G. After the paving mixture has been properly admixed and raked to grade, compaction with a steel wheeled roller shall be required to establish a uniform density consistent to that of the adjacent surface within the work area. The finished patch shall be level with no depression retaining water on any of its surface.

3.10 CEMENT CONCRETE ROADWAY

A. Provide score lines or expansion joints at minimum every 10-feet.

B. Install full-depth preformed expansion joint filler adjacent to or around all existing structures and barriers.

C. Apply alkaline resistant protective penetrating concrete sealer in accordance with Section 901.41 Protective Sealing and Section 02524 – CURBS, WALKS AND DRIVEWAYS.

END OF SECTION 02500

SECTION 02520

FLEXIBLE POROUS PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. The work of this Section includes subgrade preparation and installation of flexible porous paving, widths vary.

1.2 RELATED DOCUMENTS

A. Section 02100 – SITE PREPARATION AND TREE PRUNING

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02500 – PAVING AND SURFACING

1.3 SUBMITTALS

A. Submit a list of materials proposed for work under this Section including the name and address of the materials producer and the location from which the materials are to be obtained.

B. Submit certificates, signed by the materials producer and the paving subcontractor, stating that materials meet or exceed the specified requirements. **City of Cambridge requires that the General Contractor must become a certified installer of this product for the purposes of this Contract.**

C. Submit name and contact information of company responsible for performing paving operations (certified installer) as soon as this information becomes available.

D. Material samples (1) for the following:

1. Flexible porous paving, color = Redwood

E. Constructed Samples. Submit the following:

1. Sample Panel: Construct a 5' x 5' sample of the Flexible Porous Paving material for approval. The sample shall show all aspects of finish appearance. The sample, upon approval, shall be maintained as the standard of minimal quality for approval of all proposed surfacing and paving work required for the project.

1.4 QUALITY ASSURANCE

A. 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 in this Section.

1. Flexible Porous Pavement must be installed by a certified installer.

2. Contractor must either become a Certified Installer or use a Certified Installer for mixing and placement of Flexible Porous Pavement.

B. Codes and Standards

1. All materials, methods of construction and workmanship shall conform to applicable requirements of ASTM Standards unless otherwise specified.

1.5 PROJECT CONDITIONS

A. Protection of Existing Conditions:

1. Protect adjacent work from splashing of paving materials. Remove all stains from exposed surfaces of paving, structures, and grounds. Remove all waste and spillage.

2. Do not damage or disturb existing improvements or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work.

3. Restore damaged improvements, including existing paving on or adjacent to the site that has been damaged as a result of construction work, to their original condition or repair as directed to the satisfaction of the Owner's Representative, and authority having jurisdiction at no additional cost.

B. Safety and Traffic Control:

1. Notify and cooperate with local authorities and other organizations having jurisdiction when construction work will interfere with existing roads and traffic.

2. Provide temporary barriers, signs, warning lights, flaggers, and other protections as required to assure the safety of persons and vehicles around the construction area and to organize the smooth flow of traffic.

C. Weather Limitations:

1. Flexible Porous Pavement shall not be placed when the ambient air temperature at the paving site in the shade away from artificial heat is below 45° F or above 95° F.

2. The Contractor shall not pave on days when rain is forecast for the day, unless a change in the weather results in favorable paving conditions as determined by the Owner's Representative.

PART 2 - PRODUCTS

2.1 SUBBASE

A. Sub-base material for Flexible Porous Paving system shall be crushed stone:

1. Crushed stone shall satisfy the requirements specified in MHD specification Section M2.01.7 for Dense Graded Crushed Stone for sub-base.

2.2 FLEXIBLE POROUS PAVING

A. Reference manufacturer's information. The certified installer is responsible for supplying and installing a warranteed material that meets the following manufacturer's specifications: The material must consist of and utilize recycle tires, aggregate, and binder.

B. Flexible porous paving shall be HD2000 "Flexi-pave" as manufactured by K.B. Industries, Inc., 28100 US Hwy 19N, Suite 410, Clearwater, FL 33761, 877-KBI.FLEX, www.kbius.com, or approved equal.

C. The material is to be porous to precipitation with an 18% - 22% dynamic flexible void capacity.

D. Color: Redwood.

PART 3 – EXECUTION

3.1 FLEXIBLE POROUS PAVING

A. Reference manufacturer's installation recommendations.

B. The material must be applied in a minimum 2" thickness (nom.) in such manner that it is completely free of joints or seams, provides impact absorption, is

flexible to substrate movement and root growth and is non-cracking during freeze-thaw conditions.

C. The material shall have an available 5-year warranty for pedestrian or non-traffic applications.

D. The material must withstand continual daily foot, bicycle, and wheelchair use with vehicular crossings.

E. Application of the material will occur in locations identified by the Engineers, over various substrate materials with the majority of application occurring over natural earth and existing tree roots. The product must retain durability over the various substrates.

F. Contractor shall excavate, remove and dispose of existing sidewalk at least 5 working days in advance of installation of flexible porous pavement to allow for Engineer and City Arborist to examine existing conditions and revise limits of flexible porous paving to minimize damage to existing root systems.

END OF SECTION 02520

SECTION 02524

CURBS, WALKS AND DRIVEWAYS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies the following: cement concrete and brick sidewalks and driveways, pedestrian ramps, and walkways; the removal and resetting of curb and edging; the construction of new granite curb and granite back curb; and the construction of raised intersection pavers and permeable pavers.

1.2 RELATED WORK

A. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

B. Section 02500 – PAVING AND SURFACING

C. Section 02950 – BACK OF SIDEWALK RESTORATION

D. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Shop Drawings. Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Manufacturer product data and specifications for all materials, including, but not limited to:

a. Cement Concrete for sidewalks, driveways, and pedestrian ramps including design mix
b. Micro-fiber for sidewalk reinforcement
c. Membrane Curing Compound
d. Alkaline Resistant Penetrating Liquid Concrete Sealer
e. Expansion Joint and Caulking
f. Wire Cut Brick
g. Brick Setting Bed and Mastic Adhesive
h. Edge Restraint and Spikes
i. Concrete Pavers for Raised Intersections
j. Permeable Pavers, stone joint, setting bed, and base course

k. Granite Curb, Granite Curb Corner

l. Cement Concrete Design Mix for granite curb work

m. Hot mix asphalt for driveways, including design mix – Refer to Section 02500 – PAVING AND SURFACING for requirements

n. Gravel Subbase – Submit in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2. Detail drawings and layout plans for all materials.

B. Submit compaction testing results.

1.4 QUALITY CONTROL

A. Cement concrete and hot mix asphalt placement, weather, and temperature restrictions shall be in accordance with Section 03300 – CONCRETE and Section 02500 – PAVING AND SURFACING.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

B. Cement Concrete delivery time and storage time onsite shall be in accordance with Section 03300 – CONCRETE.

C. Batch ticket information shall be submitted to the Engineer upon placement of cement concrete and hot mix asphalt.

1.6 REGULATIONS

A. All pedestrian ramps and sidewalks shall conform to the most current applicable details of the MassDOT Highway Division; to the latest MA AAB rules and regulations; and to the latest ADA standards for accessible design.

1.7 GUARANTEES

A. The Contractor shall guarantee all work for one year from the date of Substantial Completion from damage due to improper installation and improper use.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Cement Concrete for Sidewalks, Driveways and Pedestrian Ramps: Cement concrete shall conform to the Standard Specifications, M4.01 through M4.04 and be 4000 PSI at 28 day test, ¾-inch coarse aggregate, 610 pounds cement per cubic yard, 6% air entrained (AASHTO - M154), Type A water reducing admixture (AASHTO - M194), 3 to 4-inch slump, and Type II dark-colored by adding 1.5 – 2 lbs. of lamp black per cubic yard at the plant, dependent on the concrete supplier. Contractor shall coordinate with City of Cambridge prior to specifying lamp black additive. Cement concrete shall contain micro-fiber added during batching at the plant to ensure uniform distribution.

B. Micro-fiber: The cement concrete shall contain 1 pound of polypropylene micro-fiber per cubic yard. Fibers shall be 1/2" or 3/4" 100% polypropylene fibers, maximum 3 denier, complying with ASTM C 1116, Type III, Par. 4.1.3. Fibers per pound shall be not less than 50 million individual fibers. The micro-fiber shall be used in accordance with the manufacturer's specifications.

C. Curing Compound: Shall conform to Section 03300 – CONCRETE for evaporation retarder.

D. Penetrating Liquid Concrete Sealer: Shall conform to Section 03300 – CONCRETE.

E. Expansion Joints: Shall be 3/8" thick polyethylene foam and ¼" thick polyethylene foam conforming to ASTM D1751.

F. Hot Mix Asphalt for back of sidewalk driveway restoration: Shall conform to the applicable subsections of Section 02500 – PAVING AND SURFACING.

G. Granite curb, granite back curb, granite curb corners, granite edging, granite curb transitions at pedestrian ramps, beveled curb, and beveled curb transitions: Shall conform to the Standard Specifications Section M9.04.

H. Cement Grout: Shall conform to Section 03315 – GROUT.

I. Cement Concrete for Granite Curb, Granite Back Curb, Granite Curb Corner, Granite Transitions for Pedestrian Ramps, Granite Edging, Beveled Curb and Beveled Curb Transitions: Shall conform to Class A Concrete as indicated in Section 03300 – CONCRETE.

J. Water: Potable.

K. Gravel Subbase: Shall be in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

L. Forms: Shall be in accordance with Standard Specification Section 701.35 and 901.34.

M. Brick: Shall be a full dimension paver conforming to the quality standards, size

and color range of: "Pathway Full Range" brick paver as manufactured by Pine Hall Brick, Winston-Salem, NC, or an equivalent approved by the Engineer. Size shall be 4" W by 8" L by 2 1/4" D. The brick shall be clay brick, uniform in size and evenly burned, and when broken shall show a dense structure free from lime, air pockets, cracks, and lamination. Laminated bricks will not be accepted. Brick shall meet or exceed the requirements of ASTM C902, Class SX, Abrasion Type I, Application PS with average water absorption of not more than 5% with the five hour boil and an average compressive strength of 8,000 PSI (55Mpa) or more. Brick shall pass a minimum of 100 freeze thaw cycles.

N. Setting Bed: Shall contain coarse sand and aggregates mixed with the Portland Cement as processed by Rowe Contracting Company, Malden, Massachusetts or Quinn Perkins Company, Burlington, Massachusetts or approved equivalent, in order to add stability to the brick walk so that bricks will not roll, move, or rock. The sand for joint sweeping shall be mixed with Portland Cement Type II (2 parts sand to 1 part Portland Cement) and be free of coarse aggregates, enabling the fines to freely fill in around all sides of the bricks.

O. Edge Restraints: Edge sections shall be L-shaped galvanized steel paver restraints and are to be notched to provide for smooth curves and crisp angles. Sections shall be provided at all tree pits, all locations where the sidewalk does not abut a hard edge and as directed by the Engineer. Sections shall conform to the following specifications: Height: 1.5”, Flange:1.75”, Lengths:6’0” or 8’0” and Thickness: 16 gauge. Edge Restraints to be supplied by Border Concepts, Inc., P.O. Box 471185, Charlotte, NC 28241, Telephone Numbers: 1-800-845-3343 or 1-704-541-5509, Fax Number: 1-704-541-5610 or approved equivalent.

P. The mastic adhesive shall consist of 2% neoprene (grade WM1) oxidized asphalt with 155 degrees F softening point (80 penetration) and 10% asbestos-free fibers and 88% asphalt. Contractor shall follow manufacturer’s installation procedure.

Q. Spikes: Are to be galvanized steel spiral not less than 10” in length.

R. Removeable False Curb Utility Cover shall be galvanized steel with a stainless steel locking arm to hold cover open in a 90 degree position. Dimensions shall be field verified by the Contractor prior to ordering to ensure removal false curb utility cover adequately fits on top of utility manholes or other conflicting structures. Removeable false curb utility cover shall be manufactured by EJ Group or approved equal.

S. Concrete Pavers at Raised Intersections: Heavy duty industrial paver designed for prolonged vehicular use. Concrete Pavers shall be 3.125” thick and “L” shaped. Concrete Pavers shall be Optiloc by Unilock in color “Rustic Red” or approved equivalent.

T. Permeable Pavers: Full dimension paver conforming to the quality standards,

size and color range of: StormPave brick permeable paver in "Full Range" color as manufactured by Pine Hall Brick, P.O. Box 11044, 2701 Shorefair Drive, Winston-Salem, NC, Telephone 800-334-8689 or an equivalent approved by the Engineer. Size shall be 4" W by 8" L by 2 1/4" D. Paver shall meet or exceed the requirements of ASTM C902 and shall conform to the PX standard. In addition, the dimensional tolerances around the mean values for length, width, and depth shall be 1/16". The average cold water absorption shall not be greater than 6% with no individual unit testing greater than 7%. Absorption test results may not be achieved through the use of sealers or other products applied to the clay paver. Pavers shall have a minimum average compressive strength of 10,000 PSI. Paver shall pass a minimum of 50 freeze thaw cycles when tested in accordance with ASTM 67. In addition, the clay paver must pass CSA-A231.2 freeze thaw test in saline solution without the use of sealers or other products applied to the paver. A test report must be submitted by the manufacturer.

U. Permeable Paver Joint and Setting Bed: The setting bed course and void joint filler aggregate shall be double-washed, crusher run, free of fines, organics, and soluble salts or other contaminants likely to cause efflorescence. The aggregate shall conform to ASTM C33 and the gradation requirements of ASTM D448 No.9 as follows.

Sieve Size	Percent Passing
3/8 inch	100
No. 4	85 to 100
No. 8	10 to 40
No. 16	0 to 10
No. 50	0 to 5

V. Permeable Paver Base Course: The base course aggregate shall consist of double-washed, open-graded stone conforming to MassDOT material specification M2.01.4 and shall meet the following gradation requirements:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	90 to 100
1/2 inch	10 to 50
3/8 inch	0 to 20
No. 4	0 to 5

W. Nonwoven geotextile separating Permeable Pavers on Setting Bed and Base from adjacent soils in Select Locations shall be 6 oz. and shall conform to the following:

1. Minimum flow rate of 110 gal/min/sf – ASTM D4491 - 99A
2. Grab tensile strength min 150 lb – ASTM D4632 - 91
3. Mullen Burst strength min 300 psi – ASTM D3786 - 87
4. Puncture strength min 90 lb – ASTM D4833 - 00
5. Apparent opening size 60-70 US Sieve – ASTM D4751 - 99A

X. Detectable warning panels: The detectable warning strip at concrete pedestrian ramps, raised side street treatments abutting concrete sidewalks, and raised crosswalks abutting concrete sidewalks shall be the Cast Iron Detectable Warning Plates by East Jordan Iron Works (800-626-4653) or approved equivalent product. The Cast Iron Detectable Plate shall meet all ADA Accessibility Guidelines for Detectable Warnings. Plates should have truncated domes and a slip resistant texture with a coefficient of friction rating greater than 0.80. Warning panels shall be at least 24" deep and 60" wide at the point of crossing. The detectable warning strip at brick interfaces shall be yellow dipped.

Size: 24 in. (+/- 1") deep, cut as wide as the pedestrian ramp opening, and as wide of the crosswalk at raised side street treatments and raised crosswalks.

PART 3 – EXECUTION

3.1 PREPARATION

A. The edges of existing pavement, which is to remain, shall be saw cut to an even, straight edge in accordance with Section 01045 – CUTTING AND PATCHING. This includes roadways, sidewalks, and driveways.

B. Excavate, remove, segregate, and stockpile existing asphalt and cement concrete walks and driveways as required for utility installation or as indicated for replacement on the Contract Drawings.

1. Existing walks and driveways shall be sawcut at the limits of removal. Cement concrete walks and driveways shall be sawcut at existing score joint, so entire panel is removed.

2. Prior to excavation for pedestrian ramps, the Contractor shall review the location with the Engineer to determine what is necessary to allow for the installation to be compliant with the standards referenced above. Fixed objects such as utility poles and fire hydrants must be considered in location of pedestrian ramps. The type of pedestrian ramp may vary based on sidewalk width and slope.

3. Removed cement concrete and asphalt pavement including reinforcement shall be disposed of in accordance with Section 02051 – DEMOLITION, MODIFICATION, AND ABANDONMENT.

4. Excess soil material removed shall be disposed of in accordance with Section 02080 – SOIL AND WASTE MANAGEMENT.

C. Excavate, remove, protect, and stack existing granite curb, granite edging, granite curb corners, and granite curb inlets as required for utility installations or as indicated for replacement on the Contract Drawings.

D. Existing granite curb, granite edging, granite curb corners, and granite curb inlets not indicated to be reset shall be disposed of in accordance with Section 02051 – DEMOLITION, MODIFICATION, AND ABANDONMENT

E. The Contractor shall exercise special care when excavating near trees and roots. Excavation shall conform to the requirements in Section 02100 – SITE PREPARATION AND TREE PRUNING.

F. Traffic signs shall be removed as required during the excavation. Bike rings, trash receptacles, parking meters and signs, etc. to be reused shall be appropriately protected, stacked, and stored for reuse. Traffic signs to be replaced, as indicated on the Contract Drawings or as required by the Engineer, shall be disposed of by the Contractor. Reinstallation of traffic signs shall be done prior to the concrete pour. All regulatory signs shall be maintained throughout construction.

G. Subgrade under walks, pedestrian ramps, driveways, and curbs shall be graded to required elevations and proof rolled.

H. <u>Finish Grades</u>: At locations where the Drawings do not indicate proposed sidewalk grades, the grades shall be discussed with the Engineer prior to work, in order to address existing and proposed drainage concerns. The Contractor shall be responsible for ensuring that all new sidewalk areas are graded to drain, either to existing structures or new structures.

I. Gravel subbase under sidewalks, pedestrian ramps, driveways, and curbs shall be graded to required elevations and compacted with plate-type mechanical compactors to ninety-five percent (95%) of the maximum dry density at optimum moisture content as determined by the AASHTO Standard Method of Test T99 Method.

J. Existing in-situ material shall be used for gravel subbase only when approved by the Engineer. The Contractor shall provide analytical proctor results of the existing material in accordance with Section 02210 - EARTH EXCAVATION, BACKFILL, FILL, AND GRADING for compaction testing if requested by the Engineer.

K. Imported gravel subbase shall be placed in one six-inch lift, loose measure unless otherwise noted.

L. Add approved material to bring to required grade and compact.

M. The subbase for sidewalks shall be graded to be sloped from the City right of way towards the street in order to meet ADA requirements, or as shown on the Contract Drawings, or as required by the Engineer.

N. Materials shall not be placed when subgrade and subbase is muddy, frozen, or has frost, snow, or water thereon.

O. The Contractor shall raise all water curb stop boxes and sewer, drain, and combined sewer castings to final grade and shall coordinate raising of other utility boxes and castings prior to pouring of concrete. The Contractor shall remove material from curb stop boxes with compressed air, after raising is complete and prior to pouring of concrete. Prior to pouring the concrete, the Contractor shall review locations where curb boxes have been raised with the Engineer.

3.2 CEMENT CONCRETE WALKS AND DRIVEWAYS

A. Concrete shall be installed to a depth of 6" at pedestrian ramps, across driveways, at street intersection corners (5' beyond the point of tangency on either side of the corner curve), on shared streets (Ashburton Place, Worcester Street, Suffolk Street, Pine Street) and at other locations as directed by the Engineer. At all other locations, concrete shall be installed to a depth of 4".

B. Concrete shall be placed between April 1st (pending no upcoming snow storms) and November 1st only. Do not place concrete when air temperature at time of placement, or anticipated temperature for following 24 hours, is lower than 40° F or higher than 90° F.

C. Concrete placement shall be in accordance with the Standard Specifications Section 701.

1. The concrete shall be placed in alternating slabs 30 feet in length unless otherwise required by the Engineer.

2. The slabs shall be separated by transverse performed expansion joint filler as specified below:

a. Expansion joints of 3/8" thick foam shall be placed every 30 feet perpendicular to curb alignment extending through the sidewalk depth. Expansion joints of 3/8" thick foam shall also be placed around all appurtenances such as utility poles, hydrants, manholes, and other obstructions extending into and to a depth to match the adjacent sidewalk (4", 6"). Six-inch expansion joints shall be placed at all locations where six-inch concrete driveways meet four-inch concrete walks. Expansion material protruding above the finished sidewalk shall be trimmed flush with a sharp instrument as soon as the concrete has set.

b. A 3/8" thick expansion joint shall be installed between all new cement concrete installations and existing cement concrete.

3. The slabs shall be separated by the curb by longitudinal expansion joint filler as specified below:

   a. Expansion joints of ¼" thick foam shall be placed 4", or 6 deep longitudinally along the granite curb between curb and the concrete and also between buildings and retaining walls and the concrete as required by the Engineer. Six-inch expansion joints shall be placed at all locations where six-inch concrete corner slabs or driveways meet four inch concrete walks. Expansion material protruding above the finished sidewalk shall be trimmed flush with a sharp instrument as soon as the concrete has set.

4. In conveying the concrete from the place of mixing to the place of deposit, the operation shall be conducted in such a manner that no mortar will be lost and the concrete shall so be handled that the concrete will be of uniform composition throughout, showing neither excess not lack of mortar in any one place.

D. Concrete finishing shall be in accordance with the Standard Specifications Section 701.

1. No finishing operation shall be performed while free water is present. Finishing operations shall be delayed until all bled water and water sheen has left the surface and concrete has started to stiffen.

2. Between the expansion joints at 30 foot spacing, the sidewalk shall be divided at equal and approximately 5-foot intervals by sawcutting or by score joints, made with creasing tools, having a penetration depth of minimum 1-1/2" and at 10-foot intervals with construction joints. Joints shall be placed 90° transverse with the direction of traffic and shall be straight within a tolerance of ¼-inch of a straight edge laid along the joint. Longitudinal joints shall be installed, at the requirements of the Engineer when the sidewalk is greater than 6' wide.

3. The surface shall be floated after completion of edging.

4. Immediately after floating the surface shall be steel troweled. If necessary, the joints and edges shall be rerun before and after troweling to maintain uniformity.

5. After troweling, the surface shall be brushed by drawing a soft-bristled pushbroom with a long handle over the surface of the concrete to produce a non-slip surface.

E. Concrete shall be membrane-cured. The curing compound shall not discolor the concrete and shall be applied according to the manufacturer's specifications. The mixture shall be applied immediately after the finishing is

complete and free water has left the concrete's surface. The Contractor shall provide the Engineer with the curing compound specification prior to its use.

F. Alkaline Resistant Protective Penetrating Concrete Sealer shall be applied to the concrete sidewalks after the concrete is at least 14 days old and after a 48-hour minimum drying period just prior to the time of treatment (if walk has become wet), the exposed surface shall be cleaned to remove all oil, grime and loose particles which would prevent the mixture from penetrating the concrete immediately before the application of the mixture, an air blast shall be directed over the surface to be treated so that all dust will be removed. Unless otherwise directed, the temperature of the concrete and air shall be 50ºF or higher at the time of application. For the rate of application see Section 03300 – CONCRETE. The second application of the surface treatment mixture shall not be made until the concrete, in the judgment of the Engineer, has regained its dry appearance.

G. Forms shall be left in place for a period of 12-hours prior to removal. Upon removal, the Contractor shall backfill the void with either loam in accordance with Section 02210 – EARTH EXCAVATION, FILL, BACKFILL AND GRADING and seeded in accordance with Section 02900 – LANDSCAPING or match the existing material and grade as specified.

H. The Contractor shall fully protect all new concrete work for a minimum of forty-eight hours. A representative of the Contractor shall remain on site at least three hours after the last section of concrete is placed. In addition, the contractor shall fully protect the concrete with plastic sheeting or matting. Plastic sheeting shall be installed so that it cannot pull or blow away under windy conditions and not damage installed concrete. Sidewalk vandalized or disturbed within three hours after the last section of concrete is placed shall be replaced by the Contractor at no additional cost to the Owner.

3.3 CEMENT CONCRETE PEDESTRIAN RAMPS

A. Concrete shall be installed to a depth of 6" depth.

B. The Contractor shall establish grade elevations at all pedestrian ramp locations and shall set transition lengths as shown on the Contract Drawings and as per ADA and MA AAB requirements.

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

D. At intersections, pedestrian ramps shall be located in front of vehicle stop lines and within the crosswalk. The ramp shall be constructed so that the finished elevation of the concrete (curb removed) will meet the roadway flush (less than ½" lip) for a width no less than 48-inches. The elevation at this meeting point shall be properly designed to meet the gutter elevation of the road. The

Contractor shall install pedestrian ramps and road grades in a manner which minimizes the potential for puddles in front of them.

E. The Contractor shall use a digital "Smart Level" to check all subbase grades for compliance prior to installation of concrete. The Contractor shall not proceed with concrete installation on a ramp that is out of compliance without first contacting the Engineer.

F. Forming, placement, finishing, curing and alkaline resistant protective penetrating concrete sealer shall be completed in accordance with Paragraph 3.2 of this Section except the pushbroom finish, which shall be perpendicular to the direction of the slope.

3.4 CAST-IN-PLACE DETECABLE WARNING PANEL

A. Set detectable warning panel plate(s) into wet concrete in accordance with ADA and MA AAB requirements.

B. Tamp plate(s) thoroughly with rubber mallet until concrete seeps through vent holes.

C. Clean off excess concrete from plate(s) and finish concrete around plate(s).

D. Cast iron detectable warning panels shall be installed at the time of sidewalk construction per manufacturer's directions and as shown on the plans and specified herein. Retrofit, bolter or surface applied installations shall not be accepted.

3.5 BRICK WALKS AND DRIVEWAYS

A. Hot mix asphalt base shall be installed to a depth of 4" and placed in accordance with the MassDOT Standard Specifications for hot mix asphalt.

1. Hot mix asphalt surface shall be rolled to remove irregularities prior to installing setting bed.

B. The iron edge shall be installed as detailed, longitudinally to the granite curb at the back edge of the specified brick walk width and at all tree wells. The iron edge shall be secured by 10" spiral galvanized steel spikes placed every 12".

C. A 3/4" sand setting bed shall be installed on the asphalt base. Wet saw is required for cutting of bricks and filling in pieces where needed. No other method will be acceptable.

D. After all the bricks are in place, a sand and cement dry mix shall be swept into the joints.

E. Once the bricks are placed in their specified patterns, they shall be compacted with a plate compactor. The compactor shall have a minimum force of 5000 lbs. and a frequency of 75 to 90 cycles per second.

F. Contractor shall follow manufacturer's installation procedures for the installation of mastic adhesive.

3.5 GRANITE CURB, GRANITE BACK CURB, GRANITE CURB CORNER, AND GRANITE CURB TRANSITION AT PEDESTRIAN RAMPS.

A. Granite Curb, Granite Back Curb, Granite Curb Corners, and Granite Curb Transitions at Pedestrian Ramps shall be installed in accordance with the requirements of Section 501 of the Standard Specifications.

B. Existing Granite Curb, Granite Curb Corners, and Granite Curb Transitions at Pedestrian Ramps that are to be removed and reset/relocated shall be installed in accordance with the requirements of Section 580 of the Standard Specifications.

1. The Contractor shall verify and record all existing grades at locations where granite will be reset at the existing grade.

C. Installations shall be backfilled with concrete as indicated on the Contract Drawings.

D. Placement and installation of granite curb over existing tree root systems shall be coordinated with the City Arborist.

3.6 ASPHALT CURBS, BERMS, WALKS, DRIVEWAYS AND WATERWAYS

A. Hot mix asphalt driveways shall be placed in accordance with the Standard Specifications Section 702.

3.7 PERMEABLE PAVERS

A. Do not install bedding or pavers during rain or snowfall. Do not install on frozen bedding.

B. Nonwoven geotextile shall be placed in select locations in accordance with manufacturer's standards and recommendations and as indicated on the Contract Drawings. Adjacent strips of geotextile shall overlap a minimum of 18 inches or per manufacturer specifications, whichever is greater.

C. The Engineer shall verify the structural planting medium has been shaped and compacted in conformance to the lines, grades, and cross-sections shown on the plans before work on the paver and bed installation begins.

D. A 3/4"crushed stone base for the permeable pavers shall be installed at the

depth as indicated on the Contract Drawings to a maximum 95% standard Proctor compaction.

E. The edge restraint shall be installed as detailed, longitudinally to the granite curb at the back edge of the specified permeable paver walk width and at all tree wells. The edge restraint shall be secured by 10" spiral galvanized steel spikes placed every 12".

F. A 2" stone setting bed of ASMT No.9 aggregate shall be installed on the stone base. Permeable pavers shall be installed per manufacturer's recommendations. Wet saw is required for cutting of permeable pavers and filling in pieces where needed. No other method will be acceptable.

G. Once the pavers have been placed upon the bedding course and all cut pavers have been inserted to provide the complete surface, inspect the pavers for damaged units and remove and replace those units. After all the permeable pavers are in place, the void joint filler stone shall be placed into the paver openings to the top of the chamfer on the pavers and the surface swept room clean.

H. The pavement surface shall be compacted to achieve consolidation of the bedding course and pavers and brought to design levels and profiles by two passes of a suitable plate compactor. Compaction of the pavers shall be accomplished using a vibratory plate compactor capable of a minimum of 4,500 pounds of compaction force. No compaction shall be permitted within three feet of unrestrained edges of the pavement. After compaction, inspect the pavers for damaged units and remove and replace those units.

I. After completing compaction, the surface tolerances shall be plus or minus ½" from finished grades. The pavers shall be flush to ½" above edge restraints. Additional void filler material shall be swept into the joints as required, to within ½" from the bottom of the chamfer on the paver. Upon completion, the pavement surface shall be swept clean of all excess materials. Remove from the site all surplus materials, equipment and debris resulting from these operations.

J. Contractor shall avoid driving over the pavers, tracking any dirt or sediment, and storing any mulch or soil on the pavers. Any debris or sediment tracked on to the paver surface shall be promptly removed and swept.

K. Upon completion of the permeable paver installation, any remaining permeable pavers in good condition shall be returned to the Owner.

L. The full permeability of the permeable paver surface shall be tested by application of clean water at the rate of at least 5 gpm over the surface, using a hose or other distribution device. Water used for the test shall be clean, free of suspended solids and deleterious liquids and will be provided at no extra cost to the Owner. All applied water shall infiltrate directly without puddle formation or surface runoff and shall be observed by the Engineer and Owner.

3.8 POST CONSTRUCTION MAINTENANCE OF PERMEABLE PAVER WALKWAYS

A. During the guarantee period, the permeable pavers should be inspected for cracks, water ponding (failure to infiltrate), settling or other failures.

B. Notify Owner of cracks, ponding, or settlement areas exceeding ½" and any protruding pavers that lip by more than ¼" from surrounding pavers. For settlement areas pavers should be picked up and re-laid after base or bed layers are repaired at the Owners direction. Replace any badly damaged pavers at Owners direction.

C. Inspect joints and refill to the top of the paver if necessary. Joint material shall be refilled after 3 to 6 months.

D. Quarterly (every three months). Pavement surface should be vacuumed to remove sediment and organic debris. Vacuum sweeping shall be completed with a walk behind leaf, litter, and debris vacuum (i.e. Billy Goat) or with a leaf blower.

E. If either puddle or sheet flow across the joints is observed in areas of the pavers, then that area of the paver likely needs to be regenerated. Owner shall be notified.

F. Any product like sand or sawdust that is used to provide traction during times of snow or ice shall not be used. These products will increase clogging.

END OF SECTION 02524

SECTION 02535

ILLICIT CONNECTIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section includes the following:

1. Perform private service lateral investigations for identification and confirmation of all illicit connections, select private inflow sources, and the function of unknown laterals for redirection to or from the storm drain system within the entire Project Area, or as otherwise required in the Contract Drawings, or by the Engineer. The Work shall include, but shall not be limited to the following:

a. Coordination with representatives from the Owner, including the Engineer, various City of Cambridge departments, and Building Owner throughout the implementation of the work to obtain permission and approval to access the building to inspect,

b. Furnishing and performing dye testing of private service laterals,

c. Performing Closed-Circuit Television (CCTV) Inspection of private service laterals.

2. Furnishing, installing, and testing of PVC pipe and fittings to perform redirections of all illicit connections from storm drain to sanitary sewer.

3. Perform illicit connection survey. The work shall include, but shall not be limited to the following:

a. Furnishing and performing gravity-flow cleaning of all storm drains within the entire Project Area,

b. Dry weather flow sampling and water quality testing,

c. Visual inspection of manholes and catch basins.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02622 – POLYVINYL CHLORIDE PIPE

D. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Product data for dye test product to be furnished under this section.

2. A log tracking and documenting location where dye is introduced for testing and observing, and within which pipe the dye was found including the downstream manhole of observation,

3. Closed-Circuit Television (CCTV) reports and video footage for all private service laterals inspected,

4. At the completion of redirection of all illicit connections within the Project Area, an Illicit Summary Report indicating the sources of illicit connections and confirmation that said sources have been reconnected to the proper pipe (e.g. sanitary sewer).

5. Within 8 weeks after the Notice to Proceed, an Illicit Connection Survey Work Plan that includes the following:

a. Description of equipment, methods, and sequencing of dry weather sampling of storm drains for the following parameters: fecal coliform, ammonia, surfactants, and oil & grease,

b. Description of methods and products for flow sampling and testing,

c. Description of methods and sequencing of dry weather inspection of storm drain manholes and catch basins.

6. Confined Space Entry Certificates for all Contractor's personnel entering pipeline or access structures.

7. An Illicit Connection Survey Log tracking and documenting field survey procedures and results for dry weather flow sampling. The log shall include the following:

a. Dates of dry weather sampling, time, and weather of test,

b. Method(s) of field survey for each test conducted,

c. Locations, and if applicable, street number, where dry weather samples are collected,

d. Observations during sampling (any visible debris or evidence of odors).

e. Date and time samples were sent and returned from the lab,

f. Results from dry weather sampling and testing.

8. A report documenting dry weather manhole and catch basin inspections that includes which structures were inspected for illicit connections, dates, and observations from the inspection (any visible debris or evidence of odors).

9. At the completion of the survey, an Illicit Connection Summary Report compiling all data collected including the completed Illicit Connection Survey Log and completed reports of dry weather structure inspections.

1.4 QUALITY CONTROL

A. Comply with Section 01400 – Quality Control.

B. All Contractor's personnel entering pipeline or access structures shall be Confined Space Entry trained per OSHA, Title 29 CFR 1910.46 and shall have a copy of their certification available on site at all times.

C. Dry weather flow sampling and testing shall follow best practices per the Massachusetts Department of Environmental Protection (MassDEP) freshwater quality sampling procedures.

PART 2 – PRODUCTS

2.1 MATERIALS

1. Piping and fittings shall conform to the requirements of Section 02622.

PART 3 – EXECUTION

3.1 PRIVATE SERVICE LATERAL INVESTIGATIONS

A. Contractor shall conduct dye testing of waste fixtures and storm water inflow sources for identified potential illicit connections, potential private inflow sources, and when suspect laterals are encountered during excavation. Contractor shall adapt their approach to suit site specific conditions encountered in the field. The inspection is to be conducted from the private

property to the mainline pipe. The general dye testing approach shall be as follows based on the suspected function of the lateral.

1. Potential Illicit Lateral – Perform initial dye tests of waste fixtures to verify functions of the lateral. Undertake additional dye tests if results suggest alternate function.

2. Unknown Lateral – Perform initial dye tests to identify suspected function of the lateral. Undertake additional dye tests based on the suspected function.

3. Potential Private Inflow Lateral – Perform initial dye tests of area drains, roof drains and the like to verify functions of the lateral. Undertake additional dye tests if results suggest alternate function

B. Contractor shall observe the results of dye testing by opening and closing manholes within the public right of way and breaking into collection system mains and service laterals encountered during excavation. Supply all materials needed to completely repair pipes broken into.

C. Contractor shall redirect all illicit connections, and select private inflow sources directed by the Owner/Engineer, within the project area upon completion of private service lateral investigations.

3.2 REDIRECTION OF ILLICIT CONNECTIONS

A. Contractor shall redirect all illicit connections within the project area upon completion of private service lateral investigations.

B. Contractor shall install pipe within the public right-of-way in accordance with Section 02622 and the Contract Drawings.

3.3 ILLICIT CONNECTION SURVEY

A. Pipe cleaning shall be conducted at the completion of pipe and structure installation and cured-in-place pipelining activities, repair, replacement and reconnection of services, and testing of installed systems. Pipe cleaning shall conform to the following:

1. The purpose for cleaning of the drain is to facilitate the dry weather sampling of the drain and ensure debris and residual contaminants are removed.

2. It is the intent of this Contract that drains are cleaned in accordance

with Section 02760.

B. The illicit connection survey shall be concluded at the completion of pipe and structure installation and cured-in-place pipelining activities, repair, replacement and reconnection of services, testing of installed systems, and upon completion of pipe cleaning of all drains within project limits.

C. Dry weather isolation shall begin after a 72-hour period of no precipitation. Dry weather sampling shall follow after dry weather isolation extends for a 48-hour period. Dry weather sampling shall be according to the Contractor's Illicit Connection Survey Work Plan submittal and in the order noted in the Work Plan sampling schedule. In the event that results obtained from a dry weather sample indicate an illicit connection, the Contractor shall further investigate the upstream storm drains, catch basins, and manholes to determine and isolate the source and extent of the illicit discharge.

D. The Contractor shall investigate and determine the purpose and source of all building service laterals, whether existing, proposed, re-directed or abandoned. Methods shall include, but are not limited to, CCTV inspection of laterals, internal inspections within adjacent buildings, and dye testing. Contractor shall record location, size, material and relative invert elevation of each lateral connection with respect to the pipeline. For each existing or proposed drain lateral, Contractor shall investigate all sanitary fixtures within the associated building to verify connectivity to the sewer lateral. Contractor shall note presence of floor drains or other outlet pipes adjacent to buildings. Contractor shall obtain written approval from the Owner and property owner(s) prior to any testing and/or building entry.

E. It is the Contractor's responsibility to survey and remove illicit connections within the entire Project Area. The Project Area constitutes the entire limit of work for construction and the Contractor shall assume and rule out the presence of illicit discharges within all aspects of the storm drain system, including but not limited to: newly installed storm drains, existing storm drains, newly installed manholes and catch basins, existing manholes and catch basins, existing sewers converted to drain, newly installed drain laterals, existing drain laterals, existing sewer laterals converted to drain, and all private plumbing and fixtures connected to drain laterals.

F. During the illicit connections survey, the Contractor shall submit ongoing results of the field survey to the Owner for review. Upon completion of the field survey and removal of illicit connections, the Contractor shall submit in writing to the Owner, a summary of the results of the illicit connections survey and confirmation that illicit connections have been removed from the

Project Limits. The Contractor shall obtain Owner approval prior to the commencement of final paving in the Project Area. If an illicit connection is detected in the Project Area after the confirmation has been submitted and prior to Project Closeout, the Contractor shall remove the illicit connection and restore the surface to final conditions at no additional cost to the Owner.

-END OF SECTION 02535-

SECTION 02555

MANHOLE LINING

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Cleaning of manhole interior; stopping of active manhole leaks; repair of cracks and voids in base, walls, chimney and invert; resetting the frame and cover; and interior application of a Geopolymer Lining System (GLS).

1.2 RELATED TECHNICAL SECTION

A. Section 01300 – SUBMITTALS

B. Section 02080 – SOIL AND WASTE MANAGEMENT

C. Section 02252 – MANHOLES

D. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

E. Section 02761 – FLOW BYPASS

F. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Manufacturer’s technical data sheet and Material Safety Data Sheet for each product used. Also provide the lining manufacturer's written instructions and recommendations on surface preparation, application, and repair of discontinuities.

2. Lining manufacturer’s written certification that the products meet or exceed the technical requirements of this Specification Section, are all compatible to be used together as a complete system, and that the products have been successfully manufactured and installed for at least 5 years.

3. Lining installer’s written certification that it has a minimum of one year of experience with installation of the products. Provide contact information for a minimum of three project references to verify

experience.

4. Proposed method of manhole cleaning including the equipment to be used and OSHA-compliant confined space entry procedures. Include method of solid and liquid waste management, a list of permits required, and a list of lawful sites and/or facilities proposed for disposal of grit, debris and degreased petroleum product.

1.4 QUALITY CONTROL

A. GENERAL

1. Perform all work in compliance with the most recent federal, state, and local codes.

2. All work shall be in compliance with the National Association of Sewer Service Companies (NASSCO).

3. Routine testing will be performed by a testing agency provided by the Contractor. The Owner may engage a third-party testing agency to validate testing by the Contractor.

4. Materials and installed work may require testing and retesting at any time during progress of work. Testing and retesting of rejected materials shall be done at Contractor's expense.

5. All non-conforming work shall be removed and replaced by the Contractor at no additional cost to the Owner.

6. Equipment data and calibrations of all testing instruments must be maintained on site and be available for inspection upon request of the Engineer.

B. Daily Logs and Activity reposts shall be completed – These shall be filled out completely and include the following information:

- Personnel present at the site, when they arrived and when they left.
- Amount and type of material used and work completed.
- Times material was applied and under which atmospheric conditions the ambient air temperature, the dry powder temperature, the mixing water temperature, and the temperature inside the pipe.
- Recorded measurements shall also include where applicable the water addition rate taken at the meter tube, the retrieval speed of the retraction system and the pump motor speed recorded at the pump.
- Any special conditions.
- Quality sampling and testing conducted and the results (if available at the time of testing).
- Digital photos of work conducted and results of quality sampling and testing to be maintained and submitted to Engineer.

C. WARRANTY

1. All work shall be guaranteed against defective workmanship and materials for a period of one (1) year after Project Substantial Completion.

PART 2 – PRODUCTS

2.1 MATERIALS

A. PREPARATORY INFILTRATION CONTROL PRODUCTS

Preparatory products used shall be compatible with the lining system to be used.

1. PATCHING MATERIAL

A quick setting corrosion resistant cementitious material shall be used as a patching material, shall be mixed and applied according to manufacturer's recommendations, and shall have the following minimum properties:

Compressive Strength	ASTM C109	1,400 psi, 6 hours
Bond Strength	ASTM C952	Minimum 145 PSI
Cement		Sulfate Resistant
Applied Density		105 pcf +/- 5 lbs
Shrinkage	ASTM C596	0% at 90% R.H.

Product shall be Hyperform by Vortex Companies, Houston, TX; Strong Seal QSR by The Strong Company, Inc., Pine Bluff, AK; Raven 700 by Raven Lining Systems, Broken Arrow, OK; or approved equal.

2. INFILTRATION CONTROL MATERIAL

A rapid setting cementitious product specifically formulated for leak control shall be used to stop minor water infiltration, and shall be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Compressive Strength	ASTM C109	1 hour - 400-600 psi
	(2-inch Cubes)	24 hours - 2,000-2,400 psi
Expansion	ASTM C827	1 day - 10 percent
Freeze/Thaw	ASTM C666	No loss after 15 cycles
	"Method A"	At 2,000 ppm, test continuing
Pull out strength	ASTM C234	14,000 pounds
Placement time		<60 seconds

Product shall be Quad-Plug by Vortex Companies, Houton, TX; Strong Seal Strong-Plug by The Strong Company, Inc.; Raven 715 by Raven

Lining Systems; or approved equal.

3. GROUTING MATERIAL

A cementitious grout shall be used for stopping active infiltration and filling voids, and shall be mixed and applied according to manufacturer's recommendations. The cement grout shall be volume stable and have a minimum one day compressive strength of 250 psi. Constituents of cement grout shall conform to Section 03300 – CONCRETE.

B. GEOPOPLYMER LINING SYSTEM (GLS)

The Geopolymer Lining System (GLS) defined herein shall be applied to all interior concrete and brick surfaces of manholes, with exception of formed channels.

All materials used in the liner installation shall be industry-accepted materials for sewer/drain pipe rehabilitation and to the satisfaction of the Engineer. Linings shall be chemically resistant to internal exposure to sewage containing gases at aggressive levels for domestic sewage such as hydrogen sulfide, carbon monoxide, carbon dioxide, methane, dilute sulfuric acid, external exposure to soil bacteria and any other chemical attack which may be due to materials in the surrounding ground.

Any defects which will affect, in the foreseeable future as determined by the Engineer, the integrity or strength of the lining, shall be repaired or the lining replaced at the Contractor's expense and to the satisfaction of the Engineer.

A GLS product shall be used to form a structural/structurally enhanced monolithic liner covering all interior substrate surfaces, except as otherwise indicated, and shall have the following minimum properties at 28 days:

The geopolymer lining material shall be a micro-fiber reinforced ultra-dense geopolymer. This material shall provide a high strength fiber reinforced mortar specifically designed for ease of mechanical pumping, spraying and spin casting. The final mixed geopolymer product shall have a minimum of 70% pozzolanic material as a group containing SiO_2, MgO, Al_2O_3, Fe_2O_3.

Acceptable manufacturers and products:

1. GeoSpray® HCE geopolymer mortar – GeoTree Solutions (formerly Milliken)

2. GeoKrete® geopolymer - Quadex (A Vortex Company)

The GLS shall conform to the following properties under laboratory conditions:

Compressive Strength (24-Hour)	ASTM C39	>2,500 psi

Compressive Strength (28-Day)	ASTM C39	>8,000 psi
Flexural Strength (28-Day)	ASTM C78 or C293	>800 psi
Tensile Strength (28-Day)	ASTM C496	>800 psi
Shrinkage (28-Day, 65% R.H.)	ASTM C1090	<0.02%
Bond Strength to Concrete (28-Day)	ASTM C882	>2,500 psi
Freeze/Thaw Durability (300 cycles)	ASTM C666	<0.01% weight loss
Abrasion Resistance (6 cycles, 28-Day sample)	ASTM C1138	<3.5% weight loss

For chemical resistance – at a pH of 1.0 of sulfuric acid (1.0% solution) with 0% loss after 12 weeks of exposure per ASTM C267.

The geopolymer lining system shall have less than 5% rebound when applied to the structure.

C. WET FILM THICKNESS GAUGE

Wet film thickness gauges shall meet the requirements of ASTM D4414, Standard Practice for Measurement of Wet Film Thickness Gauges. Gauges shall be as supplied by Paul N. Gardner Company, Inc. or equal.

PART 3 – EXECUTION

3.0 GENERAL

1. The Contractor shall install the approved structural rehabilitation liner as defined herein and as detailed in the contract drawings.

2. Prior to the start of any rehabilitation work, the Contractor shall ensure that all materials and rehabilitation systems shall not leach toxic substances into the environment or the collection system.

3. The Contractor shall carry out their operations in strict accordance with all OSHA and manufacturer's safety requirements.

3.1 CLEANING AND PREPARATION

The following procedures prior to lining shall be adhered to according to the lining method submitted or as deemed necessary by the Engineer:

A. Cleaning of Main Line: Prior to lining, it shall be the responsibility of the Contractor to remove debris and clean out manholes and connecting pipes as required to facilitate installation of the liner.

B. Properly preparing the existing surface is critical to the success of the rehabilitation. Any existing loose or unsound material shall be removed prior to hydroblasting and lining application. Chip or scarify areas to be repaired to extent necessary to provide sound substrate where hydroblasting or abrasive blasting will not suffice. Remove loose material from areas receiving lining. All

internal debris should be removed. Surfaces should be cleaned with hydraulically powered equipment. All surfaces to be lined shall be cleaned by hydroblasting and/or abrasive blasting. Minimum nozzle pressure for hydroblasting shall be 5,000 psi; 100 psi for abrasive blast cleaning. Hydroblasting shall be completed using potable water. Only non-silica abrasives shall be used for dry abrasive blasting. Contractor shall collect and dispose of all material and prevent material from falling into the sewer. No water with concrete dust shall be allowed to remain on any surface following washing and must immediately be removed, prior to drying and rehardening.

C. All prepared surfaces to receive the lining shall be thoroughly water washed from the top down following hydroblasting or abrasive blasting to remove all cement paste, dust, dirt, gypsum, leaving a clean sound concrete substrate. Surfaces to receive the approved lining system shall be free of dust, loose particles, oils, grease, chemical contaminants, attacked concrete, and previously applied protective coatings. The surface of the structure to be lined shall be capable of directly receiving the lining materials and achieving the requisite bonding for adhesion testing.

D. The interior of the structure shall be carefully inspected to determine the location of any conditions, which may prevent proper installation, and it shall be noted so that these conditions can be corrected. The contractor shall coordinate with Engineer and the lining manufacturer to confirm that existing conditions are suitable for lining installation. Should this not be the case then the Contractor shall take all necessary steps, as compatible with the lining product, to improve the existing conditions so as to be suitable for lining installation, or submit information of such unsuitable conditions for approval to the Engineer of alternative lining solutions conducive to the existing conditions.

E. Lining shall not be placed where any free running water is present. Leaks shall be stopped by use of cementitious grout, which if ineffective shall be substituted with a product proposed by the Contractor such as chemical grout. All infiltration within the structure to be continuously lined shall be stopped at no additional cost to the Owner. All structural defects, voids, or cracks in the substrate shall be repaired prior to the application of the lining. Repair methods and materials shall be submitted for approval and approved by the lining manufacturer and the Engineer.

F. Any open joint separation that shall prevent the achievement of a uniform ID of the lined structure shall be sealed prior to lining the structure. Joint sealing methods and materials shall be submitted for approval and approved by the lining manufacturer and the Engineer.

G. If additional repair procedures must be undertaken by the Contractor to prepare the existing structure/pipe for lining a plan will be submitted for approval of the Engineer prior to proceeding.

3.2 INVERT REPAIR

A. Inspect the invert and consult the Engineer with a recommendation for repair. If the invert is a smooth and continuous surface without defect, or will be CIPP lined under this Contract, adjust the extent of repair as directed by the Engineer.

B. Remove all loose material and wash walls again after preparation has been completed. Apply patching material to the invert in an expeditious manner. Trowel the mix uniformly onto the invert at a minimum thickness of 1/2 inch, extending out onto the bench sufficiently to tie into the liner material. The finished invert shall be smooth and free of ridges.

3.3 GEOPOLYMER LINER SYSTEM

A. MIXING

Contractor shall mix geopolymer material to Manufacturer's recommended water cement ratio. Mixing water temperatures must be determined before blending and mixing operations begin. The mixing water temperature must be recorded in the daily operation log at multiple times throughout the day during the installation process. If water temperatures exceed 80ºF, then the water should be chilled to 80ºF or lower. The ability to provide mixing water at a consistent temperature is a critical aspect of the mixing and installation process. Industrial electronic chillers are available and should be of a suitable capacity to provide the proper amount of water and at the required temperature.

The geopolymer lining material shall be mixed in a high shear mixer. This ensures thorough and uniform mix of water with the material prior to pumping. The mixing operations must be performed so that minimal dust is released into the surrounding environment and shall comply with local air quality regulations.

Mixing and curing water should be clean and free from substances that may be injurious to the specified liner material, concrete or steel. Potable water shall be used.

B. SPRAYING

The geopolymer lining material shall be applied to a damp surface, with no flowing water.

The necessary equipment, calibration and application methods to apply the liner materials shall be only as approved and recommended by the material Manufacturer. Controlled passes shall be made until the specified minimum finished thickness is attained. If the procedure is interrupted for any reason, the operator shall arrest the retrieval of the applicator head until flows are recommenced.

For standard application: The cementitious liner thickness shall be 1-inch thick. Material thickness may be verified at any point with a depth gauge. If additional

material is required at any location, applicator shall be placed at the location and application shall recommence until that area meets the required thickness.

For locations where the structure is significantly corroded: The cementitious liner thickness shall be built up to restore the original interior dimension plus 1/2-inch additional material. This results in varying thickness greater than 1-inch depending upon the degree of degradation.

The thickness calculations are site specific and involve careful consideration of loading conditions that are applicable to those for the construction phase and long-term service of the infrastructure in question.

Geopolymer liner may be troweled following the spray application in an upward motion to compress the material and solidify the pipe wall, with precautions taken not to over-trowel. Only a wood float or Magnesium (Mg) float should be utilized.

C. CURING

Follow manufacturer's recommended cure schedule in curing of the geopolymer liner. The material must be allowed to fully cure prior installation of a subsequent application. The material must be allowed to cure a minimum of 2 hours or until the material has reached an initial set condition whichever is longer prior to the release of bypass or flow through the pipe.

Proper steps shall be taken to ensure the material is cured in a moist and moderate climate. General underground conditions are usually adequate to meet this curing requirement. However, when situations of dry and/or hot conditions are present, the use of a wind barrier and fogging spray with potable water may be required.

D. TERMINATION AND SEALING AT MANHOLE

At locations where a pipe or conduit extends into a manhole, the spray-on liner shall be continuously applied to the entire outer surface of the pipe or conduit and manhole walls to create a smooth monolithic surface.

E. WEATHER

The GLS shall not be placed when the ambient temperature is 37ºF and falling or when the temperature is anticipated to fall below 32ºF during the next 24 hours unless specific precautions are employed and approved by the engineer.

Do not apply geopolymer liner material when ambient and surface temperatures are 100°F and above. Shade the material and prepare the surface to keep it cool. To extend working time, mix the material with chilled water. Be certain the substrate is saturated surface dry (SSD) before application begins. Proper curing is always required and is particularly important in hot weather.

At temperatures below 45°F, warm the material and monitor substrate temperatures.

Properly ventilate the area when heating. Protect the new liner from freezing for the first 6 hours after application.

F. PRODUCT TESTING

Standard Practice for making and Curing Concrete Testing Specimens in the Field (ASTM C31) shall be consulted and followed prior to casting samples of mortar in the field.

For compression testing (ASTM C39) use 4-inch x 8-inch cylinders (or the metric equivalent). A minimum of six cylinders are to be cast with each sample. 2 cylinders will be broken at 7 days of aging, 3 at 28 days of aging, and 1 will be broken at 56 days or as directed. Samples should be cured and tested as per manufactures recommended procedures.

For flexural strength testing cast a minimum of 9 beams with each sample. 3 beams will be broken at 7 days of aging, 3 at 28 days of aging and 3 will be broken at 56 or as directed. The sample dimensions should be as directed by the manufacturer. In addition, the samples should be cured and tested as per manufactures recommended procedures.

G. FIELD TESTING

The manhole shall be visually inspected for leakage and for a smooth, even finish with good bonding to the manhole. The completed liner shall be smooth and relatively flat for future coatability and free from honeycomb and areas of segregation.

Prior to installing lining system, the manhole shall exhibit no visible leakage in the structure, around pipe penetrations or at the interface to the cut open sewer pipe liner. Any leakage shall be corrected to the Engineer's satisfaction.

Note if the liner material is suspected of being changed or altered during construction, as indicated by color or consistency changes, in addition to the sampling listed below, the contractor may be directed by the Engineer to perform QAQC XRF testing on the material brought to the site to verify it matches the original submittal XRF information at no additional cost to the Owner.

H. SAMPLING

Testing sample frequency shall include the first and last day of construction and the more frequent of: once for every 50 VF of installation or once every other day of application.

The Contractor shall employ an independent third party ACI certified testing agency to conduct and report required strength testing of the geopolymer mortar utilized in the rehabilitation.

Standard Practice for Sampling Freshly Mixed Concrete (ASTM C172) should be consulted prior to any sampling of mortar in the field.

Sample size to be used for strength tests requires a minimum of 1 CF.

Mortar sample should be collected at the end of the hose near as possible to the discharge point. In rare circumstances where this may not be possible a sample may be drawn from a section of hose at minimum 30 feet from the mixer/pump. All sample points and approximate distance from the mixer pump must be recorded. In the event the certified technician does not have access to the sampling point then samples should be drawn by the contractor responsible for the placement of the material and immediately transferred to the nearest access point to allow the chain of custody to be transferred to the certified technician for testing.

I. THICKNESS VERIFICATION

During application, the GLS applicator shall regularly perform liner thickness readings with a depth gauge.

Small indicator tabs or stainless-steel depth screws shall be attached on the structure to verify the proper thickness is achieved. These are positioned approximately 1/8 of an inch below the specified thickness and are left in place when sprayed over and should not be visible after application. Depth checks should be taken during installation to further verify the thickness.

In addition, when requested by the Engineer, the liner shall be cored at three different clock positions, and the average thickness measured shall be taken as the actual thickness of the liner. Coring of the liner is not an ideal method of measurement and should only be done if there is a concern over the proper thickness being achieved. Removal and repair of these cores is at the Contractors' expense. The Contractor shall mark the core samples with the location taken, the date that the liner was installed and the date that the core was removed.

The completed Geopolymer Liner System (GLS) shall be hammer sounded at every 1'-0" x 1'-0" location to assure it is well bonded to the concrete substrate. No hollowness will be acceptable. If hollow areas are identified, GLS removal and localized repairs following the manufacturer's written instruction must be followed.

Acceptance: The following criteria must be met for acceptance:

- Thickness must fall within 90% of the target design thickness.
- Compressive strength average of 3 measurements for each sample must reach the 28 day specified strength. If a 28 day sample is defective or a low value occurs, the retained 56 day results may be substituted at the Engineers discretion.
- Flexural strength average of 3 measurements for each sample must reach the 28 day liner design submittal strength. If a 28 day sample is defective or a low value occurs, the retained 56 day results may be substituted at the Engineers discretion.
- No hollowness indicated in the lining by hammer sounding.

<u>If the above criteria are not met, then the liner is considered unacceptable. The contractor should submit a proposed method of repair or replacement for review and approval by the Engineer. Work required to remedy non-conforming work shall be at no additional cost to the Owner.</u>

3.5 QUALITY ASSURANCE

A. FINAL INSPECTIONS

Visual inspections should be made periodically throughout construction. Any deficiencies in the finished lining shall be marked and repaired or removed and replaced by the Contractor according to the procedures set forth herein and as directed by the Engineer.

Remove and replace liner that lacks uniformity; shows infiltration; that exhibits segregation, honeycomb overspray, rebound, or delamination; or that contains dry patches, long cracks, single voids in excess of ½-inch in any direction, or sand pockets.

Should small points of infiltration (minor weeping) and/or surface cracking occur then these shall be repaired as directed by the Engineer and in coordination with the lining manufacturer. The Contractor shall, as directed by the Engineer, and depending on the severity of the infiltration clean and treat with either a topical application of patching material or drill and chemically grout by injection to permanently stop infiltration.

The Contractor shall, as directed by the Engineer, clean the crack and the area immediately around the crack using a small wire brush. The crack will then be rinsed and filled as directed the Engineer and in coordination with the lining manufacturer. The treated area will be blended to match the surrounding surface creating a permanent solution.

B. POST-APPLICATION VIDEO INSPECTION

The Contractor will perform a post-installation television inspection that meets NASSCO MACP requirements. The video will show the completed work, including condition of restored connections.

C. CLEAN UP

After the rehabilitation work has been completed, the Contractor shall clean up the entire project area and return any disturbed areas to as good a condition as existed prior to the work being performed. The Contractor shall dispose of all excess material and debris not incorporated in the permanent installation.

3.5 FRAME AND COVER

A. Reinstall manhole frame and cover in accordance with the standard drawing details and Section 02252 – MANHOLES.

-END OF SECTION 02555-

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02577

PAVEMENT MARKINGS

PART 1 – GENERAL

1.1 SUMMARY

A. Furnish and apply pavement markings in accordance with the MassDOT Highway Division, Standard Specifications for Highways and Bridges, latest edition, hereinafter referred to as the "Standard Specifications." All references to method of measurement, basis of payment, and payment items in the standard specifications are hereby deleted. References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein.

1.2 RELATED WORK

A. Section 02500 – PAVING AND SURFACING

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Product data and specification submittals.

2. For information purposes only, submit manufacturer's printed installation instructions.

PART 2 – PRODUCTS

2.1 MATERIALS

A. M7.01.03 Liquid Thermoplastic Striping Material

B. M7.01.04 Fast Drying White and Yellow Waterborne Traffic Paint

C. M7.01.07 Glass Beads

D. High Friction Surface Treatment: Shall be "TYREGRIP VS" as manufactured by Prismo, USA, Inc.; or approved equivalent product. Color shall be green for bicycle applications and shall conform to the latest edition of the Manual of Uniform Traffic Control Devices (MUTCD) and the following:

a. Daytime chromaticity coordinates for the color green shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.266	0.500	0.367	0.500	0.444	0.555

b. Daytime chromaticity coordinates for the color terra cotta shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.266	0.500	0.367	0.500	0.444	0.555

c. Daytime luminance factor (Y) shall be at least 7, but no more than 35 for both green and terra cotta colors.

d. Nighttime chromaticity coordinates for the color green shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.230	0.754	0.336	0.540	0.450	0.500	0.479	0.520

e. Nighttime chromaticity coordinates for the color terra cotta shall be as follows:

1		2		3		4	
x	y	x	y	x	y	x	y
0.023	0.754	0.336	0.540	0.450	0.500	0.479	0.520

E. High SRI Pavement Coating shall be Streetbond SB150 as manufactured by GAF, or approved equivalent. Provide warranty of 3 years. City to provide color.

PART 3 – EXECUTION

3.1 GENERAL

A. Apply Pavement Markings as follows:

Material	Material Application Temperature Degrees F	Line Thickness Above Roadway Surface	Reflectorized Application
M7.01.03	400-425	125 to 188 mils	1lb/10 SF Drop On

B. The ambient air temperature for thermoplastic application shall be minimum of 45 degrees F and rising at the time of marking operations. If work has started and air temperatures fall below 45 degrees F [7.2 C] and continuous cooling is indicated, work shall be stopped. In cool weather conditions, temporary drops in temperature down to 40 degrees F [4.4 C] may be tolerated, providing temperatures also vary upwards. Sustained striping (greater than one hour) at 40 degrees F [4.4 C] shall not be allowed. Starting work at air temperatures lower than 45 degrees F [7.2 C] shall not be allowed.

C. Apply markings at cross walks and stop lines at the locations required by the Engineer or as shown in the Drawings.

D. Align new markings to match existing in color, dimensions, and spacing, and extend new markings where required.

E. Marking widths for crosswalks shall be 24 inches within travel lanes and 12 inches within the bike lanes and applied within a tolerance of five percent. Marking widths for stop lines shall be 12 inches and applied within a tolerance of five percent. Deviation of straight strips shall not exceed ½-inch in 50 feet.

F. Existing pavement markings no longer required shall be completely removed, by grinding method, prior to placement of any temporary lines.

G. Pavement markings for crosswalks, fog lines, and stop lines shall be white. Pavement markings for centerlines shall be yellow.

H. All temporary pavement markings shall be traffic paint. All final markings shall be thermoplastic unless otherwise directed by the Engineer. Pavement markings for centerlines shall be yellow.

I. Pavement markings shall not be installed until a minimum of 15 days after final paving is completed. The Contractor shall notify the City of Cambridge Traffic Engineer at least 72 hours in advance of scheduled pavement marking installation. The exact location of pavement markings will be determined by the City's Traffic Engineer at the time of installation. The City's Traffic Engineer or representative must be present to supervise the pavement marking operations.

J. Broken lines through intersections (vehicular and bicycle) are indicated only graphically on the plans. Actual pattern shall be 2-foot line and 4-foot space.

K. Pavement arrows and legends in areas subject to general vehicle traffic shall be thermoplastic. Pavement arrows, legends and "Bikes Yield to Peds" pavement marking on bicycle facilities shall be surface applied tape.

L. The green-colored high friction surface treatment shall be installed at bicycle conflict areas and bicycle turn boxes as indicated on the plans and as directed by the Engineer. The terra cotta -colored high friction surface treatment shall

be installed at bus lanes as indicated on the plans and as directed by the Engineer. The Contractor shall install the high friction surface treatment in accordance with all manufacturers' installation and materials specifications. Copies of the manufacturer's installation procedures and materials specifications shall be provided to the Engineer for approval before placement of the surface treatment is allowed.

M. High SRI Pavement Coating shall be installed with a minimum of 4 layers with 5 gallons per 600 square feet. Thoroughly clean the surface and mask off areas where the surface paint is not required. Install surface paint in accordance with all manufacturers' installation and materials specifications.

END OF SECTION 02577

SECTION 02590

BRICK MASONRY

PART 1 – GENERAL

1.1 DESCRIPTION

A. The work covered under this Section includes the furnishing of all plant, labor, equipment, appliances and materials, and in performing all operations in connection with providing brick masonry, as directed, for furnishing and installing masonry plugs, brick inverts and tables, raising and adjusting castings, and for all other necessary appurtenant work complete and accepted in accordance with the Drawings and Specifications and as directed.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02051 – DEMOLITION, MODIFICATION, AND ABANDONMENT

B. Section 02252 – MANHOLES

C. Section 02610 – CATCH BASINS

D. Section 03410 – PLANT-PRECAST STRUCTURAL CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit manufacturer specification sheets for and shop drawings for all masonry items, mortar and appurtenances.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Masonry

1. Masonry shall include brick masonry for extending manhole and catch basin frames to grade, brick masonry plugs for pipes and structures, manhole invert tables, cement mortar plaster on interior and exterior surfaces of masonry walls, mortar and related work. Brick masonry plugs for pipes and structures shall be a minimum of 8-inches thick, unless otherwise shown or directed. Other brick masonry shall be provided to the details and the dimensions specified, indicated or as directed.

B. Bricks

1. Bricks in general shall be clay or shale brick and shall conform in all respects to ASTM C32, latest revision, Grade SS. Bricks that are broken, warped, cracked or of improper size or quality, or otherwise defective shall not be used in the work and shall be removed from the site.

2. Brick for extending manhole frames to grade shall be concrete brick conforming to ASTM C139, latest revision.

C. Cement

1. Cement shall conform to the standard specifications for Portland cement of ASTM C150, latest revision, Type II, unless otherwise directed. Whenever directed by the Owner, a quick-setting cement (Type III) shall be used for any desired purpose at no additional expense to the Owner.

D. Sand

1. Sand for mortar shall be graded uniformly from fine to coarse and when dry shall pass a No. 8 sieve. Sand shall consist of aggregate having clean, hard, durable, strong, uncoated grains and free from injurious amounts of dust, lumps, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances. The sand shall be washed clean before loading on delivery trucks. Natural sand which shows a color darker than the standard color when tested in accordance with the Colorimetric Test for Sands as described in ASTM C40, latest revision, will be cause for rejection.

E. Lime

1. Lime shall be hydrated lime conforming to ASTM C207, latest revision.

F. Water

1. Mixing water for concrete and mortar shall be clean and free from oil, acid, alkali, injurious amounts of vegetable matter and other impurities. Potable water obtained from a municipal supply is preferable.

G. Mortar

1. Mortar and mortar plaster shall be composed of one part Type II portland cement, and two parts sand to which a small amount of hydrated lime, not to exceed 10 lbs. to each bag of cement, shall be added. Only a sufficient amount of water shall be added to make a

stiff plastic mortar of a consistency and texture satisfactory to the Owner. Retempering of mortar in which the cement has started to set will not be permitted.

PART 3 – EXECUTION

3.1 GENERAL

A. All exterior surfaces of masonry walls shall be plastered with mortar plaster to provide a minimum thickness of 1/2 inch. Mortar plaster shall be applied with sufficient pressure to insure a dense plaster completely filling all voids and thoroughly bonded to the masonry wall. Masonry construction shall be done in a manner to insure watertight construction and all leaks in masonry shall be sealed.

B. All workmanship shall conform to the best standard practice, and all brick masonry shall be laid by skilled workmen. Brick masonry for extending frames to grade shall be constructed to the thickness indicated. Brick masonry walls shall be constructed to the thickness indicated. All beds on which masonry is to be laid shall be cleaned and wetted properly. Brick shall be wetted as required and shall be damp but free of any surface water when placed in the work. Bed joints shall be formed of a thick layer of mortar which shall be smoothed or furrowed slightly. Head joints shall be formed by applying to the brick to be laid a full coat of mortar on the entire end, or on the entire sides as the case requires, and then shoving the mortar-covered end or side of the brick tightly against the bricks laid previously; the practice of buttering at the corners of the brick and then throwing mortar or scrapings into the empty joints will not be permitted. Dry or butt joints will not be permitted. Joints shall be uniform in thickness and shall be approximately 3/8-inch thick. Joints on the inside face of walls shall be tooled slightly concave with an approved jointer when the mortar is thumbprint hard; the mortar shall be compressed with complete contact along the edges so as to seal the surface of the joints. Brickwork shall be constructed accurately to dimensions, and brickwork at top of manholes shall be to the dimensions of the flange of the cast iron frames.

C. No water shall be allowed to flow against brickwork or to rise on the masonry for 60 hours after it has been laid, and any brick masonry damaged in this manner shall be replaced as directed at no additional expense to the Owner. Adequate precautions shall be taken in freezing weather to protect the masonry from damage by frost. Plaster shall be troweled to a smooth hard finish and no backfill shall be placed until the mortar has thoroughly hardened.

-END OF SECTION 02590-

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02604

CATCH BASINS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of precast concrete catch basins, complete and in place, within the limits and to the lines and grades indicated.

2. Furnishing and installing of precast leaching risers, complete and in place, for inclusion in catch basin assemblies. Contractor is responsible to coordinate with precast manufacturer to custom design and fabricate leaching risers to meet the Engineer's design intent.

3. Cleaning of all new and existing catch basin and offline manhole sumps in the City right-of-way that lie within the project limit of work.

1.2 RELATED TECHNICAL SECTION

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

D. Section 02590 – BRICK MASONRY

E. Section 03300 – CONCRETE

F. Section 03315 – GROUT

G. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Prior to preparation of Submittals, examine the location of existing utilities depicted in the drawings, or otherwise evident from utility records or Dig Safe markings, that are in proximity to each proposed catch basin and connecting sump manhole and/or drain manhole. Openings for catch basin laterals shall not be fabricated, and instead by made by field coring, unless advance test pitting is completed to evaluate potential utility conflicts with respect to the following criteria:

1. Catch Basin or Manhole Type – Test pit utilities that pass next to the proposed structure, which may warrant a different size, shape or configuration of structure.

2. Pipe Opening – Test pit utilities that cross the alignment of proposed catch basin laterals, which may warrant a different elevation, size or orientation of the pipe opening.

Where test pits identify a potential conflict, the Contractor shall propose any changes in the elevation and/or type of pipe and structures for review and acceptance by the Engineer prior to making related Submittals.

B. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Complete shop drawings for all precast catch basin sections, cast iron frames and covers and appurtenances.

2. Prior to fabrication, submit clock drawings showing details of precast monolithic base sections; risers; eccentric cone and flat slab catch basin tops; pipe openings; joints and gaskets; and construction details, tolerances, and other information as required by the Owner.

3. Submit manufacturer's recommended installation procedures for informational purposes.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

C. Engineer reserves the right to direct the Contractor to use blank riser sections in lieu of sections with pre-cast holes, should unknown site conflicts require field cutting of concrete for the connection of laterals.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

B. Removed catch basin fixtures must not be reused and shall be salvaged and delivered to the City of Cambridge Public Works storage yard unless directed by the Owner to dispose off site.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Precast Bases, Risers, and Tops: catch basins shall be constructed as per the requirements specified for manholes in Section 02252 – MANHOLES.

1. Catch basins shall be constructed as detailed. Catch basins shall be designed for a minimum of H-20 loading. Catch basins shall have a minimum of 6 ft sump depth, unless otherwise noted.

B. Concrete: catch basins shall be constructed as per the requirements specified for manholes in Section 02252 – MANHOLES.

C Frames and Grates:

1. The general applications are as follows:

a. Frames positioned at the curb shall be 3-flange style.

b. Frames positioned away from curbs shall be 4-flange style.

c. Standard frame height shall be 8 inch. Compact 4-inch high frames shall be used only where indicated on the drawings or directed by the ENGINEER.

d. Where ADA-compliant grates are indicated, their frames (whether square, rectangular or round) shall be interchangeable with waffle type grates.

2. Frames and Grates shall be Cast Iron, conforming to ASTM A48, Class 35B and as follows:

a. Castings to be free from pouring faults, cracks, scale, lumps, blisters, sand holes and other defects affecting the strength and value for the service intended.

b. Machine contact surfaces to prevent rocking.

c. Thoroughly clean and hammer inspect.

3. Frames and grates shall be rated for AASHTO H-20 loading unless otherwise indicated or specified.

4. Catch Basin Grates shall be waffle type by EJ Group (5520M5) or approved equal, unless otherwise indicated.

5. ADA-Compliant Grates shall be EJ Group (square 5520M6; round 2110 series) or approved equal.

5. Single Catch Basin Frames shall be EJ Group (3-flange 5520Z / 5544Z; 4-flange 5525Z / 5521Z) or approved equal.

6. Double Catch Basin Frames shall be EJ Group (3-flange 5444Z/5448Z) or approved equal.

D Hoods

1. For round structures with laterals up to 15-inch diameter, Catch Basin Hoods shall be EJ Group (Series 5902 with grouted hanger) or approved equal.

2. For flat wall structures or laterals greater than 15-inch diameter, composite hoods of the appropriate size shall be used (Eliminator by Ground Water Rescue, Inc.).

F. NO DUMP Curb Markers

1. No-dump markers shall be installed on all existing-to-remain, or proposed catch basins and inlets within the project area unless otherwise indicated in the catch basin schedule on the Drawings. Curb markers shall be similar to a style typified by EJ Group (Series 7267) or approved equal.

G. Jointing: catch basin jointing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

H. Gaskets: catch basin jointing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

I. Grout for Sealing Joints: catch basin sealing grout shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

J. Mortar for Brickwork: catch basin brickwork mortar shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

K. Brick: catch basin chimney bricks shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

L. Waterproofing: catch basin waterproofing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

M. Bituminous Dampproofing: catch basin dampproofing shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

N. Flexible Seals: catch basin pipe seals shall be as per the requirements specified for manholes in Section 02252 – MANHOLES.

PART 3 – EXECUTION

3.0 PROCUREMENT:

A. In addition to riser sections identified in the pre-cast manufacturer's clock drawings, procure an additional one each of every nominal height of 4-ft diameter riser section for use as blanks when field conditions warrant hole coring of openings for pipe connections. Replenish sections when used to maintain suitable inventory of blanks throughout construction.

3.1 HANDLING:

A. Handle catch basin sections as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.2 INSPECTION

A. Inspect catch basins sections as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.3 INSTALLATION

A. Install catch basins sections as per the requirements specified for manholes in Section 02252 - MANHOLES.

3.4 BACKFILLING

A. Backfill catch basins sections as per the requirements specified for manholes in Section 02252 - MANHOLES.

3.5 INSTALLING HOODS AND TRAPS

A. Hoods shall be built into the catch basin wall, shall be watertight, and shall be installed in conformance with the manufacturer's instructions.

B. Hoods with Inserts shall be built into the catch basin wall and into the pipe, shall be water tight and shall be installed in conformance with the manufacturer's instructions.

3.6 INSPECTION AND TESTING

A. Inspect and test catch basins as per the requirements specified for manholes in Section 02252 – MANHOLES.

3.7 CLEANING

A. Clean catch basins as per the requirements specified for manholes in Section 02252 – MANHOLES.

B. Upon reaching substantial completion, clean all new and existing catch basin and offline manhole sumps by way of vactor truck or clamshell. The standard for a clean sump shall be that the depth of sediment and/or debris at the base of a structure does not exceed an average of 4 inches when probing with a rod.

3.8 NO DUMP CURB MARKERS INSTALLATION

A. "No Dumping" curb markers shall be installed at all existing-to-remain or proposed catch basins and inlets unless otherwise indicated in the catch basin schedule on the Drawings.

-END OF SECTION 02604-

SECTION 02609

REINFORCED CONCRETE PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing of precast concrete circular and elliptical pipe, complete and in place, within the limits and to the lines and grades indicated.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

D. Section 02622 – POLYVINYL CHLORIDE PIPE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop drawings of pipe and fittings,

2. Product data and certified dimensional drawings of all pipe, joints, bends, special fittings, and appurtenances,

3. Gasket and pipe manufacturer's joint assembly directions,

4. Certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards,

5. For informational purposes only, submit manufacturer's printed installation instructions,

6. Certification with each delivery, that pipe complies to this specification,

7. Anticipated production and delivery schedule,

8. Results of leakage tests performed prior to final paving.

a. Test results shall be logs maintained during Infiltration or Exfiltration Tests, or footage and logs of Close Circuit Television Inspection.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Reinforced Concrete Pipe

1. The concrete pipes provided shall be of types having bell and spigot or tongue-and-groove ends, and the pipe units modified as required to receive the type of gaskets specified. Except as modified herein or on the Drawings, all precast reinforced concrete pipe shall meet the requirements of ASTM C76, latest revision, for Wall "B" or Wall "C" pre-cast concrete pipe. Pipe shall be of the Class indicated in the table below or as specifically indicated on the Plans. Regardless of the process used in the manufacture of the pipe, all pipe shall be manufactured of concrete having uniform high density and impermeability, and free from any objectionable voids, and shall have uniform positive and complete steel reinforcement bond and shall conform to the additional requirements specified herein. Workmanship and methods shall be in accordance with the best practices of modern shops for this type of work and shall be the product of a manufacturing firm having at least five years experience in the manufacture of this type of pipe. Pipe shall have a smooth and even interior surface free from roughness or irregularities. Prior to fabrication of pipe, submit shop drawings showing lengths of pipe, pipe joint details, construction details and tolerances as required by the Owner. Each pipe shall be marked with the date of manufacture, mark or trademark of the manufacturer, and the class, wall thickness of the pipe, and serial number. No slurry mix shall be used on interior of pipe.

Nominal Diameter Inches	Fill Height: Greater than 1'- 0" Not exceeding 3'	Fill Height: Greater than 3' Not exceeding 10'	Fill Heights: Greater than 10' Not exceeding 15'	Fill Height: Greater than 15' Not exceeding 20'	Fill Height: Greater than 20' Not exceeding 25'	Fill Height: Greater than 25' Not exceeding 30'	Fill Height: Greater than 30' Not exceeding 35'
10	NA	NA	NA	NA	NA	NA	NA
12	IV	III	IV	V	V-3160D	V-3790D	V-4000D
15	IV	III	IV	V	V-3080D	V-3390D	V-3575D
18	IV	III	IV	V	V	V-3115D	V-3300D
21	IV	III	IV	V	V	V	V-3100D
24	IV	III	IV	V	V	V	V
27	IV	III	IV	V	V	V	V
30	III	III	IV	V	V	V	V
33	III	III	IV	IV	V	V	V
36	III	III	IV	IV	V	V	V
42	II	III	IV	IV	V	V	V
48	II	III	IV	IV	V	V	V
54	II	III	IV	IV	V	V	V
60	I	II	IV	IV	V	V	V
66	I	II	III	IV	IV	V	V
72	I	II	III	IV	IV	V	V
78	I	II	III	IV	IV	V	V
84	I	II	III	IV	IV	V	V
90	I	II	III	IV	IV	V	V
96	I	II	III	IV	IV	V	V
102	I	II	III	IV	IV	V	V
108	I	II	III	IV	IV	V	V

2. Bends, fittings, and special sections shall be fabricated by cutting the pipe at the required angle and then rejoining the sections. Special pipe sections are defined as manhole pipe with and without a branch wye or tee and manhole pipe bends with both horizontal and vertical rotation. Complete shop drawings shall be submitted to the Engineer before fabrication. Concrete for repairs shall be as specified herein. The interior surface (face) of all repairs shall be smooth finished, equal to the pipe interior finish. All materials and workmanship shall be subject to the approval of the Engineer.

3. Dimensions, Reinforcement, and Strength Requirements: The dimensions, reinforcing steel, and strength requirements of the pipe shall meet the requirements of ASTM C76, latest revision, for Wall "B", Class III and IV pipe and for Wall "C", Class V pipe and the additional requirements specified herein. Reinforced concrete pipe shall be provided in full-length units, except where shorter lengths are indicated and/or required to meet field conditions; field cutting of pipe shall be avoided wherever possible. The cross-section of all

ASTM C76 pipe shall be circular with circular reinforcing cages properly held in place with adequate longitudinal members to insure the accurate placement of all steel. The total cross-sectional area of steel in the pipe for the class and wall thickness specified herein shall be not less than that shown in ASTM C76, latest revision.

B. Pipe Joints

1. Each length of pipe shall be provided with bell-and-spigot or tongue-and-groove ends of concrete formed on machined joint rings in a manner to insure accurate joint surfaces. The diameter of the joint surfaces depended upon to compress the gasket shall not vary from the theoretical diameters by more than 1/16 inch. The joint shall be sealed by a round rubber gasket so that the joint will remain watertight under all conditions of service, including movement due to expansion, contraction, and normal settlement. The bell-and-spigot or tongue-and-groove ends of pipe shall be designed to enclose the gasket on four surfaces when the joint is in its final position. Pipe for jacking shall be provided with steel end rings and rubber gaskets.

2. Gaskets for sealing joints shall be the "O-ring" type gaskets meeting requirements of ASTM C443, latest revision, in all respects, and shall be of neoprene of a special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five years experience in the manufacture of rubber gaskets for pipe joints. Gaskets shall be of a composition and texture which shall be resistant to sewage, gasoline, industrial wastes, including oils and groundwater, and which will endure permanently under the conditions likely to be imposed by this use. Each gasket shall be a continuous ring of round solid section having smooth surfaces free from blisters, porosity and other imperfections. The gasket shall be the sole element of sealing and depended upon to make the joint watertight. When the pipe is laid, the gaskets shall be of adequate size to fill the groove on the spigot ring in which the gasket is placed. Cement mortar or other plastic materials, if required to finish the joints, shall not be employed as means for making joints watertight. Each compression ring shall be marked with type of rubber used. The jointing of the precast reinforced concrete pipe and stoppers using the watertight joints specified above shall be installed in strict accordance with the published recommendations of the pipe manufacturer and as approved. Lubricants shall be used for jointing of pipe and shall be as recommended by the pipe manufacturer. The position of the gasket shall be checked and examined to insure the proper positioning of the gasket; joints that have been improperly made shall be taken apart and remade. It shall be the Contractor's responsibility to install the pipe in a manner that will maintain the gasket joint in adequate compression to insure watertight joints conforming to the test requirements specified herein.

3. Provide flat gaskets when size of pipe requires this type. The gasket manufacturer shall supply test data and affidavits showing compliance with these Specifications.

C. Concrete

1. Concrete used in the manufacture of all precast reinforced concrete pipe shall have an average strength of not less than 4,000, 5,000 and 6,000 pounds per square inch at 28 days as applicable for the size class and wall specified. Strength of concrete used in the manufacture of the pipe shall be determined by tests on 6-inch by 12-inch vibrated test cylinders cured in the same manner as the pipe or by cores cut from pipe wall or by other approved method. Cement shall be moderate heat of hydration Portland cement conforming to ASTM C150, latest revision, Type II. Absorption determined by boiling test described in ASTM C76, latest revision, shall not exceed 5.3 percent of dry weight.

D. Marking

1. Each length of pipe shall be plainly marked with the piping class designation which it is designed for, wall of pipe, its individual identifying serial number, the date of its manufacture, manufacturer's mark or trademark, and in addition, all other identification marking or data required by the Owner.

PART 3 – EXECUTION

3.1 PIPE AND PIPE FITTINGS

A. General: Install piping in accordance with governing authorities having jurisdiction, except where more stringent requirements are indicated.

B. Handling Pipe: Each pipe unit shall be handled into its position in the trench only in such manner and by such means, as the Engineer accepts as satisfactory. The Contractor will be required to furnish suitable devices to permit satisfactory support of all parts of the pipe unit when it is lifted.

C. Laying Pipe: Except where a concrete cradle or envelope is required, all pipe greater than or equal to 18-inches in diameter shall be laid in a crushed stone cradle in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING. In trenches, no blocking or supporting of the piping by concrete, stones, bricks, wooden wedges, or method other than bedding the pipe on crushed stone will be permitted. Each length of pipe shall be shoved home against the pipe previously laid and held securely in position. Joints shall not be "pulled" or "cramped" without approval of the Engineer.

D. Jointing Pipe: After the pipe are aligned in the trench and are ready to be jointed, all joint surfaces shall be cleaned.

E. Alignment and Placement: All pipe shall be laid with extreme care as to grade and alignment. Each pipe shall be so laid as to form a close joint with the next adjoining pipe and bring the inverts continuously to the required grade.

F. Stakeout of drain work and setting of line and grade is the responsibility of the Contractor. The Contractor shall establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stake as a checkpoint between manholes. Laser aligning shall not be used to establish a continuous line in excess of 400 feet.

G. For installation near crossing utilities and encasement requirements, refer to Contract Drawings.

H. For Cast-In-Place concrete field closures, refer to Contract Drawings.

I. For lateral service connections, refer to Section 02622 – Polyvinyl Chloride Pipe and the Contract Drawings.

J. Cleaning: Care shall be taken to prevent earth, water and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and manholes being careful to prevent soil, water and debris from entering any existing Drain.

1. Place plugs in end of uncompleted conduit at end of day or whenever work stops.

2 Flush lines between manholes if required to remove collected debris.

K. Review of Completed Storm Drain System: If the visual observation of the completed drain or any part thereof shows any pipe, manhole, or joint to be of defective work or material the defect shall be replaced or repaired as directed. The visual observation shall be conducted by the Engineer and any defects shall be as identified by such. The Contractor shall coordinate and provide site access for the Engineer.

3.2. LEAKAGE TESTS

A. Refer to Article 51 – “Leakage Tests” in Section 00825A – SPECIAL CONDITIONS.

B. Leakage Test method consists of visual or Close Circuit Television Inspection. The contractor shall perform at this no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

-END OF SECTION 02609-

SECTION 02615

DUCTILE IRON PIPE FOR GRAVITY STORM DRAIN AND SANITARY FORCE MAIN

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes the following:

1. Furnishing, installing, and testing ductile-iron pipe and fittings for gravity storm drains complete in place within the limits and to the lines and grades indicated.

2. Furnishing, installing, and testing ductile-iron pipe and fittings for sanitary pressure mains complete as indicated and specified.

B. Options:

1. For joints in buried exterior pipelines, provide either push-on or mechanical-joint. All force main joints shall be restrained. All fittings and valves shall be mechanical joint.

2. Concrete Encasement: For sanitary sewer and/or storm drain installed above water pipe, see Details.

3. CDF Encasement: For shallow depth of cover at catch basins, see Details.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

D. Section 02622 – POLYVINYL CHLORIDE PIPE

E. Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

G. Section 03300 – CAST-IN-PLACE CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Shop drawings of pipe and fittings,

2. Product data and certified dimensional drawings of all pipe, joints, bends, special fittings, and appurtenances.

3. Gasket and pipe manufacturer's joint assembly directions,

4. Certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards,

5. For informational purposes only, submit manufacturer's printed installation instructions.

6. Certification with each delivery, that pipe complies to this specification,

7. Anticipated production and delivery schedule.

8. Results of leakage tests performed prior to final paving.

   a. Gravity pipe test results shall be logs maintained during Infiltration or Exfiltration Tests, or footage and logs of Close Circuit Television Inspection.

9. Manufacturer's literature stating that the ductile iron pipe and fittings for force mains have been manufactured and tested in accordance with AWWA/ANSI specifications.

10. Detailed description of proposed pressure testing procedures to be used for force mains. The description shall contain the name of the person responsible for pressure testing, and equipment to be used. Review of the description shall not be construed as approval of any methods to be used, the Contractor shall be fully responsible for achieving the specified test results.

1.4 QUALITY CONTROL

A. Provide quality control in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 GENERAL

A. Listed Manufactures:

1. US Pipe and Foundry Company,

2. Griffin Pipe Products Company,

3. American Cast Iron Pipe Company,

4. or equal.

2.2 DUCTILE IRON PIPE

A. Ductile iron pipe shall be that of a United States manufacturer who can demonstrate at least 5 years of successful experience in manufacturing ductile iron pipe conforming to ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.

B. The ductile iron pipe shall be Class 52 and furnished in nominal 18-foot lengths. For shallow installations, Class 53 or higher shall be used where indicated in the Details.

C. The ductile iron pipe shall be lined and coated as specified in section 2.8 herin. The pipe shall be furnished along with necessary materials and equipment recommended by the manufacturer for use in joining pipe lengths and fittings.

2.3 FITTINGS

A. Fittings shall be manufactured in the United States and shall be compact ductile iron Class 350 Mechanical Joint, conforming to ANSI/AWWA C153/A21.53, latest edition, for pipe sizes 16 inches and smaller. Pipe sizes larger than 16 inches shall be Class 350 standard Mechanical Joint fittings conforming to ANSI/AWWA C110/A21.10, latest edition except as specified, or indicated on the drawings. Fittings shall be suitable for use with restraints as specified hereinafter.

B. Fittings shall be of the same material and have the same lining and coating as the pipe specified above. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends.

C. Caps and plugs installed in all new work as indicated on the drawings shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to future connection.

D. Solid sleeves shall be ductile iron with 350 psi rating. Sleeves shall conform to ANSI/AWWA C110/A21.1.

2.4 ADAPTERS

A. Furnish and install for joining pipe of different types, unless solid sleeves indicated.

1. Provide ends conforming to above specifications for appropriate type of joint, to receive adjoining pipe.

2. Joining two classes of pipe may be of lighter class provided annular space in bell-and-spigot type joints sufficient for jointing.

2.5 JOINTS

A. Ductile iron pipe and fittings for buried pressure service shall be furnished with restrained joints, unless otherwise indicated. Ductile iron pipe and fittings for buried gravity service shall be furnished with mechanical joints or push-on joints as required, unless otherwise indicated. Above ground ductile iron pipe and fittings joints shall be as indicated. Flanged joints or grooved and shouldered joints shall be furnished where required.

a. Provide mechanical joint or push-on joint pipe with necessary accessories, conforming to ANSI/AWWA C111/A21.11.

b. Flanged joints shall conform to AWWA C115. Where threaded flanges are provided, the pipe wall thickness under the cut threads shall not be less than the calculated net thickness required for the pressure class of the pipe. Nuts and bolts shall be Type 304.

c. Restrained joints shall be Flex-Ring or Lok-Ring restrained joint by American Ductile Iron Pipe, TR FLEX or HP Lok restrained joint by U.S. Pipe, or equal.

B. Provide gasket composition suitable for exposure to liquid within pipe.

C. Restrained joints for field cuts shall be furnished for installation on all fittings, sleeves, hydrants and valves.

1. Restraints for mechanical joints shall be:

a. EBAA Series 1100,

b. Stargrip Series 3000 by Star Pipe Products,

c. or equal.

2. Restraints for push-on joints shall be:

a. EBAA Series 1700,

b. Stargrip Series 3100 by Star Pipe Products,

c. or equal.

2.6 COUPLINGS

A. For gravity applications, couplings shall be shielded flexible type in accordance with Section 02622 – POLYVINYL CHLORIDE PIPE.

B. For pressure applications, couplings shall be solid sleeve type as follows:

1. Pressure rating at least equal to that of related pipeline with a minimum rating of 150 psi. Couplings shall be provided with; steel sleeve that is fusion bonded epoxy coating; 2 steel followers; 2 nitrile rubbed gaskets; and steel bolts.

2. Couplings shall be similar to a style typified by Style 411 manufactured by Smith Blair, Inc, or an approved equal.

3. Restrained couplings shall be similar to a style typified by Style 471 manufactured by Smith Blair, Inc, Romac Style 400, or an approved equal.

2. Dismantling joints shall be similar to a style typified by Style 975 manufactured by Smith Blair, Inc, Romac DJ400, or an approved equal.

2.7 CONNECTIONS - TAPPED

A. Provide watertight joint with adequate strength against pullout. Use only tapered thread taps. Maximum size of taps in pipe or fittings without bosses not to exceed that listed in appropriate table of Appendix to ANSI A21.51 based on: 2 full threads for ductile iron.

B. Where size of connection exceeds that given above for pipe, provide boss on pipe barrel or use tapping saddle. Make tap in flat part of intersection of run and branch of tee or cross, or connect by means of tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, as indicated or permitted.

2.8 STANDARD LINING AND COATING

A. Inside of pipe and fittings:

1. Gravity Storm Drain: Provide double thickness cement lining and bituminous seal coat conforming to ANSI/AWWA C104/A21.4.

2. Sewer Force Main: Provide Protecto 401 ceramic epoxy.

B. Outside of other pipe and fittings: Standard bituminous coating conforming to appropriate ANSI Standard.

2.9 POLYETHYLENE PIPE ENCASEMENT

A. Material: Virgin polyethylene conforming to ANSI/ASTM D1248.

B. Thickness: Minimum nominal thickness of 8 mils.

C. Material and installation methods to conform to requirements of AWWA C105.

2.10 INSULATION

A. Pipe to be insulated as shown on the plans. Where required, insulation shall be factory formed-in-place polyurethane foam insulation having nominal thickness of 3", with an in-place density of 2.5 pcf, and a "K" factor of 0.14 BUT/in./hr/°F/ft². Straight joints between insulated pipe lengths, and the end section of non-insulated pipe shall be 20-gauge corrugated aluminum performed to be fastened with stainless steel screws and bands. Jackets shall have expansion joints at 25-foot intervals.

B. Jacket shall have one layer of one (1) mil polyethylene film with a protective coat of 40-lb. virgin draft paper to act as a moisture and galvanic corrosion barrier.

C. Insulation shall be manufactured by:

1. Thermal Pipe Systems, Inc,

2. Insul Tek Piping Systems, Inc,

3. Tricon Piping Systems, Inc,

4. or equal.

2.11 THRUST BLOCKING

A. Where applicable or directed, reaction or concrete thrust blocks shall be furnished at all tees, plus bends as directed or as detailed on drawings with minimum 3,000 psi cement concrete. The blocks will be poured against undisturbed original ground and shall be so placed that the pipe joints will be accessible for any possible future repairs. The primary means of restraint

shall consist of a mechanical joint restraint or push-on joint restraint as specified.

PART 3 – EXECUTION

3.1 HANDLING PIPE

A. The Contractor shall take care not to damage pipe by impact, bending, compression, or abrasion during handling, and installation. Joint ends of pipe especially shall be kept clean.

B. Pipe shall be stored above ground at a height no greater than 5 feet, and with even support for the pipe barrel.

C. Only nylon-protected slings shall be used for handling the pipe. No hooks or bare cables will be permitted.

D. Gaskets shall be shipped in cartons and stored in a clean area, away from grease, oil, heat, direct sunlight and ozone producing electric motors.

3.2 ALIGNMENT AND PLACEMENT OF PIPE

A. For installation near crossing utilities and encasement requirements, refer to Contract Drawings.

B. Jointing of ductile iron pipe and fittings shall be done in accordance with the printed recommendations of the manufacturer and as specified. The last 8 inches of the outside of the spigot end of pipe and the inside of the bell end of pipe shall be thoroughly cleaned. The joint surfaces and the gasket shall be painted with a lubricant just prior to making up the joint. The spigot end shall then be gently pushed home into the bell. The position of the gasket shall be checked to insure that the joint has been properly made and is watertight. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.

C. Installation and jointing of push-on ductile iron pipe shall be in accordance with AWWA C600 Sections 9b and 9c, latest revision, as applicable.

D. Mechanical joints for force mains: Restraints shall be installed in full accordance with the manufacturers' instructions. All bolt heads shall be tightened sufficiently so that they shear off to provide indication that proper tightening torque was achieved (if applicable).

E. Restrained push on joints for forces mains shall be installed with specified gasket joint restraints. Restraints shall be installed in full accordance with the manufacturers' instructions.

F. Ductile iron pipe joints that will be encased in concrete or CLSM shall be fully encased with polyethylene.

G. Ductile iron pipe installed within 5 feet of gas lines or within areas subject to corrosive soils or waters shall be fully encased with polyethylene material.

H. Insulated pipe with jacket is to be installed where shown on the drawings and on any pipe having less than 4-foot cover.

I. Solid sleeves shall be used to join plain ends on ductile iron pipe. Mechanical joints shall be installed as specified herein before.

3.3 INSTALLATION

A. Piping Support:

1. Furnish and install supports to hold piping at lines and grades indicated or specified.

2. Support pipe and appurtenances connected to equipment to prevent any strain imposed on equipment.

B. Pipe and Fittings:

1. Remove and replace defective pieces.

2. Clear of all debris and dirt before installing and keep clean until accepted.

3. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

4. Provide firm bearing along entire length of buried pipelines.

C. Socket Pipe Clamps, Tierods, and Bridles: Where indicated or necessary to prevent joints or sleeve couplings from pulling apart under pressure, provide suitable socket pipe clamps, tierods, and bridles. Use bridles and tierod at least 3/4 in. in diameter except where they replace flange bolts of smaller size with nut on each side of flange pairs. Coat clamps and tierods or bridles with two coats of bituminous coating after assembly and allow to dry before backfilling.

D. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.4 JOINTS AND COUPLINGS

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.

2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

3. Where required install restraint and secure in accordance with manufacturer's instructions.

B. Mechanical Joints:

1. Wire brush surfaces in contact with gasket and clean gasket.

2. Lubricate gasket, bell, and spigot with soapy water.

3. Slip gland and gasket over spigot, and insert spigot into bell until seated.

4. Seat gasket and press gland firmly against gasket.

5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above.

C. Sleeve-Type Coupling:

1. Clean pipe ends for distance of 8 inches.

2. Use soapy water as gasket lubricant.

3. Slip follower and gasket over each pipe to a distance of 6 inches from end and place middle ring on pipe end until centered over joint.

4. Insert other pipe end into middle ring and bring to proper position in relation to pipe laid.

5. Press gaskets and followers into middle ring flares.

6. After bolts inserted and nuts made fingertight, tighten diametrically opposite nuts by use of torque wrench of size and torque specified below:

TORQUE

Nominal pipe size (inches)	Bolt diameter (inch)	Range of torque (ft-lb)
3-24	5/8	75
30-36 (1/2 in. mid ring) (3/8 in. mid ring)	 5/8 5/8	 75 65
30-48	3/4	70
48-72	3/4	70

7. After assembly and inspection and before backfill, coat exterior surfaces of buried couplings with heavy-bodied bituminous mastic.

D. Tapped Connection:

1. Drill and tap normal to longitudinal axis.

2. Drilled by skilled mechanics using proper tools.

3. Use only tapered threads.

E. Joining to Existing Pipe:

1. For connecting proposed pipe to existing pipe, refer to Details.

F. Service Connections:

1. For connection of laterals to proposed or existing pipe, refer to Section 02622 – Polyvinyl Chloride Pipe and the Drawing Details.

3.5 TESTING

A. Refer to Article 51 – “Leakage Tests” in Section 00825A – SPECIAL CONDITIONS.

B. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

C. Force Main Pressure and Leakage Tests: Refer to Section 02704 – PIPELINE PRESSURE AND LEAKAGE TEST for requirements. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

-END OF SECTION 02615-

SECTION 02622

POLYVINYL CHLORIDE PIPE

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing of PVC pipe and fittings complete and in place, within the limits and to the lines and grades indicated.

1.2 RELATED TECHNICAL SECTIONS

A. Section 00825A – SPECIAL CONDITIONS

B. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

C. Section 02252 – MANHOLES

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop drawings of pipe and fittings,

2. Product data and certified dimensional drawings of all pipe, joints, bends, special fittings, and appurtenances.

3. Gasket and pipe manufacturer's joint assembly directions,

4. Certified affidavit of compliance for all pipe and other products or materials furnished under this Section of the Specifications, as specified in the referenced standards,

5. For informational purposes only, submit manufacturer's printed installation instructions.

6. Certification with each delivery, that pipe complies to this specification,

7. Anticipated production and delivery schedule.

8. Results of leakage tests performed prior to final paving.

a. Test results shall be logs maintained during Infiltration or Exfiltration Tests, or footage and logs of Close Circuit Television Inspection.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent services at manufacturer's plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 MATERIALS

A. General

1. All PVC pipe shall be continuously and permanently marked with the manufacturer's name, pipe size, and pressure rating or stiffness in psi (kpa).

2. The Contractor shall also require the manufacturer to mark the date of extrusion on the pipe. This dating shall be done in conjunction with records to be held by the manufacturer for 2 years, covering quality control tests, raw material batch number, and other information deemed necessary by the manufacturer.

B. Pipe

1. All PVC pipe shall be joined by compression joints unless otherwise shown or specified, and shall conform to the following requirements:

2. Non Perforated Polyvinyl chloride pipe (PVC) shall conform to the requirements of ASTM D 3034, Class SDR 35. Material for PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein. All diameters shall be as specified on the Contract Drawings.

3. Perforated PVC pipe shall conform to the requirements of ASTM D 3034, Class SDR 35. Material for perforated PVC pipe shall conform to the requirements of ASTM D 1784 for Class 12454-B or 12454-C as defined therein. The pipe shall have 3/8-inch to ½-inch perforations, 6-inch on-center top and sides. The pipe shall be 6

inches in diameter unless otherwise specified on the Contract Drawings.

5. Elastomeric seals for compression type joints for PVC pipe and fittings shall conform to the requirements of ASTM D 3212.

6. Service pipes for storm services shall be minimum of 6 inches and shall match diameter of existing services for reconnections. Service pipes for sanitary services shall be minimum of 6 inches and shall match diameter of existing, services for reconnections.

C. Fittings

1. All fittings shall conform to the requirements of ASTM D 3034 or ASTM F 679. The ring groove and gasket ring shall be compatible with PVC pipe ends. The flanged fittings shall be compatible ductile iron pipe fittings.

2. The strength class of the fittings shall be not less than the strength class of any adjoining pipe.

3. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type fittings are not allowed. Inserta-tees may be used only for certain sizes/materials of maineline pipe per this specification or where approved by the Engineer.

D. Shielded Flexible Couplings

1. General

a. Shielded flexible couplings shall be used to connect sewer and drain pipe. Typical applications are where new pipe connects to existing pipe or a pipe with dissimilar material or size.

b. Non-shielded flexible couplings are permitted for sewer and drain service laterals 6-inch in diameter or less.

c. Couplings and shields shall be sized to fit the outer diameter of pipe, and be rated for the pipe material and conditions of service by the manufacturer.

d. Eccentric couplings shall be used where connecting pipes of different nominal diameter.

e. The CONTRACTOR will not be allowed to substitute any other type of coupling unless approved by the ENGINEER.

2. Construction

a. Flexible couplings shall be in accordance with ASTM C1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems.

b. Rubber sleeves shall be rated for heavy earth loads and be immune to attack by chemicals and impurities normally found in water or wastewater.

c. Shields shall consist of a rigid stainless steel shear ring.

d. Bolts, nuts, straps, and all miscellaneous hardware shall be Type 316 stainless steel.

3. Manufacturer

a. Shielded flexible couplings shall be Fernco (5000 Repair series), Mission Rubber (Flex-Seal Repair series), Indiana Seal (Heavy Duty Repair series) or approved equal.

b. Non-shielded flexible couplings shall be Fernco (Stock and Eccentric series), Mission Rubber (Flex Seal Stock series), Indiana Seal (Stock series) or approved equal.

E. Service Connections

1. Make service lateral connections to main line pipe in accordance with the following and as directed by the Engineer:

a. Brick gravity mains shall be cored and laterals connected with a concrete collar per the standard drawing detail.

b. PVC, Ductile Iron and RCP gravity mains may be cored and laterals connected with Insert-a-Tee fittings per the following table and manufacturer written instruction:

Mainline Pipe Material & Diameter		Insert-A-Tee Allowed For These Lateral Diameters:
PVC SDR 26/35	18" - 21"	6" - 8"
	24" - 27"	6" - 12"
	30"	6" - 15"
	36"	6" - 18"
Ductile Iron	24" -30"	6"
	36"	6" - 8"

Reinforced Concrete	12" - 15"	6"
	21"	6" - 10"
	24"	6" - 12"
	30"	6" - 15"
	36"	6" - 18"

For use of Insert-a-Tees with smaller lateral sizes or other mainline pipe materials, consult Engineer.

c. In all other cases, laterals shall be connected to mains with full bodied tee and wye fittings. Utilize solid transition couplings to install these fittings on existing mains.

F. Bedding Materials

1. Unless otherwise specified or shown, all material used for pipe bedding shall conform to the requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

G. Gaskets

1. Gaskets shall be flexible elastomeric rings conforming with ASTM F 477.

H. Waterstop Grouting Ring

1. Waterstop grouting rings shall be used to connect smooth wall pipe to irregular openings in structures where the annular space is sealed with masonry and/or grout. The product shall consist of an annular rubber gasket secured with a stainless steel tightening band. The gasket shall be synthetic or natural rubber per ASTM 1478 and ASTM C-923 with a keylock profile that extends into the area to be grouted.

2. Manufacturers: A-LOK, Press-Seal, Trelleborg or equal.

PART 3 – EXECUTION

3.1 PIPE AND PIPE FITTINGS

A. Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally 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-inch per foot of length. If a piece of pipe fails to meet this requirement for straightness, it shall be rejected and removed from the site. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.

B. All premolded gasket joint polyvinyl chloride pipe of a particular manufacturer may be rejected if there are more than five unsatisfactory joint assembly operations or "bell breaks" in 100 consecutive joints, even though the pipe and joint conform to the appropriate ASTM Specifications as hereinbefore specified. If the pipe is unsatisfactory, as determined above, the Contractor shall, if required, remove all pipe of that manufacturer of the same shipment from the work and shall furnish pipe from another manufacturer which will conform to all of the requirements of these specifications.

3.2 INSTALLATION

A. Install PVC pipe and fittings in accordance with manufacturer's printed instructions.

B. No pipe or fitting shall be permanently supported on saddles, blocking, or stones. Bedding material shall be as specified in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Suitable bell holes shall be provided, so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material. Special care shall be taken to hold the trench width at the crown of the pipe to the maximum indicated on the Trench Detail included in the Details Section of these Specifications.

D. Before any joint is made, the previously installed unit shall be checked to assure that a close joint with the adjoining unit has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber or other unyielding object.

E. All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be checked to see that the rubber ring is properly seated. Apply lubricant to the spigot end only, paying particular attention to the bevel, in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer. The resulting joints shall be watertight and flexible.

F. Where any two pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units and new gaskets.

G. Allowable Pipe Deflection

1. Pipe provided under this Specification shall be so installed as to not exceed a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

2. Upon completion of a section of pipe, including placement and compaction of backfill, the Contractor shall measure the amount of deflection by pulling a specially designed gage assembly through the completed section. The gage assembly shall be in accordance with the recommendations of the pipe manufacturer, and be reviewed by the Engineer. The section of pipe must be placed and backfilled for a minimum of 90 days before the deflection can be measured.

3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem without additional compensation.

H. Open ends of pipe and branches shall be closed with polyvinyl chloride stoppers secured in place in an acceptable manner.

I. After each pipe has been properly bedded, enough bedding material shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes, provided for jointing, shall be filled with bedding material and compacted, and additional material shall be placed and compacted to complete the pipe bedding.

J. The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench. At all times pipe installation is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs, or by other acceptable means.

1. If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe. Pipelines shall not be used as conductors for trench drainage during construction.

K. For installation near crossing utilities and encasement requirements, refer to Contract Drawings.

L. For lateral service connections and encasement requirements, refer to Contract Drawings.

M. Cleaning

1. Care shall be taken to prevent earth, water and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipeline and

manholes being careful to prevent soil, water and debris from entering any existing pipe.

O. Shielded Flexible Couplings

1. Where couplings are used, plain ends of pipe shall be made smooth and round for a distance of 12 inches from the ends of the pipe, with an outside diameter not more than 1/64 inch smaller than the manufactured outside diameter of pipe. Install couplings per manufacturer's written instructions.

2. SPARE PARTS - CONTRACTOR shall maintain an on-site inventory of couplings suitable for use with the various nominal diameters and materials of proposed and existing pipe referenced in the CONTRACT DOCUMENTS. CONTRACTOR shall be responsible to verify the outer diameter of pipe in advance through measurements taken at access manholes and test pits. The lead times for fabrication, stocking and shipping of couplings shall not be cause for delay or the use of other types of couplings.

P. Connections to Sewer and Drain Structures

1. Make round opening connections in accordance with the drawing details and Spec 02252 – Manholes

2. Make irregular opening connections with waterstop grouting rings in accordance with manufacturer's written instructions.

3.3. LEAKAGE TESTS

A. Refer to Article 51 – "Leakage Tests" in Section 00825A – SPECIAL CONDITIONS.

B. If Leakage Test method consists of visual or Close Circuit Television Inspection, the contractor shall perform at no additional cost to the Owner. The Engineer must be able to witness the tests and must be provided with a video recording of each test for further inspection.

END OF SECTION 02622

SECTION 02630

DUCTILE-IRON PIPE AND FITTINGS FOR WATER MAINS

PART 1 - GENERAL

1.1. SUMMARY

A. Furnishing and installing ductile-iron pipe and fittings, as indicated and specified.

B. Options:

1. For joints in buried exterior pipelines, provide push-on joints.

2. Fittings within 10-foot horizontally from any existing or proposed sewer and/or any sewer crossing within 18-inches below, shall be restrained (in addition to joints as identified in the enclosed restraint table based on their proximity to bends, valves, tees, reducers, and dead ends).

3. All fittings and valves shall be mechanical joint.

C. Related sections include the following:

1. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

2. Section 02640 – VALVES AND APPURTENANCES

3. Section 02645 – HYDRANTS

4. Section 02647 – CONNECTION TO EXISTING WATER MAINS

5. Section 02660 – WATER SERVICES

6. Section 02675 – DISINFECTION OF WATER MAINS

7. Section 02685 – TEMPORARY BYPASS PIPING FOR WATER MAINS

8. Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

D. Permits:

1. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial

CWD permit) CWD permits are met. These requirements ***include accurate and legible swing tie dimensions (using 2 swing ties per item from existing building corners, existing gate valves, and/or existing hydrants only) to all new water main gate valves, tee's and elbows***, required CWD "sign offs" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The contractor is hereby advised that the CWD will not be responsible for the contractor's slip in project schedule if these requirements for permits are not followed.

2. All water main installed within the same right-of-way as MWRA sewer or water infrastructure shall be subject to the requirements of the MWRA 8(m) permit included in the Specifications.

1.2. SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Submit shop drawings or descriptive literature, or both, showing dimensions, joint and other details for each type and class of pipe, fitting and restraint system to be furnished for the project. All materials furnished under the Contract shall be manufactured only in accordance with the Specifications. Submittals shall include material information, dimensions, pipe class information, weights, coating and lining system data.

2. Submit manufacturer's literature stating that the ductile iron pipe and fittings have been manufactured and tested in accordance with AWWA/ANSI specifications.

3. Perform disinfection and pressure testing of installed mains as specified in Sections 02675 and 02704.

1.3. QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Owner reserves right to inspect and test by independent service at manufacturer's plant or elsewhere at their own expense. Materials which testing shows to be not in compliance shall be removed and replaced at no additional costs to the Owner. All expenses related to the material testing which showed non-compliance shall be reimbursed to the Owner by the Contractor.

C. All standards referenced in this section shall be the latest current version.

1.4. DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT and below in section 3-EXECUTION.

PART 2 - PRODUCTS

2.1. PIPE

A. Ductile Iron:

1. Ductile iron pipe shall be that of a United States manufacturer who can demonstrate at least 5 years of successful experience in manufacturing ductile iron pipe. The pipe shall be equipped with push-on joints.

2. All ductile iron pipe shall conform to AWWA C151 (ANSI A21.51) “Ductile-Iron Pipe, Centrifugally Cast”.

3. The ductile iron pipe shall conform to AWWA C150 (ANSI A21.50) “Thickness Design of Ductile-Iron Pipe” and shall be **Class 52** and furnished in nominal 18-foot lengths, with Push-on Joints as manufactured by U.S. Pipe and Foundry Company, American Pipe, McWane Ductile, or equal with gaskets conforming to AWWA C111 (ANSI A21.11) "Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings".

4. The ductile iron pipe shall be double cement lined inside and then asphalt seal coated on the outside and inside approximately 1 mil. thick. The cement lining shall conform to AWWA C104 (ANSI A21.4) “Cement-Mortar Lining for Ductile-Iron Pipe and Fittings”.

5. Ductile iron pipe shall be furnished along with necessary materials and equipment recommended by the manufacturer for use in joining pipe lengths and fittings.

2.2. FITTINGS

A. Ductile iron fittings shall be new, cement lined, and manufactured in the United States. Fittings shall be compact ductile iron Class 350 and are required to be equipped with a mechanical joint, conforming to AWWA C153 (ANSI A21.53) “Ductile-Iron Compact Fittings”, latest edition, for pipe sizes 24-inches and smaller. Fittings shall be of the same material and have the same lining and coating as the pipe specified above. All fittings shall be marked with the weight and shall have distinctly cast upon them the pressure rating, the manufacturer's identification, nominal diameter of openings and the number of degrees or fraction of the circle on all bends. All nuts and bolts shall be of a type equal to

ductile iron or COR-TEN steel T-bolts and nuts and shall be installed such that there is a minimum of three (3) threads showing beyond the nut.

1. Hydrant tees shall have a rotatable mechanical joint gland on the 6-inch plain end branch to provide positive valve restraint, unless otherwise allowed by the Engineer.

2. Caps and plugs installed in all new work as indicated on the drawings shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to future connection.

3. Solid sleeves shall be ductile iron with a 350-psi rating. Sleeves shall conform to ANSI/AWWA C110. Contractor shall verify outside diameter of cast iron pipe to determine compatibility with standard mechanical joint solid sleeves. Couplings shall be used when existing cast iron pipe is incompatible with solid sleeve.

2.3. JOINTS

A. Provide mechanical joint, push-on joint, or flanged pipe (at structures or as approved) with necessary accessories, conforming to AWWA C111-12 (ANSI A21.11) "Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings".

1. Provide gasket composition suitable for exposure to liquid within pipe.

2. Provide gasket composition suitable for exposure to potable water.

3. Provide gasket composition suitable for exposure to fluctuating groundwater conditions.

B. Where specifically indicated, provide pipe flanges and accessories conforming to AWWA C115 (ANSI A21.15) "Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges".

1. Provide flat faced flanges.

2. Provide 1/8 in. thick, full faced gaskets suitable for exposure to liquid within pipe.

C. All fittings, sleeves, hydrants, valves, and pipe shall be restrained. Restraint Glands for mechanical joints shall be Megalug Series 1100 as manufactured by Ebaa Iron Co., MJ Field Lok by US Pipe Company, or approved equivalent. Restraints for push-on joints shall be Series 1700 as manufactured by Ebaa Iron Co., or Series 1390 as manufactured by Uni-Flange or approved equivalent.

D. Restraint systems for push-on pipe utilizing steel-wedge gaskets having a pressure rating of 350 psi will be acceptable.

2.4. COUPLINGS

A. Couplings shall be manufactured in accordance with AWWA C219 “Bolted Sleeve-Type Couplings for Plain-End Pipe” and as specified hereinafter.

B. Pressure rating at least equal to that of related pipeline with a minimum rating of 150 psi.

C. Couplings shall be furnished with SBR gaskets per ASTM D2000 MBA 710, have fusion bonded epoxy coating in accordance with AWWA C213 “Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings”. Gaskets for couplings shall be consistent with fittings. Ductile iron center and end rings shall comply with ASTM A536. Bolts shall be high strength-low alloy steel, 5/8-inch diameter steel per AWWA C111. Couplings shall be suited for extended range of pipe materials and diameters. Couplings shall be provided with plain, Grade 27, rubber gaskets and with black steel, track-head bolts with nuts. Coupling up to 24-inch diameter shall be rated for 250 psi and shall be Series 501 as manufactured by Romac Industries, Smith Blair 441, Dresser Style 153, Rockwell, or an approved equal. Couplings shall be manufactured in the United States. Restraints for couplings shall be Series 3800 Mega-Coupling as manufactured by EBAA Iron Co., or Series 1100 CH Split Megalug Coupling Harness as manufactured by EBAA Iron Co. or equal.

D. For connections to existing cast iron pipe:

1. Restrained couplings shall be provided where indicated on the Drawings or where location is within a required restrained length of water main as indicated in Part 3 of this Section.

2. Contractor shall verify coupling model is compatible with outside diameter of cast iron pipe.

3. If outside diameter of cast iron pipe is compatible with a solid sleeve, Contractor shall use solid sleeve with joint restraint. Restraint lugs on cast iron side shall be tightened down but not torqued off.

4. If outside diameter of cast iron pipe is not compatible with solid sleeve, Contractor shall use restrained coupling. Restrained coupling shall be Hymax Grip by Mueller or approved equal.

5. Non-restrained couplings by Mueller (Hymax), Romac, or approved equal shall only be used if pipe is restrained by other methods and approved by the Engineer and CWD.

6. If unable to install restrained coupling or confirm pipe restraint by other methods, and approved by Engineer and CWD, Contractor may install dresser style coupling without restraint. Dresser style coupling shall be by Smith Blair or approved equal.

7. Where restrained couplings will not work, couplings shall be restrained using friction clamps and tie rods. For 24-inch diameter cast iron water mains, Contractor shall provide (4) friction clamps and (4) 1-1/4" rods. Rods, friction clamp washers, and heavy hex nuts shall be AISI 316 series stainless steel manufactured in the United States in accordance with ASTM A193 grade B8M class 1. Where 316 stainless steel is not available the Contractor shall provide fusion bonded epoxy coated hardware. Tie rods shall be double nutted on each end.

2.5. FILLING RINGS

A. Provide where necessary.

B. Materials, workmanship, facing, and drilling, conforming to 125-lb. ANSI Standard.

C. Suitable length with nonparallel faces and corresponding drilling, if necessary, for correct assembly of adjoining piping or equipment.

2.6. CONNECTIONS - TAPPED

A. Provide watertight joint with adequate strength against pullout. Use only tapered thread taps.

B. Maximum size of taps in pipe or fittings without bosses not to exceed that listed in appropriate table of Appendix to AWWA C151/ANSI A21.51 based on:

1. 3 full threads for ductile iron.

C. Where size of connection exceeds that given above for pipe, provide boss on pipe barrel or use tapping saddle. Make tap in flat part of intersection of run and branch of tee or cross, or connect by means of tapped tee, branch fitting and tapped plug or reducing flange, or tapping tee and tapping valve, as indicated, or permitted.

D. Provide stainless steel tapping saddles for all service line corporations.

2.7. STANDARD LINING AND COATING

A. Inside and outside of pipe and fittings: Provide double cement lined inside and then asphalt seal coated on the outside and inside approximately 1 mil. thick. The cement lining shall conform to AWWA C104 (ANSI A21.4).

B. Outside of pipe and fittings within structures: Shall have factory applied asphaltic coating per AWWA/ANSI C151/A21.51.

2.8. GASKETS, BOLTS, AND NUTS

A. Provide ring rubber gaskets with cloth insertion for flanged joints,

1. Gaskets 12 in. in diameter and smaller, 1/16 in. thick.

2. Larger than 12 in., 1/8 in. thick.

B. Make flanged joints with:

1. Bolts.

2. Bolt studs with nut on each end.

3. Studs with nuts where flange is tapped.

C. Number and size of bolts conform to same ANSI as flanges.

D. Provide bolts and nuts, except as specified or indicated, Grade B, ASTM A307 "Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength".

E. Provide bolt studs and studs of same quality as machine bolts.

F. Flanged joints for wall castings flush with masonry or anything specified as requiring to be made up with Type 316 stainless steel stud bolts and nuts shall be in accordance with ASTM F593 "Standard Specifications for Stainless Steel Bolts, Hex Cap Screws, and Studs"

G. Submerged flanged joints made up with Type 316 stainless steel bolts and nuts.

2.9. POLYETHYLENE PIPE ENCASEMENT

A. Material: Virgin polyethylene conforming to ASTM A674 "Standard Practice for Polyethylene Encasement for Ductile Iron Pipe" and/or AWWA C105 (ANSI A21.5) "Polyethylene for Ductile-Iron Pipe Systems".

B. Thickness: Minimum nominal thickness of 6 mils.

C. Material and installation methods to conform to requirements of AWWA C105/A21.5.

2.10. INSULATION

A. Insulation shall be manufactured by Thermal Pipe Systems, Insulated Piping Systems, Inc., or equivalent. Insulation shall be factory formed-in-place polyurethane foam insulation having nominal thickness of 3", with an in-place density of 2.5 pcf, and a "K" factor of 0.14 BTU/in./hr/deg./F/sq. ft. Straight joints between insulated pipe lengths, and the end section of non-insulated pipe shall be 20-gauge corrugated aluminum preformed to be fastened with stainless

steel screws and bands. Jackets shall have expansion joints at 25-foot intervals. Sections of jacket shall have 2-inch minimum at all seams.

B. Jacket shall have one layer of one (1) mil polyethylene film with a protective coat of 40-lb. virgin draft paper to act as a moisture and galvanic corrosion barrier.

C. Insulation shall be provided for water mains that have less than 3 feet of cover, or water services that have less than 3.5 feet of cover, or as otherwise directed by CWD.

2.11. THRUST BLOCKING

A. Concrete thrust blocks shall be furnished as detailed on drawings, or as otherwise directed using with 3,000 psi, ¾", 470 cement concrete masonry. The blocks will be poured against undisturbed original ground and shall be so placed that the pipe joints will be accessible for any possible future repairs. Thrust blocks may not be used in lieu of mechanical restraint unless specifically authorized by CWD in writing.

PART 3 - EXECUTION

3.1. HANDLING PIPE

A. The Contractor shall take care not to damage pipe by impact, bending, compression, or abrasion during handling, and installation. Joint ends of pipe especially shall be kept clean.

B. Pipe shall be stored above ground at a height no greater than 5 feet, and with even support for the pipe barrel.

C. Only nylon-protected slings shall be used for handling the pipe. No hooks or bare cables will be permitted.

D. Using anything placed inside the pipe, like loader forks, to transport pipe is strictly prohibited. Pipe transported using anything inside the pipe shall be replaced at the cost of the contractor.

E. All pipe shall be tipped and cleared of debris prior to placement in the trench to clear potential debris from the pipe that may have accumulated in pipe that has been stored open to air.

F. Gaskets shall be shipped in cartons and stored in a clean area, away from grease, oil, heat, direct sunlight and ozone producing electric motors.

3.2. ALIGNMENT AND PLACEMENT OF PIPE

A. Jointing of ductile iron pipe and fittings shall be done in accordance with the printed recommendations of the manufacturer and as specified. The last 8-inches of the outside of the spigot end of pipe and the inside of the bell end of pipe shall be thoroughly cleaned. The joint surfaces and the gasket shall be painted with a lubricant just prior to making up the joint. The spigot end shall then be gently pushed home into the bell. The position of the gasket shall be checked to ensure that the joint has been properly made and is watertight. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.

B. Installation and jointing of push-on ductile iron pipe shall be in accordance with AWWA C600.

C. Mechanical joints shall be installed with Mega-Lug or Uni-Flange restraints. Restraints shall be installed in full accordance with the manufacturer's instructions. All bolt heads on Mega-Lugs or Uni-Flanges shall be tightened sufficiently so that they shear off to provide indication that proper tightening torque was achieved.

D. Fittings and valves shall be restrained for the minimum lengths listed on the following table:

Lengths shown are based on 150 psi test pressure, 4-foot bury, soil type GP, trench Type 3, a 0-foot length of run, a 45-degree vertical offset, a 6-foot low side depth, and 2:1 safety factor. Changes in conditions will require revision in lengths.

MINIMUM RESTRAINED LENGTHS	
Fitting	**Restrained Length**
4'' DIAMETER	
4" – 90° BEND	14-FEET IN EACH DIRECTION
4" – 45° BEND	6-FEET IN EACH DIRECTION
4" – 22.5° BEND	3-FEET IN EACH DIRECTION
4" – 11.25° BEND	2-FEET IN EACH DIRECTION
4" – 90° VERTICAL DOWN BEND	21-FEET IN EACH DIRECTION
4" – 45° VERTICAL DOWN BEND	11-FEET IN EACH DIRECTION
4" – 22.5° VERTICAL DOWN BEND	5-FEET IN EACH DIRECTION
4" – 11.25° VERTICAL DOWN BEND	3-FEET IN EACH DIRECTION
4" – 90° VERTICAL UP BEND	12-FEET IN EACH DIRECTION
4" – 45° VERTICAL UP BEND	4-FEET IN EACH DIRECTION
4" – 22.5° VERTICAL UP BEND	2-FEET IN EACH DIRECTION
4" – 11.25° VERTICAL UP BEND	1-FEET IN EACH DIRECTION
4" VALVE OR DEAD-END	25-FEET IN EACH DIRECTION
6'' DIAMETER	
6" – 90° BEND *	20-FEET IN EACH DIRECTION
6" – 45° BEND	8-FEET IN EACH DIRECTION
6" – 22.5° BEND	4-FEET IN EACH DIRECTION

6” – 11.25° BEND	2-FEET IN EACH DIRECTION
6” – 90° VERTICAL DOWN BEND *	31-FEET IN EACH DIRECTION
6” – 45° VERTICAL DOWN BEND	15-FEET IN EACH DIRECTION
6” – 22.5° VERTICAL DOWN BEND	7-FEET IN EACH DIRECTION
6” – 11.25° VERTICAL DOWN BEND	4-FEET IN EACH DIRECTION
6” – 90° VERTICAL UP BEND *	17-FEET IN EACH DIRECTION
6” – 45° VERTICAL UP BEND	6-FEET IN EACH DIRECTION
6” – 22.5° VERTICAL UP BEND	3-FEET IN EACH DIRECTION
6” – 11.25° VERTICAL UP BEND	2-FEET IN EACH DIRECTION
6”X6”X6” TEE	35-FEET ALONG THE BRANCH
6”X4” REDUCER	18-FEET LARGER DIRECTION ONLY
6” VALVE OR DEAD END	35-FEET IN EACH DIRECTION
8’’ DIAMETER	
8” – 90° BEND *	26-FEET IN EACH DIRECTION
8” – 45° BEND	11-FEET IN EACH DIRECTION
8” – 22.5° BEND	6-FEET IN EACH DIRECTION
8” – 11.25° BEND	3-FEET IN EACH DIRECTION
8” – 90° VERTICAL DOWN BEND *	40-FEET IN EACH DIRECTION
8” – 45° VERTICAL DOWN BEND	19-FEET IN EACH DIRECTION
8” – 22.5° VERTICAL DOWN BEND	10-FEET IN EACH DIRECTION
8” – 11.25° VERTICAL DOWN BEND	5-FEET IN EACH DIRECTION
8” – 90° VERTICAL UP BEND *	23-FEET IN EACH DIRECTION
8” – 45° VERTICAL UP BEND	8-FEET IN EACH DIRECTION
8” – 22.5° VERTICAL UP BEND	4-FEET IN EACH DIRECTION
8” – 11.25° VERTICAL UP BEND	2-FEET IN EACH DIRECTION
8”X8”X8” TEE	46-FEET ALONG THE BRANCH
8”X8”X6” TEE	35-FEET ALONG THE BRANCH
8”X6” REDUCER	19-FEET LARGER DIRECTION ONLY
8” VALVE OR DEAD-END	46-FEET IN EACH DIRECTION
12’’ DIAMETER	
12” - 90° BEND *	36-FEET IN EACH DIRECTION
12” - 45° BEND	15-FEET IN EACH DIRECTION
12” - 22.5° BEND	8-FEET IN EACH DIRECTION
12” - 11.25° BEND	4-FEET IN EACH DIRECTION
12” - 90° VERTICAL DOWN BEND *	57-FEET IN EACH DIRECTION
12” - 45° VERTICAL DOWN BEND	27-FEET IN EACH DIRECTION
12” - 22.5° VERTICAL DOWN BEND	13-FEET IN EACH DIRECTION
12” - 11.25° VERTICAL DOWN BEND	7-FEET IN EACH DIRECTION
12” - 90° VERTICAL UP BEND *	32-FEET IN EACH DIRECTION
12” - 45° VERTICAL UP BEND	11-FEET IN EACH DIRECTION
12” - 22.5° VERTICAL UP BEND	5-FEET IN EACH DIRECTION

12” - 11.25° VERTICAL UP BEND	3-FEET IN EACH DIRECTION
12”X12”X30” TEE	144-FEET ALONG THE BRANCH
12”X12”X12” TEE	65-FEET ALONG THE BRANCH
12”X12”X10” TEE	55-FEET ALONG THE BRANCH
12”X12”X8” TEE	46-FEET ALONG THE BRANCH
12”X12”X6” TEE	35-FEET ALONG THE BRANCH
12"X10" REDUCER	19-FEET LARGER DIRECTION ONLY
12” VALVE OR DEAD-END	65-FEET IN EACH DIRECTION
16’’ DIAMETER	
16” - 90° BEND *	46-FEET IN EACH DIRECTION
16” - 45° BEND	19-FEET IN EACH DIRECTION
16” - 22.5° BEND	10-FEET IN EACH DIRECTION
16” - 11.25° BEND	5-FEET IN EACH DIRECTION
16” - 45° VERTICAL DOWN BEND	35-FEET IN EACH DIRECTION
16” - 22.5° VERTICAL DOWN BEND	17-FEET IN EACH DIRECTION
16” - 11.25° VERTICAL DOWN BEND	9-FEET IN EACH DIRECTION
16” - 45° VERTICAL UP BEND	14-FEET IN EACH DIRECTION
16” - 22.5° VERTICAL UP BEND	7-FEET IN EACH DIRECTION
16” - 11.25° VERTICAL UP BEND	4-FEET IN EACH DIRECTION
16”X16”X6” TEE	35-FEET ALONG THE BRANCH
16”X16”X4” TEE	25-FEET LARGER DIRECTION ONLY
16” VALVE OR DEAD-END	84-FEET IN EACH DIRECTION

3.3. INSTALLATION

A. Piping Support:

1. Furnish and install supports to hold piping at lines and grades indicated or specified.

2. Support pipe and appurtenances connected to equipment to prevent any strain imposed on equipment.

B. Pipe and Fittings:

1. Contractor shall take all necessary precautions to minimize contamination of water mains while storing, handling and installing the water mains prior to disinfection. The interiors of pipes, fittings and valves shall be kept clean and dry.

2. When storing or stringing pipe on-site, Contractor shall take all necessary precautions to ensure no foreign materials enter the water

mains. Contractor shall ensure pipe is not stored on-site longer than 1-week prior to installation to minimize the risk of contamination.

3. If dirt enters the water mains upon installation, material shall be removed, and the interior of the pipe cleaned with a 1 to 5 percent hypochlorite solution.

4. Remove and replace defective pieces.

5. Clear of all debris and dirt before installing and keep clean until accepted.

6. Lay accurately to lines and grades indicated or required. Provide accurate alignment, both horizontally and vertically.

7. Provide firm bearing along entire length of buried pipelines.

8. All water mains and service pipe shall be laid in a trench separate from any other utility. The horizontal distance between water mains or service pipe and any other utility shall be at a minimum of two (2) feet, vertical distance shall be no less than one (1) foot, and no less than ten (10) feet from a sanitary sewer or surface water drain unless pre-approved by the Cambridge Water Department.

C. Temporary Plugs: When pipe laying is not in progress, close open ends of pipe with temporary watertight plugs. If water is in the trench, do not remove plug(s) until danger of water entering pipe passed.

D. Appurtenances: Set valves, fittings and appurtenances as indicated.

3.4. JOINTS AND COUPLINGS

A. Push-on Joints:

1. Insert gasket into groove bell. Apply thin film of nontoxic gasket lubricant over inner surface of gasket in contact with spigot end.

2. Insert chamfered end into gasket. Force pipe past it until it seats against socket bottom.

3. Where required, install restraint and secure push-on joint restraint in accordance with manufacturer's instructions.

B. Mechanical Joints:

1. Wire brush surfaces in contact with gasket and clean gasket.

2. Lubricate gasket, bell, and spigot with soapy water.

3. Slip gland and gasket over spigot and insert spigot into bell until seated.

4. Seat gasket and press gland firmly against gasket.

5. After bolts inserted and nuts made finger-tight, tighten diametrically opposite nuts progressively and uniformly around joint by torque wrench. Torque bolts to values specified above. Confirm that minimum of three (3) threads show beyond the nuts.

C. Sleeve-Type Coupling:

1. Clean pipe ends for distance of 8 in.

2. Use soapy water as gasket lubricant.

3. Slip follower and gasket over each pipe to a distance of 6 in. from end and place middle ring on pipe end until centered over joint.

4. Insert other pipe end into middle ring and bring to proper position in relation to pipe laid.

5. Press gaskets and followers into middle ring flares.

6. After bolts inserted and nuts made fingertight, tighten diametrically opposite nuts by use of torque wrench of size and torque specified by the manufacturer.

3.5. TESTING

A. Clean of all dirt, dust, oil, grease and other foreign material, before conducting pressure and leakage tests.

B. Pressure and Leakage Tests. Refer to Section 02704 for requirements.

3.6. DISINFECTING AND FLUSHING

A. Disinfect potable water lines using procedures and materials conforming to AWWA C651.

B. Refer to Section 02675 for additional requirements.

3.7. ENCASEMENT OF SANITARY AND STORM SEWERS

A. Sanitary, combined, and storm sewers shall be polyethylene wrapped and concrete encased according to the utility details if field conditions do not allow for a minimum of 10’ of horizontal clearance or a minimum of 18” of vertical separation with the sewer pipe below the water main. Encasement must be

provided 10’ beyond the crossing in each direction. Encasement may include concrete encasement or approved equal.

B. See utility detail sheets for more details.

C. Separation of water mains and sewers shall adhere to the Commonwealth of Massachusetts Guidelines for Public Water Systems.

END OF SECTION 02630

SECTION 02640

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

1. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements ***include accurate and legible swing tie dimensions (2 ties per item from existing building corners, existing gate valves, and/or existing hydrants only) to all new water main gate valves, Tee's and elbows***, required CWD "sign off's" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The contractor is hereby advised that the CWD will not be responsible for the contractor's slip in project schedule if these requirements for permits are not followed."

1.2 SUMMARY

A. This Section including the following:

1. Providing exterior valves, at the locations indicated and/or as required, complete in place in accordance with the drawings and specifications.

2. Valves shall be restrained mechanical joint.

B. Related sections include the following:

1. Section 02630 – DUCTILE IRON PIPE AND FITTINGS

2. Section 02645 – HYDRANTS

3. Section 02647 – CONNECTION TO EXISTING WATER MAINS

4. Section 02660 – WATER SERVICES

5. Section 02675 – DISINFECTION OF WATER MAINS

6. Section 02685 – TEMPORARY BYPSS PIPING FOR WATER MAINS

7. Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

1.3 SUBMITTALS

A. Shop Drawings: Submit the following:

1. Submit shop drawings and descriptive literature, showing valve dimensions, valve manufacturer, country of manufacture, and other details for each type and class of valve to be furnished.

2. Certification that all brass goods and valve materials in contact with potable water comply with the Safe Drinking Water Act Lead Reduction law and comply with NSF Standard 372.

1.4 QUALITY ASSURANCE

A. All valves furnished under the Contract shall be manufactured only in accordance with the Specifications and the approved drawings.

PART 2 - PRODUCTS

2.1 RESILIENT GATE VALVES AND VALVE BOXES

A. Resilient gate valves shall be iron body, bronze mounted, resilient seated type. The valves shall be designed for 200 psi working pressure and 300 psi test pressure. Valves shall have corrosion resistant fusion - bonded interior and exterior coatings.

B. Valve materials in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

C. Valves are to have O-ring seals and a rising stem. Valves shall have a 2-inch operating nut. Bolts on the bonnet and stuffing box shall be stainless steel (304 stainless steel). Valves shall open right (clockwise). Operating nuts shall be painted red indicating open right. Valves installed with greater than 6’-0” of cover shall be provided with valve operating stem extensions per pre-approval of the Cambridge Water Department.

D. Resilient gate valves shall meet the most recent version of the AWWA standard specification AWWA C515 “Reduced-Wall Resilient-Seated Gate Valves for Water Supply Service”.

E. Resilient wedge valves shall have mechanical joint ends and shall be equal to ANSI/AWWA C111/A21.11.

F. Valves shall be as manufactured in North America by Clow Corporation Model R/W, Mueller Resilient Wedge, American Cast Iron Pipe Company Series 2500 RW, U.S. Pipe Metroseal 250, American AVK Resilient Seat Gate Valve, Kennedy Ken-Seal or equal.

G. The restraining mechanism shall consist of individually actuated wedges that increase their resistance to pull out as pressure or external forces increase. The device shall be capable of full mechanical joint deflection during assembly.

2.2 BUTTERFLY VALVES

A. Butterfly valves for buried service shall conform to AWWA C504 "Rubber Seated Butterfly Valves", except as hereinafter provided. Butterfly valves shall be rated for Class 150b and both valve operators shall be especially designed for service buried in ground and shall be of the totally enclosed type. The unit shall be permanently lubricated with grease or oil. A standard AWWA 2-inch square operating nut shall be provided on the input shaft. Valves shall open to the right (clockwise).

B. Butterfly valves shall have interior and exterior coated with 8-mm epoxy coating. Valve body shall be ASTM A-126 cast iron. Valve to be seat-in body design and furnished with through disc pinning. Valve disc shall be ASTM A-126 cast iron. Disc edge shall be stainless steel. Packing to be chevron "V" type, self-adjusting. Bearings shall be non-metallic to prevent galvanic corrosion.

2.3 CLEANING AND PRIME COATING VALVES AND APPURTENANCES

A. Prior to shop prime coating, all surfaces of the valves and appurtenances shall be thoroughly clean, dry, and free from all mill-scale, rust, grease, dirt, paint and other foreign substances to the satisfaction of the Engineer.

B. All ferrous surfaces shall be sand blasted or pickled according to SSPC-SP6 or SSPC-SP8, respectively.

2.4 TAPPING SLEEVES AND VALVES

A. Tapping sleeves shall be ductile iron, full body mechanical joint type and shall be Mueller H-615, American Darling 2800-C or approved equivalent.

B. Valve materials in contact with potable water shall be lead free with lead level not exceeding 0.25%". Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

C. Tapping valves shall meet the requirements of AWWA C223 "Fabricated-Steel

and Stainless-Steel Tapping Sleeves". The valves shall be full-bodied, flanged by mechanical joint outlet with non-rising stem and designed for vertical burial. Tapping valves shall be rated at 200 psi working pressure and shop tested at 300 psi. Bolts on bonnet and stuffing box shall be stainless steel (316 stainless steel); stuffing boxes shall be "O" ring type. The operating nut shall be 2-inches square. The valve shall be provided with oversized seat to permit use of full size cutters. Gaskets shall cover the entire flange surface. Valves shall open right (clockwise). Valves installed with greater than 6' of cover shall be provided with valve operating stem extensions per pre-approval of the Cambridge Water Department.

2.5 VALVE BOXES

A. Valve boxes shall be provided for each valve.

B. Valve boxes shall be cast iron of the telescopic design with two-piece construction, a top with a cover and a bottom, and manufactured in North America. The top section shall have a top flange to increase the stability of the box to remain at the present height. The lower section of the box shall have a bell-shaped bottom designed to enclose the operating nut and stuffing box of the valve without settling.

C. The valve box shall come complete with a cover on which the word "WATER" shall be cast. The cover of the valve box shall be close fitting and substantially dirt tight and flush with the top of the box rim and shall be Bingham & Taylor Model CUL5L-RDB (Fig. No. 4905-L1.5), Model CUL5L-LSK (Fig. No. 4905-L2.5) or approved equal.

2.6 INSERTION VALVES

A. Insertion valves shall be AVT EZ Valve or Equal.

PART 3 - EXECUTION

3.1 CLEANING AND PRIME COATING VALVES AND APPURTENANCES

A. All gears, bearing surfaces and other surfaces not to be painted shall be given a heavy coat of grease or other suitable rust resistant coating unless otherwise specified herein. This coating shall be maintained as required to prevent corrosion during any period of storage and installation and shall be satisfactory to the Engineer through the time of final acceptance.

3.2 INSTALLATION

A. Prior to any work or installation of any valves and appurtenances, the contractor shall contact, coordinate, and schedule with CWD a minimum of seven (7) working days pre-construction valve operation procedures.

B. All valves and appurtenances shall be installed in the location shown on the drawings or where required by the Engineer. Valves shall be true to alignment and rigidly supported. Any damaged items shall be replaced before they are installed.

C. Care shall be taken to prevent damage to valves and appurtenances during handling and installation. All materials shall be carefully inspected for defects in workmanship and materials, all debris and foreign material cleaned out of valve openings, and all operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced.

D. Restraints shall be installed as per manufacturer's instructions.

E. Butterfly valves shall be pressure tested for 15 minutes on ground prior to installation.

3.3 TAPPING SLEEVE AND VALVE

A. Tapping sleeve and valves shall be installed in accordance with specification Section 02647.

3.4 SHOP PAINTING VALVES AND APPURTENANCES

A. Interior and exterior surfaces of all valves which are not factory epoxy coated shall be given two shop coats of an approved two component epoxy coating. Interior coating shall be formulated for potable water use and exterior coating shall be asphaltic epoxy paint. The pipe connection openings shall be capped to prevent the entry of foreign matter prior to application.

3.5 BURIED VALVES

A. Buried valves and boxes shall be set with the operating stem vertically aligned in the center of the valve box. Valves shall be set on a firm foundation and supported by tamping selected excavated material under and at the sides of the valve.

3.6 VALVE BOXES

A. Valve boxes shall be installed vertically, centered over the operating nut, and the elevation of the top shall be adjusted to conform with the finished surface of roadway or other surface at the completion of the contract. Valve box aligners shall be used in the alignment process.

B. Valve boxes shall be exposed always. Burying of valve boxes shall not be allowed.

3.7 VALVE BOX ALIGNERS

A. Valve box aligners shall be installed by removing the operating nut of the valve and sliding it over the valve stem. Care shall be maintained to adequately support system during backfilling to maintain vertical alignment.

END OF SECTION 02640

SECTION 02645

HYDRANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Section 01060 – PERMITS AND REGULATORY REQUIREMENTS

1. The Cambridge Water Department (CWD) will not issue new water construction permits until all requirements for previous (i.e., initial CWD permit) CWD permits are met. These requirements ***include accurate and legible swing tie dimensions (2 ties per item from existing building corners, existing gate valves, and/or existing hydrants only) to all new water main gate valves, Tee's and elbows***, required CWD "sign off's" on the contractor's copy of the CWD executed permit (when permitted work is complete), test documentation that includes Massachusetts State certified initial chlorination and bacteria testing of new water main work, and pressure test results of new water main work. The contractor is hereby advised that the CWD will not be responsible for the contractor's slip in project schedule if these requirements for permits are not followed.

1.2 SUMMARY

A. This Section includes the following:

1. Providing hydrants, gate valves and boxes and appurtenant work, complete in accordance with the drawings and specifications.

B. Related sections include the following:

Section 02630 – DUCTILE IRON PIPE AND FITTINGS

Section 02647 – CONNECTING TO EXISTING WATER MAINS

Section 02675 – DISINFECTION OF WATER MAINS

Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

1.3 SUBMITTALS

A. Shop Drawings: Submit the following:

1. Submit shop drawings and manufacturer's location and descriptive literature, showing hydrant dimensions and features. Include country of manufacture.

2. Submit certifications that all wetted surface metals in contact with potable water comply with the 2014 Safe Drinking Water Act Lead Reduction law and comply with NSF 372.

1.4 QUALITY ASSURANCE

A. All hydrants furnished under the Contract shall be manufactured only in accordance with the Specifications and the drawings.

PART 2 - PRODUCTS

2.1 HYDRANTS

A. Hydrants shall conform to the "standard for Dry-Barrel Fire Hydrants" ANSI/AWWA C502-18. Hydrants shall be designed for 150 psi service and for installation in a trench with 5-foot cover (5-1/2 feet bury hydrant). Hydrant barrel extensions shall be furnished and installed as necessary to achieve correct bury depth. The length of the hydrant barrel shall be such that when installed with the proper depth of cover on the branch pipeline, the hydrant will be set with the normal ground line of the barrel within 3-inches of the actual ground grade surface elevation.

B. Hydrants shall be fabricated to manufacturer's standard pattern and size and shall have one 4-1/2 inch steamer and two 2-1/2 inch hose nozzles all with National Standard Thread (NST). Hydrant inlet opening on shoe shall have mechanical joints for accepting 6-inch ductile or cast iron pipe.

C. Hydrants shall open clockwise and shall be marked with an arrow and word "OPEN" to indicate the direction of turn of the stem to open the hydrant.

D. Hydrants shall have a compression type main valve, opening against and closing with water pressure. The main valve opening at the base of the hydrant shall have a minimum area of 39 square inches (5-inch minimum diameter circle). Each hydrant shall have "traffic" type ground line construction (breakaway bolts not acceptable) and permit 360-degree movement of the upper barrel to allow for any alignment without shutting down service and/or removing flange bolts and nuts. Hydrant operating nut shall be 1-1/2 inches, flat to point, pentagonal. Connecting pipe and pipe nipples between the main line tee and hydrant shall be 6-inch ductile iron conforming to the requirements for ductile iron pipe.

E. Hydrants shall be hydrostatically tested as specified in AWWA C502.

F. Hydrant tees shall be anchor type. The branch shall have a plain end with an integral gland and rotating mechanical joint restraints. Hydrant branches shall be fully restrained from the anchor tee to the hydrant. Every hydrant shall be equipped with a 6-inch shut-off valve, bolted or anchored to the hydrant tee.

G. Hydrants shall be flow tested and painted per Cambridge Water Department requirements. See 3.1.G this Section.

H. Materials used for wetted surface metals in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the 2014 Safe Drinking Water Act Lead Reduction law and comply with NSF 372.

2.2 SAFETY FLANGE REPAIR KITS

A. Safety flange repair kits shall come complete with stem coupling, safety flange, flange gasket, replacement bolts and nuts and hydrant lubricating oil.

B. Safety flange repair kits shall be compatible with hydrant furnished.

2.3 EXTENSION KITS

A. Extension kits shall be provided as necessary and shall come complete with extension barrel, extension stem, stem coupling and hardware, flange, flange gasket, 8 bolts and nuts and hydrant lubricating oil.

B. Extension kits shall be compatible with hydrant furnished.

2.4 RESTRAINTS

A. Hydrants, valves and pipe shall be restrained using methods of restraint approved by the Engineer. Restraint shall be provided with the use of thrust blocks, mechanical restraint or a combination. Mechanical restraint shall be provided using EBAA Mega-Lug, Uni-Flange Series 1400 or approved equivalent.

2.5 PAINT

A. Hydrants shall be painted with Hammond, gloss enamel, interior and exterior, industrial maintenance coating, color “Hydrant Blue” after installation and CWD has flow tested the appurtenance.

PART 3 - EXECUTION

3.1 HYDRANTS

A. Hydrants shall be installed in conformance to AWWA C600, Section 11, latest

revision approved restraint and anchor tees.

B. Hydrants shall be set at the locations shown on the Drawings or as designated by the Engineer and shall be bedded on a firm foundation. A 5-cubic foot minimum drainage pit shall be filled with ¾-inch crushed stone and satisfactorily compacted. During backfilling, crushed stone shall be brought up around, and 6-inch over, without blocking the drain ports.

C. Each hydrant shall be set in true vertical alignment and shall be properly braced.

D. Restraints shall be installed in accordance with the requirements stated herein.

E. Hydrants shall be cleaned, finish painted to match City of Cambridge color scheme, and touched up after installation.

F. Hydrants set too high or too low shall be excavated and reset to the proper depth as indicated by the bury line. Hydrant extensions shall be installed where required to maintain proper depth.

G. Remove and stack existing hydrants at as shown on the Drawings or as required by the Engineer. Removed hydrants shall be delivered to the Owner's storage facility or disposed as directed by CWD. The existing branch line shall be capped and the hydrant branch valve closed and the box removed.

H. All new hydrants installed by Contractor for the City shall be flow tested by the Contractor in coordination with the City of Cambridge Water Department (CWD). All new hydrants shall be color coded accordingly:

1. Blue/Silver – 1500 gpm or more
2. Green/Silver – 1000 -1499 gpm
3. Orange/Silver – 500-999 gpm
4. Red/Silver – 400-500 gpm
5. Black/Silver – 400 gpm or less

END OF SECTION 02645

SECTION 02647

CONNECTION TO EXISTING WATER MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:

1. Connecting to existing water mains.

B. Related sections include the following:

Section 02210 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

Section 02630 - DUCTILE IRON PIPE AND FITTINGS

Section 02640 – VALVES AND APPURTENANCES

Section 02645 – HYDRANTS

Section 02675 – DISINFECTION OF WATER MAINS

Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

PART 2 - PRODUCTS

2.1 TAPPING VALVES

A. Tapping valves and couplings shall be as specified in Section 02640.

2.2 SLEEVES

A. Contractor shall verify existing pipe materials and diameter pipe prior to ordering sleeves.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: The Contractor shall verify field conditions by test pits or other methods prior to construction.

3.2 INSTALLATION

A. The Contractor shall make all connections to the existing mains as indicated in the Contract Documents.

B. The Contractor shall develop a program for the construction and putting into service of the new work subject to the approval of the Engineer. All work involving cutting into and connecting to the existing water mains shall be planned so as to interfere with operation of the existing facilities for the shortest possible time.

C. The Contractor shall have all preparatory work done prior to making the connection and shall provide all labor, tools, material, and equipment required to do the work in one continuous operation.

D. The Contractor shall have no claim for additional compensation, by reason of delay or inconvenience, for adapting their operations to the requirements of the Owner.

E. Under no circumstances shall any customer be without water for a period of more than 7 hours without prior written approval of the Owner. Should it appear that any customer will be without water for more than 7 hours, the Contractor shall install temporary water service at no additional cost to the Owner.

F. The Owner does not guarantee a tight shut-off for existing local community water valves. No damages shall be claimed by the Contractor for delays in dewatering pipelines nor shall any damages be claimed because of water leaking through closed valves after dewatering is completed. It shall be the responsibility of the Contractor to provide the means to dewater the excavation if required when making connections.

G. The Contractor shall be responsible for the following restrictions on shutdown of water mains:

1. Distribution system valves and hydrants to be operated only by City of Cambridge Water Department personnel.

2. One-week advance notice for shutdown request shall be given to Cambridge Water Department.

3. Contractor shall notify by flyer all affected water customers a minimum of 72 hours prior to any water main shutdown.

4. The Contractor shall apply for and receive all necessary permits with the City of Cambridge Water Department prior to making any connections to the existing water system.

5. There are shutdowns that will be required to occur in the overnight. Night time shutdowns will require a "Noise Variance Permit" from the City of Cambridge. These Permits are in addition to the CWD permits. The Contractor should allow for 3-4 weeks to coordinate and receive this Permit.

3.3 APPLICATION

A. Special Techniques: Tapping Connections:

1. Tap connections to existing mains shall be made with service pressure in the main, using tapping sleeve and valve and a suitable tapping machine.

2. Hydrostatically test installed tapping sleeve to 150 psig for a minimum of 15 minutes. Inspect sleeve for leaks, and remedy leaks prior to tapping operation.

3. Other connections to existing mains shall be made with the main out of service, unless otherwise required by the Engineer.

4. Tap connections to existing mains using tapping sleeve and valve shall only be performed with prior approval by the Engineer and Cambridge Water Department.

3.4 CLEANING

A. Contractor shall clean the existing main with wire brush and wash the pipe surface and the tapping sleeve and valve interior with 5% hypochlorite (bleach) solution.

3.5 TESTING

A. Valve and sleeve shall be leak free. Any visible leakage shall be corrected at no additional cost to the owner.

END OF SECTION 02647

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02660

WATER SERVICES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. For all existing 1" or larger copper services or existing ductile iron services, the service will be reconnected from the new main to the point of reconnection with a service that is copper or ductile iron and equal or greater in size than the reconnected service.

2. For all existing cast iron services, the service will be replaced with a service that is ductile iron and equal or greater in size than the reconnected service from the new main to the property line or the building face, unless otherwise directed by the Engineer

3. Replace all existing non-copper services (3" and smaller) within the project limits in their entirety from the water main to the meter, including corporation stops, saddles, curb stops and boxes, meter valves, foundation core & seals and meter reconnections unless otherwise directed by CWD or the Engineer in writing. All new copper services shall be 1" minimum and be equal or greater in size than the existing service.

4. In general, a service shall be brought to each developed parcel of property along the water main route. Reconnect new services to existing copper, ductile iron, or cast iron services.

5. Replace all services ¾" and smaller with 1" copper services. Copper services (¾" in size) that run from the curb stop to the meter shall not be replaced unless directed by the Engineer.

6. Contractor shall coordinate with property owners for replacement of water services on private property. No work shall occur on private property unless there is a Right-of Entry signed by the Owner of that property that authorizes the work.

7. The contractor shall provide concrete encasement of existing sewer mains and/or laterals as necessary if adequate horizontal and/or vertical separation cannot be maintained between sewer piping and water piping. Encasement shall be per the Massachusetts Guidelines for Public Water Systems, Separation of Water Mains and Sewers and the

Construction Details shown on the Contract Drawings.

8. Contractor shall inspect each water service box over the curb stop to check for ¼ turn valves at each curb stop within the water main work area. If a curb stop is not a ¼ turn valve, the contractor shall replace the existing curb stop with a new ¼ turn curb stop and new curb stop box.

B. Related sections include the following:

Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

Section 02630 – DUCTILE IRON PIPE AND FITTINGS

Section 02640 – VALVES AND APPUTENANCES

Section 02675 – DISINFECTION OF WATER MAINS

Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

1.2 SUBMITTALS

A. Shop Drawings: Submit the following:

1. Submit manufacturer's technical product data or descriptive literature, or both, showing services, corporation stops, saddles, curb stops, tubing, fittings and other details for each type of service to be furnished for the project.

2. Submit curb box and lid information and valve box and cover information for all services.

3. For informational purposes only, submit manufacturer’s written installation instructions.

1.3 QUALITY ASSURANCE

A. Provide in accordance with Section -1400 – QUALITY AND CONTROL

B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of potable water services materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than five years.

PART 2 - PRODUCTS

2.1 SERVICES

A. Unless otherwise specified, all pipe for services for 1-inch to 3-inch mains shall be copper tubing, type K, drawn temper.

1. Type K hard-temper in sizes larger than 1-inch.

2. Type K soft-temper for 1-inch services.

B. Copper type shall conform to ASTM B42 and AWWA C800 “Underground Service Line Valves and Fittings”.

C. Fittings shall be cast bronze for copper pipe and cast bronze or copper stream-lined fittings for copper tubing conforming to ASTM B16.18.

D. Unions shall be bronze with ground joints and shall be semi-finished.

E. Joints for copper fittings shall be made with solder composed of 95 percent tin and five percent antimony. Connections to ductile iron fittings and pressure reducing valves within valve vaults shall be threaded.

F. Pipe and fittings in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

2.2 CORPORATIONS, CURB STOPS AND SADDLES

A. The corporation stops shall meet the most recent revision of the AWWA standard "Threads for Underground Service Line Fittings" (AWWA C800). Corporation stops shall be Mueller 110, Model H-15008, designed for 175 psi test pressure and manufactured by Mueller Inc. or approved equivalent. Stops to have full keyway and rigid liners.

B. Curb stops shall be Mueller H15219 Mark II Oriseal or approved equivalent with drain suitable for use with copper tubing. Stops shall have integral checks, O-ring seal and shall be furnished with rigid liners.

C. Curb stop boxes shall be cast iron Buffalo type with recessed lid with pentagon bolt, adjustable sliding type. Curb stop covers shall be Bingham & Taylor “2 ½” New Style Flush Fit Lid.

D. Service saddles for 1-inch and 2-inch taps shall be Smith-Blair 317 Double Strap or approved equivalent. Bodies shall be ductile iron and straps shall be stainless steel. Units shall be complete with Buna-N gaskets or approved equivalent.

E. Pipe and fittings in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

2.3 FITTINGS

A. Unless otherwise approved, only compression type fittings manufactured by Mueller Inc., or approved equivalent, shall be used.

B. Adapters required to allow connection to existing services shall be provided.

C. Pipe and fittings in contact with potable water shall be lead free with lead level not exceeding 0.25%. Materials shall comply with the Safe Drinking Water Act Lead Reduction law and with NSF Standard 372.

PART 3 - EXECUTION

3.1 CONSTRUCTION

A. Water service corporations may be installed as a "wet" or “dry” tap. The Contractor should give consideration to the close proximity of other existing utilities immediately adjacent to the new main and consider preinstalling saddles and corporations as necessary.

B. Exact locations of services shall be located in the field by the Contractor and shall be located so that they align with existing copper or ductile iron services scheduled for reconnection. All services shall be installed to a minimum depth of 4' unless specifically shown or directed otherwise by the Engineer. If an existing service is at a depth less than 3.5’, Contractor shall contact Cambridge Water Department.

C. Water service trenches shall be excavated and backfilled in accordance with the specifications and in conformance to the details provided in the plans.

D. Each service shall be flushed thoroughly, and the end closed with a plug or corporation stop prior to backfilling prohibiting soils or groundwater from entering the pipe.

E. Connections to the existing services shall be thoroughly flushed, from the water main to the water meter, prior to connecting. Contractor shall be responsible for removal of the household meter and filters and flushing the entire service line to prevent scale-debris from blocking fixtures and appliances when and where applicable.

F. Curb and Valve boxes shall be straight, plumb, centered over curb stops or

corporations. Curb or valve boxes not straight, plumb or centered shall be removed and reset by the Contractor at no additional cost to the Owner.

G. The contractor shall be responsible for confirming that ALL curb stops be "1/4 turn" style, and replacing any curb stops that are found to be of a different style.

END OF SECTION 02660

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02675

DISINFECTION OF WATER MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This section includes the following:

1. Flushing and Disinfection of pipelines.

B. Related section includes the following:

Section 02630 - DUCTILE IRON PIPE AND FITTINGS FOR WATER MAINS

Section 02640 - VALVES AND APPERTANENCES

Section 02645 - HYDRANTS

Section 02704 - PIPELINE PRESSURE AND LEAKAGE TESTING

1.3 SYSTEM DESCRIPTION

A. Disinfect all water mains installed under this contract. Disinfection shall occur subsequent to the installation of the new pipe in accordance with Section 02630 – DUCTILE IRON PIPE AND FITTINGS FOR WATER MAINS.

B. The location of new main line is shown on the Drawings.

C. Pipeline disinfection shall be performed in conjunction with the related work items of dewatering, testing, flushing, dechlorination of water with high concentrations of chlorine, and discharge; prior to placing newly installed water main in service. The Contractor's responsibility shall include:

1. Providing chlorine product for disinfection at the rate and dose specified and in accordance with AWWA standards.

2. Providing pipeline taps for dosing and testing of chlorinated water, as necessary.

3. Furnishing, installation and removal of bulkheads required for testing.

4. Labor, equipment, and materials necessary and required to dispense and dose chlorine at points and rates required by the Engineer, dechlorinate and chlorinate water for discharge, and operate newly installed mainline valves, air release valves, and blowoff valves as necessary and required by the Engineer shall be the responsibility of the Contractor.

D. All new water main segments longer than 15' shall be disinfected and tested between 2 new valves per the Cambridge Water Department requirements, unless pre-approved otherwise by the Cambridge Water Department.

E. Contractor shall be responsible for coordinating all activities with the Cambridge Water Department (CWD) when using City hydrants or water for disinfection purposes.

1.4 PROJECT/SITE CONDITIONS

A. All flushing water shall be discharged in accordance with local, state and federal regulations. The DPW shall be contacted prior to flushing. Dechlorination facilities shall be used as required.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate operation of existing valves, timing and duration of shutdown of existing mains, and disinfecting, flushing and re-energizing of the water main with the Engineer and where applicable with the Owner including notification of the following prior to the stated work:

1. Valve Operations: Notify Engineer and CWD three (7) days prior to stated work.

a. The opening and closing of existing valves shall be performed by CWD personnel only.

2. Disinfecting and Flushing: Notify Engineer three (3) days prior to stated work.

3. Notification shall include location of work, length and diameter of the pipe and other pertinent information.

4. Contractor shall notify by flyer all affected water customers a minimum of 72 hours prior to any water main shutdown.

1.6 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS:

1. One week prior to initiating disinfection work, the Contractor shall submit to the Engineer a written workplan describing the flushing/swabbing and disinfection protocol, including but not limited to the following: management of water, chemical data, feed rates, dichlorination plan and disposal methods. The workplan shall also include, but not be limited to, the following:
   a. List of main segments by valve or station locations.
   b. Description of the pipe diameter and lengths to be tested.
   c. Full description of method to be used (slug or continuous feed) in disinfecting the mains.
   d. Chlorine agent to be utilized.
   e. Chlorine material safety data sheets.
   f. Chlorine batching calculations to show required level of chlorine being added to the mains.
   g. Flushing methods listing pipe diameter, length, flushing time calculations and location of flushing outlets.
   h. Methods of measuring chlorine solution being added to the pipe and after it has been added.
   i. Sample collection techniques.
   j. Names of personnel who will be conducting the disinfecting and sampling.
   k. Name of laboratory proposed to perform the tests.
   l. Dechlorination methods, including dechlorination agent and locations.
   m. Backflow preventor data (model, size).

B. Submit data on DEP-certified laboratory to be used for sample collection and testing.

C. Written laboratory analysis reports.

D. Test results for chlorine residuals for times as specified in the method of disinfection shall be submitted to the CWD.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Calcium hypochlorite shall conform to AWWA B300.

1. Granules with 70 percent available chlorine.

2. Calcium hypochlorite intended for swimming pool disinfection shall not be used.

B. Liquid sodium hypochlorite shall conform to AWWA B300.

C. Owner-approved backflow preventer devices.

D. Line purge dechlorinator with dechlorination tablets. Dechlorinator shall have 2-1/2 inch NPT coupling and capacity flow rates of up to 1,600 GPM. Dechlorination tablets shall be sodium sulfite or sodium thiosulfate, capable of dechlorinating the flushed water. Dechlorinator shall be H20 Neutralizer as manufactured by Measurement Technologies, Inc., Redmon, WA (860-651-3368), Model LPD-250 as manufactured by J. Pollard Co., Hyde Park, NY or approved equivalent.

E. Chlorine residual analyzer.

2.2 LABORATORY

A. Contractor shall employ a DEP-certified laboratory to collect samples and perform bacteriological tests. CWD may allow the Contractor to have CWD collect samples and perform bacteriological tests.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:

1. Perform disinfection and flushing in accordance with AWWA C651.

2. The Engineer will review flushing and disinfection procedures with CWD prior to the Contractor performing the disinfection and flushing work.

3. If connections are made to municipal water systems, Owner-approved backflow preventer shall be installed in the line to prevent backflow or siphonage of water into the municipal system.

B. Flushing:

1. Prior to chlorination, mains up to 16-inch in diameter shall be properly flushed by the Contractor. In general, flushing shall be performed at a flow rate required to achieve a minimum velocity of 3.0 feet per second (approximately 4250 GPM in a 24-inch main, 750 GPM in a 10-inch diameter main, and 400 GPM in 8-inch diameter main). Flushing shall be performed for a sufficient period of time to allow for a minimum of 3 volume changes of water in the main (approximately 20 minutes per 1000-feet of main at the above flow rate).

C. Discharge:

1. Following disinfection, water with high concentrations of chlorine shall be discharged as required by the Owner or the Owner's Representative.

a. The Contractor shall notify the Engineer of the specific location where chlorinated water will be discharged at least one week in advance of proposed discharge. The Engineer will then inform the Owner.

2. Water with high concentrations of chlorine (residual greater than 2mg/l) shall be dechlorinated to a level of 2 PPM or less prior to its discharge to storm drains or natural bodies of water. Dechlorination shall be conducted by use of a line purge dechlorinator or other method acceptable to the Engineer. Dechlorination shall be in accordance with the manufacturer's instructions and AWWA C651, Section 4.5.

3.2 INSTALLATION

A. Calcium Hypochlorite:

1. Use only as a solution.

2. Pump into pipe with a suitable chemical feed pump.

3.3 APPLICATION

A. Special Techniques:

1. Disinfect pipes by the continuous feed or slug method.

a. Continuous feed method:

1) Operate all appurtenances to ensure that all hydrants, gate valves, and sample taps have been disinfected. Work with CWD during valve operation to prevent super chlorinated water from entering existing distribution system.

2) CWD will operate all valves in the system. Contractor shall coordinate with the CWD a minimum of 48 hours in advance to arrange for CWD personnel to operate valves.

3) Perform pressure and leakage testing in accordance with specification 02704.

4) Feed chlorine into pipe so water entering contains 25 mg/l of available chlorine.

5) Apply chlorine continuously until entire pipe is filled with chlorine solution. All chlorination ports must be open before system gates are operated to ensure one-way flow.

6) Retain treated water in pipe for at least 24 hours.

7) Ensure that chlorine residual at end of test is at least 10 mg/l.

8) Coordinate a third-party testing agency or CWD to collect bacteriological samples after 24-hour hold period.

9) Provide all laboratory and pressure test results, and chain of custody documentation to Owner and Engineer under a submittal cover when results are available. Any failed test results must also be provided for review when available. Contractor shall not activate mains until final approval is received from the City of Cambridge Water Department. Allow for 24 hours for City approval.

10) All corporations used for disinfection purposes shall be closed and plugged after disinfection is complete. All tubing shall be removed.

11) Activate water main

b. Slug Method

1) Slowly feed through the main a slug of water having a chlorine concentration of 100 mg/l so that all parts of the main and appurtenances are exposed to the highly concentrated solution for a period of at least three (3) hours.

2) Water from existing distribution system or other approved supply source shall be made to flow at a constant measured rate, into the new main.

3) At a point not more than ten (10) feet downstream from the beginning of the new main, water entering the new main shall receive a constant dose of free chlorine having a concentration of 100 mg/l.

4) The free chlorine shall be measured as it moves through the main. If the level drops below 50 mg/l, flow shall be stopped chlorination equipment shall be relocated to the head of the slug and as flow is resumed, chlorine shall be applied to restore the free available level to 100 mg/l.

5) Valves and hydrants shall be operated as the chlorinated water flows past them to insure disinfection occurs.

6) Ensure that appurtenances are fully disinfected.

3.4 FIELD QUALITY CONTROL

A. Tests:

1. Measure chlorine levels with meters or color-wheel. Paper pool strips are not acceptable methods for determining chlorine levels.

2. Bacteriological test samples shall be collected by a DEP-certified laboratory for the Contractor after the chlorine solution has been flushed out of the pipe.

3. Disinfection shall be repeated, as necessary, to produce satisfactory bacteriological samples.

4. Twenty-four (24) hours after the main has been flushed of chlorinated water, bacteriological samples shall be taken. Water samples shall be taken from corporation stops along the length of the water main. A minimum of two (2) samples shall be taken 15 minutes apart with the sample tap running, per 1,200 feet of pipe, at each end, and at branches greater than 1 pipe length, each in duplicate, in sterile bottles and sent to a State approved private laboratory for analyses. The Contractor shall be responsible for all necessary work including delivery of samples to a certified laboratory, and shall include the cost for sampling and analysis in his bid price. The results of the tests on these samples will determine the acceptance of the work and allow these new mains to be connected to the Owner's system. The failure of any sample to pass the laboratory tests shall require the Contractor to re-flush and rechlorinate the mains and re-sample and test the water until acceptable results are obtained, all at no additional cost to the Owner.

5. The results of the tests on these samples will determine the acceptance of the work and allow these new mains to be connected to the Owner's system. The failure of any sample to pass the laboratory tests shall require the Contractor to re-flush and rechlorinate the mains and re-

sample and test the water until acceptable results are obtained, all at no additional cost to the Owner.

B. Main Activation

1. Upon receipt of satisfactory bacteria sample test results and successful pressure tests, Contractor shall notify Owner to have the Owner's personnel operate all valves required to place mains in service. Copies of all test reports shall be given to the Engineer and Owner prior to activation. Contractor shall not request activation of new mains until authorization from the Cambridge Water Department is received.

2. Contractor shall note that work under this Contract shall not be considered completed until satisfactory installation and testing of the water mains have been completed.

3. All corporations installed for disinfection purposes shall be closed and plugged. All tubing shall be removed.

END OF SECTION 02675

SECTION 02685

TEMPORARY BYPASS PIPING AND SERVICE CONNECTIONS FOR WATER MAINS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 RELATED WORK

Section 02201 – EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

Section 02615 – DUCTILE IRON PIPE AND FITTINGS FOR WATER MAINS

Section 02640 – VALVES AND APPURTENANCES

Section 02645 – HYDRANTS

Section 02674 – CONNECTION TO EXISTING WATER MAINS

Section 02660 – WATER SERVICES

Section 02675 – DISINFECTION OF WATER MAINS

Section 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING

1.3 SUMMARY

A. This Section includes design of a system, and furnishing all labor, materials, equipment, and appurtenant work to satisfactorily maintain fire protection and water service to customers connected to pipelines which will be taken out of service during the work of this contract.

B. Temporary piping used for fire protection shall be a minimum of 6-inch diameter.

1.4 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS: The Contractor shall provide adequate time for submittal review as submittals related to the design of the bypass system(s) will be reviewed and approved by the Cambridge Water Department (CWD) and the Cambridge Fire Department (CFD). Contractor designs that do not get CWD and CFD approval shall be

redesigned and resubmitted for additional review by CWD and CFD.

1. Submit a complete bypass piping layout including locations of system supply, pipe materials and sizes to be used in specific locations; hoses; locations and types of temporary fire hydrants; and all valves to be furnished and utilized for use in conjunction with the temporary bypass pipe and connections to services and laterals. This submitted layout shall include details for each property including multiple connections showing sizes and materials for properties having both domestic and fire protection services.

2. A separate layout showing all the required detailed information will be required for each section of bypass utilized.

3. Submit a detailed bypass disinfection plan describing the proposed methods to be used and means used to certify that the system components have been disinfected. Bypass shall not be installed until an approved plan is in place for each bypass section.

4. The Cambridge Water Department does not allow the use of temporary water main bypass between November 1st and April 1st without written pre-approval from the Cambridge Water Department.

5. Submit information on temporary ramps to be utilized for sidewalk, street, driveway and walkway crossings.

1.5 QUALITY ASSURANCE

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. The Contractor designing and installing the bypass flow handling system shall have completed at least five (5) projects of similar size and complexity as this project in the United States within the past five (5) years. Contractor may employ the services of a subcontractor that specializes in this work to fulfill this requirement.

C. Rejection of any subcontractor and/or manufacturer by the Engineer due to insufficient qualifications shall not be grounds for modifications to the Contract Documents such as change in scope, time of completion or contract amount.

1.6 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

PART 2 - PRODUCTS

2.1 PIPE AND MATERIALS

A. Piping and materials to be used by the Contractor shall be HDPE or steel and have been previously reviewed and approved by the Engineer in the bypass plan and shall be fully adequate to withstand the distribution system pressures in the vicinity of project.

B. Hoses need to be approved for use with potable water.

C. Temporary hydrants are to be compatible with standard connections for the fire hoses and are to be STORZ connections if required by CFD. The Contractor shall confer with the Fire Department to ensure adequate wrench configuration. Temporary hydrants shall be rigidly supported to be restrained against full operational pressure.

D. All bypass piping connected to fire hydrants must be provided with a tee, valve, and hydrant quick connect, for each hose connection to allow for the use of the feeding hydrants to still be used by the Fire Department for normal use to maintain sufficient fire protection during the work.

PART 3 - EXECUTION

3.1 TEMPORARY WATER SERVICE INSTALLATION AND MAINTENANCE

A. All Pipe and fittings shall be watertight and shall be disinfected prior to being put into service. Disinfection and testing shall be performed by the Contractor and shall comply with Sections 02675 – DISINFECTION OF WATER MAINS and 02704 – PIPELINE PRESSURE AND LEAKAGE TESTING of the specifications.

B. Bypass shall be limited to sections or blocks of approximately 1,000 linear feet of roadway and shall be limited to 4 side street cut and caps unless otherwise approved by the Cambridge Water Department.

C. Provide valves for control at each tie-in to existing mains and hydrants. Isolation valves shall also be installed on bypass piping at maximum of 1,000 foot spacing and to isolate no more than two (2) hydrants. Valve handles are not to be installed directly on the bypass. Contractor to have valve operating handles onsite at all times. Additional valve handles to be provided to the Cambridge Fire Department and the Engineer while bypass piping is in place. The contractor shall provide and install wheel valves at all hydrants unless otherwise directed by Cambridge Fire Department.

D. Install and remove temporary service connections and back flush permanent services at times when work can be observed by the Engineer.

E. Water shutdowns for any part of the public water system shall be approved by the Cambridge Water Department and is in general between the hours of 9:00 AM to 4:00 PM. Nighttime shut downs will be as required by CWD and will require a separate Noise Variance Permit.

F. Temporary bypass facilities shall include hoses and necessary outlets and fittings to each service connection. The Contractor shall furnish, install, and maintain the temporary lines in a safe and operative condition at all times. After service has been restored to a section of water main, the Contractor shall remove the temporary bypass and related facilities and shall restore the area to its original condition.

G. Temporary piping shall be installed adjacent to the roadways where it will cause the least obstruction and where it will be least susceptible to damage. At street intersections or access ways, the pipe shall be installed in a shallow trench and overlaid with temporary bituminous pavement. At driveways, pipe crossings shall be buried unless it is possible to maintain reasonable access by providing temporary ramps utilizing hot mix bituminous asphalt ramps or other method acceptable to the Engineer.

H. All hoses laid over the sidewalk shall have temporary ramps installed over the hoses to maintain suitable ADA access.

I. If service connections cannot be made in a way to maintain ADA access, temporary connections shall be installed in a shallow trench and overlaid with temporary bituminous pavement.

J. All temporary ramps shall be maintained during their use. Any ramps installed along the gutter or curbing shall have a minimum 2" PVC pipe placed to allow for water to flow under the ramp through the pipe to prevent puddling.

K. Frost free bibs shall be modified to accommodate the hose connections.

L. For properties that do not have outdoor spigots, the connection shall be made under ground or run in a way that does not create a safety or security concern.

M. Valves shall be placed at the connection of the existing system. If the connection to the system is a hydrant, the hydrant gate valve shall also be closed during testing.

N. For connections that are done directly to pipes a resilient gate valve shall be used at the connection.

O. Contractor to provide 24-hour emergency service personnel to fix and repair any damage to temporary bypass piping. Contractor to furnish Owner with name and telephone number of person assigned to emergency repair service. Said person shall be capable of **arriving at site within 1-hour of notification** and providing

necessary tools, equipment, and labor to repair damaged bypass line. If emergency personnel fail to arrive, Owner's forces shall be authorized to take corrective actions, and all costs for labor, materials and equipment shall be backcharged to the Contractor. Minimum charge for Owner's forces shall be two (2) people at 4 hours minimum, overtime rate, plus materials, equipment costs, and cost of estimated water loss. All backcharges shall be deducted from payments due the Contractor for work performed under this contract.

P. The contractor shall have readily available sufficient additional quantity of bypass pipe, appurtenances, and connections to replace or repair portions of the temporary bypass system in the event of damage or failure for any reason.

Q. Water for temporary servicing shall be taken from the nearest available fire hydrant or as directed by CWD and/or CFD. CWD and/or CFD require that bypass systems be fed from two active water sources. A single feed bypass shall only be allowed if pre-approved by the CWD and CFD when there is a very small amount of usage on that short section of single feed bypass.

R. All buildings, whether occupied at the time of the project or not, shall be provided with temporary water service. Prior to activating the service, the Contractor shall disinfect and flush the piping. The Engineer shall review the temporary piping system prior to placing in service. Connections to the bypass for each property shall be coordinated with the property owner.

S. Prior to installing the temporary bypass system the Contractor shall notify the Engineer and provide 72 hours notice to all customers impacted by bypass connections.

T. The use of bleeder hoses is prohibited without the consent of the Owner. If the Owner permits the use of bleeder hoses, the Contractor is required to report dates, durations, and total water usage of bleeder hoses to the Owner for review.

U. All existing water distribution system valves shall be operated by CWD personnel only. All necessary safety precautions, including traffic cones and highway safety barriers, shall be provided by the Contractor while operating valves in roadways.

V. Temporary fire hydrants shall be furnished, installed, and maintained by the Contractor and shall be placed adjacent to existing hydrants while they are out of service. Temporary hydrants shall be maintained by the Contractor until the existing and new hydrants are restored to service. Temporary hydrants shall be rigid and capable of the full thrust created by full operation by the Fire Department in the event of an emergency.

W. Restoration of services, including disconnection from the bypass system and reconnection to the new pipeline, is the Contractor's responsibility and shall be performed at the Contractor's expense.

X. Contractor shall be responsible for restoring adjacent properties to original condition. All paved roadways, access ways, driveways, and sidewalks shall be repaired and repaved to original condition.

3.2 REMOVAL OF TEMPORARY WATER MAIN

A. Upon activation of the newly installed water main and services, remove the temporary water main and related service connections, valves, and hydrants.

B. Contractor shall remove and dispose of all bituminous pavement, concrete, and excess soil materials. Upon removal of lines and services, walkways and driveways shall be paved with bituminous material or concrete to match pre-construction conditions. Brick sidewalk areas may be repaired with concrete or bituminous asphalt if approved by the City.

3.3 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01701 – PROJECT CLOSEOUT.

END OF SECTION 02685

SECTION 02704

PIPELINE PRESSURE AND LEAKAGE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Perform field hydrostatic pressure and leakage testing of water distribution pipes.

B. Related section includes the following:

1. Section 02630 – DUCTILE IRON PIPE AND FITTINGS

1. Section 02640 – VALVES AND APPUTENANCES

2. Section 02645 – HYDRANTS

3. Section 02647 – CONNECTION TO EXISTING WATER MAINS

4. Section 02660 – WATER SERVICES

5. Section 02675 – DISINFECTION OF WATER MAINS

1.2 DEFINITIONS

A. Leakage - Leakage is defined as total amount of water introduced into pipe during leakage test to maintain test pressure.

1.3 SYSTEM DESCRIPTION

A. The working pressure of the pipeline ranges between 20 psi and 75 psi.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Testing schedule and test procedure.

a. Indicate proposed time and sequence of testing on schedule.

b. Indicated test procedure requirements as follows:

(1) Limits of each pipe tested.
(2) Position of all valves during testing.
(3) Location of temporary bulkheads.
(4) Meter calibration data.
(5) Pressure gauge calibration data.
(6) A report containing calculations and documentation pertaining to the pressure and leakage testing shall be submitted to the Cambridge Department of Public Works and the Engineer.

1.5 SEQUENCING AND SCHEDULING

A. Complete pressure and leakage testing of pipes prior to final cleaning and disinfection; Engineer shall be present during all testing.

1. Notify Engineer of time and place of testing at least 3 days prior to commencement of work.

PART 2 – PRODUCTS

2.1 GENERAL

A Provide test equipment as follows: Piping connections between pipe tested and water source; Equipment, materials, and facilities required to perform specified tests including but not limited to the following:

1. Pumping equipment

2. Calibrated water meter

3. Calibrated pressure gauges

B. Sectionalizing devices required including but not limited to the following:

1. Flanges

2. Valves

3. Bulkheads

4. Bracing

5. Blocking

PART 3 – EXECUTION

3.1 PREPARATION

A. Provide blocks, anchors, and supports for pipe before test pressure is applied.

3.2 INSTALLATION

A. Water:

1. Schedule filling of line through Engineer at least three (3) days in advance of testing. Do not allow water to enter other parts of the pipeline, not subject to testing, unless approved by the Engineer. Dispose of test water in a manner approved by the Engineer.

B. Venting:

1. Ensure that air release valves and other venting devices are properly installed and placed in open position when filling pipe with water. Do not close hand-operated vent valves until water flows in an uninterrupted stream from each valve.

3.3 APPLICATION

A. Pressure Testing:

1. All pipe and appurtenances installed shall be hydrostatically tested in accordance with ANSI/AWWA C600, latest version unless stated otherwise herein.

2. Test pressure, expressed in terms of feet of water, applied at any point in pipe equals arithmetic difference between specified test pressure plane elevation and elevation of horizontal center line of pipe at selected location. Multiply value by 0.433 to obtain pounds per square inch. Ensure pressure gauges are accurately calibrated. Do not attempt pressure testing until all air has been vented from the mains.

3. All ductile iron pipe shall be pressure tested at 1.5 times the working pressure, 150 psi minimum, for a continuous period of two hours.

B. Leakage Testing:

1. Conduct leakage testing in conjunction with pressure tests. Ensure that joints in piping are watertight and free from visible leaks during leakage test.

2. Leakage Test Pressure: Maintain specified normal operating line pressure for pressure testing of reach during leakage test. Maintain hydrostatic pressure within plus or minus 5 psi during entire time of leakage measurements.

3. Leakage Measurement: Do not attempt measurement of leakage until trapped air has been vented and constant test pressure has been established. Measure leakage by means of an approved water meter installed in the pressure piping on discharge of the pump. Ensure that water meter is accurately calibrated.

4. Allowable Leakage: Ensure that pipe reach does not exceed the allowable leakage rate. Calculate allowable leakage with following formula:

   Q = 0.0068 DLN where
   Q = allowable leakage in gallons per hour
   D = nominal diameter of pipe in inches
   L = length of section tested in thousand feet (1000-foot maximum; 0.8 for 800 feet)
   N = square root of avg test pressure in psi (12.25 for 150 psi)

5. Calculate allowable leakage separately for each diameter and add resulting allowable leakage rates to obtain total allowable leakage for entire reach.

3.4 FIELD QUALITY CONTROL

A. Inspection: Locate defective joints and pipe materials during pressure testing.

B. Locate and repair leaking joints and other defective items of work to reduce pipe leakage to an amount acceptable to Engineer, or where applicable, the Owner's requirements. All repairs shall be performed at no additional cost to Owner.

END OF SECTION 02704

SECTION 02710

REMOVAL OF PROTRUDING SEWER LATERAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, and performing removal of protruding sewer laterals in accordance with these Specifications.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Description of equipment, sequence, and a schedule for the removal of protruding laterals.

2. Confined Space Entry Certifications for all Contractor's personnel entering pipeline or access structures.

1.4 QUALITY CONTROL

A. Comply with Section 01400 – QUALITY CONTROL.

B. Contractor to submit description of construction method for internally grinding of sewer laterals.

C. All Contractor's personnel entering pipeline or access structures shall be Confined Space Entry trained per OSHA, Title 29 CFR 1910.46 and shall have a copy of their certification available on site at all times.

D. Grinding operation shall be observed using concurrent Close Circuit Television (CCTV) Inspection to immediately identify the onset of any damage caused by the cutter.

1.5 REPAIR OF DAMAGES

A. Any damages to service laterals or the host pipe during the removal of protruding sewer laterals shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this Contract and at no additional cost to the Owner.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. Protruding sewer lateral removal equipment shall consist of remote controlled hydraulically driven cutters and reamers, and remotely operated robotic routers or grinders capable of cutting back protruding sewer service laterals without damage to host pipe.

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor shall perform all work in accordance with municipal, state and federal requirements. Contractor shall obtain all permits required to perform work prior to the commencement of construction.

B. Internal grinding of protruding sewer services shall be completed prior to cured-in-place pipelining work.

C. All work associated with removal of protruding sewer laterals shall be accomplished without excavation from existing ground surface, except in areas specifically designated on the Drawings or as approved by the Owner.

D. At the locations indicated in the Contract Drawing or as required by the Engineer, the existing protruding service laterals shall be internally grinded to the acceptance of the Owner and/or Engineer.

E. Edges of protruding pipes that have been grinded shall be consistent across the circular face of the edge and parallel to the surface of the host pipe.

F. The Contractor shall take care to utilize grinding methods that will not break or fracture protruding pipes or the host pipe. The grinded edge of pipes shall not be jagged or fractured. Methods chosen by the Contractor shall not break or damage the portion of a protruding pipe that is to remain.

G. The Contractor shall arrange the use of CCTV equipment during the removal of protruding services to document the condition of the host pipe before, during and after the procedure.

- END OF SECTION 02710 -

SECTION 02750

ROOT INTRUSION REMOVAL

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, and performing removal of root intrusions by means of cutting or chemical treatment in accordance with these Specifications.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop drawings and/or manufacturer's descriptive literature indicating materials, equipment and methods to complete root intrusion removal and testing and sealing operations. Details and description of construction methods, equipment, and process description including all pertinent information for any chemical agents to be used in the operation.

2. Confined Space Entry Certifications for all Contractor's personnel entering pipeline or access structures.

3. Name, business address and telephone number of the firm performing the root intrusion removal (if different from the Contractor).

4. Contractor to submit written evidence that they have obtained pollution liability coverage for the use of chemical agents for root intrusion removal.

5. Contractor to submit qualifications of a Massachusetts State Certified pesticide applicator.

1.4 QUALITY CONTROL

A. The Contractor performing the root intrusion removal shall have completed at least three (3) projects, in the United States, within the past two (2) years and projects that included root intrusion removal. Note: A combination of projects satisfying each of the above provisions may be acceptable as long as two (2) projects have been successfully completed for each provision.

B. Supervisory personnel shall have a minimum of five (5) years experience and

shall have completed at least two (2) projects of similar size and complexity as this project with the United States within the past five (5) years.

C. Rejection of any subcontractor and/or manufacturer by the Engineer due to insufficient qualifications shall not be grounds for modifications to the Contract Documents such as change in scope, time of completion or contract amount.

D. Designated supervisory personnel shall be directly involved with and used on this project. Substitutions of personnel will not be allowed without written authorization of the Engineer.

E. All Contractor's personnel entering pipeline or access structures shall be Confined Space Entry trained per OSHA, Title 29 CFR 1910.46 and shall have a copy of their certification available on site at all times.

1.5 ACCEPTANCE

A. The Engineer shall inspect and approve the root intrusion removal work. Any pipes damaged by the Contractor during the root intrusion removal work shall be repaired and/or replaced by the Contractor at no additional cost to the Owner.

B. Final acceptance of work shall not be granted until all damaged areas have been repaired to the satisfaction of the Owner and Engineer.

C. Contractor shall perform a post construction internal inspection in accordance with Section 2760 – PIPELINE CLEANING AND INTERNAL INSPECTION. Final acceptance of the work shall not be granted until post installation inspection has been reviewed and approved by the Engineer.

D. Contractor shall perform testing as specified.

PART 2 – MATERIALS

2.1 COMPOSITION OF CHEMICAL ROOT TREATMENT

A. The chemical root control agent shall be registered with the EPA and in compliance with all local, state, and federal requirements. The chemical root control shall be labeled for sewer lines. The chemical root treatment material shall not permanently affect the parts of the trees distant from the treated roots.

B. The chemical root control agent shall contain an active ingredient for controlling root intrusion and deterring their re-growth. The active ingredient shall meet the following requirements:

1. Shall be a Category "E" compound,

2. Shall not be considered a carcinogen, tetratogen, mutagen, or oncogene, based on laboratory testing,

3. Shall be non-volatile,

4. Products containing the active ingredient(s) metam-sodium or copper sulfate are not allowed.

C. The chemical root control agent shall contain a surfactant system to deliver the active ingredient to the target root issue. The surfactant system shall meet the following requirements:

1. Shall produce a dense, small bubble, clinging foam, which sustains its shape for a minimum of one hour,

2. Shall enhance the penetration of herbicide into root masses,

3. Shall contain an Alkylpolyglucoside (formulations of vegetable oil and carbohydrate from agricultural products),

4. Surfactants designed to foam chemically, upon contact with water, shall not be accepted.

PART 3 – EXECUTION

3.1 GENERAL

A. Roots shall be removed by mechanical or hydraulic means and then treated with approved chemical agents to deter re-growth of the roots in the designated sewers where root intrusion is present. Special precautions should be exercised during the cleaning operations to assure virtually complete removal of visible roots from the sanitary sewers and/or storm drains.

B. Upon application of chemical agents, the Contractor shall wait a minimum of 5 weeks for chemical agent to take effect. After a minimum of five weeks, the Contractor shall observe treated section of pipe, remove any necessary roots by mechanical or hydraulic means, and test and seal treated section of pipe. Upon successful testing of pipe, the Contractor shall then proceed with any other required work including cured-in-place pipelining.

3.2 ROOT INTRUSION REMOVAL

A. Procedures may include devices such as rodding machines; expanding root cutters and porcupines; hydraulic procedures such as high-pressure jet cleaners; and chemical agents.

B. Contractor shall perform all work in accordance with municipal, state and federal

requirements. Contractor shall obtain all permits required to perform work prior to the commencement of construction.

C. All work associated with root intrusion removal operations shall be accomplished without excavation from existing ground surface, except in areas specifically designated on the Drawings or as approved by the Owner.

D. Application of any approved chemical root treatment shall be in accordance with the Manufacturer's printed instructions.

E. All roots removed from the sanitary sewers and/or storm drain shall be hauled away and disposed by the Contractor at the Contractors expense.

- END OF SECTION 02750 -

SECTION 02760

PIPELINE CLEANING AND INTERNAL INSPECTION

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, and performing gravity-flow infrastructure cleaning and inspection work for pipe diameters ranges of 6-in to 60-in including non-circular shapes in accordance with these Specifications.

2. Work shall include cleaning and videotaping of existing, reconstructed, rehabilitated, or new sewers and drains, as well as flow handling and/or bypass pumping of existing flows as needed to perform the cleaning and inspection. Work shall be compliant with the National Association of Sewer Service Companies' (NASSCO's) Pipeline Assessment & Certification Program (PACP) and Manhole Assessment & Certification Program (MACP) guidelines. All inspections must be performed by personnel who are PACP and MACP trained and certified (current standing).

3. Where indicated, remove deposited material from in-line storm drain sumps or catch basin sumps.

4. Requirements for the testing of removed sediment and its proper disposal.

5. Adherence to Data Delivery Requirements.

1.2 RELATED TECHNICAL SECTIONS

A. Section 01500 – TEMPORARY FACILITIES AND CONTROLS

B. Section 01570 – MAINTENANCE AND PROTECTION OF TRAFFIC

C. Section 02080 – SOIL AND WASTE MANAGEMENT

D. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL.

E. Section 02761 – FLOW BYPASS

F. Section 02767 – CURED-IN-PLACE PIPELINING AND SEGMENTAL LINING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Sewer and Storm Drain Cleaning Plan at least two weeks prior to the start of any cleaning, in which shall include:

   a. Proposed method of pipe cleaning and dewatering including the equipment to be used and OSHA-compliant confined space entry procedures.

   b. Proposed method of managing wastewater, erosion controls, solid waste management, and which, if any, additional permits are required,

   c. A list of lawful disposal sites proposed for dumping debris from cleaning operations.

2. Proposed database file name and proposed inspection record names for all locations. This information shall be submitted in hard copy (2) and PDF format at least two weeks prior to the start of any cleaning and inspection work.

3. Work Plan for each location should be provided in hard copy (2) and PDF format at least two weeks prior to the start of any cleaning and inspection work, in which shall include:

   a. location of proposed access manholes, sequencing of work description, and inspection record names
   b. anticipated schedule, hours of operation, number of shifts, number of crews, and expected time to complete the work
   c. proposed use of plugs or flow bypass, including preventing leakage from hoses and minimizing noise from equipment
   d. list of fire hydrants that will be utilized for a water source
   e. map showing the work area, location of fire hydrants to be used, and flow bypass set up
   f. City-issued or other permits the Contractor must obtain prior to performing the work.

4. Traffic Management Plan for each location should be provided in hard copy (2) and PDF format at least two weeks prior to the start of any work and shall meet all the requirements of Section 01570 – Maintenance and Protection of Traffic, including but not limited to the following:

   a. flow of vehicular, bicycle and pedestrian traffic,
   b. number and location of police details
   c. maintaining access
   d. avoiding damage to existing trees
   e. preventing leakage from hoses

f. minimizing noise from pumps
g. if detours are proposed, provide justification for road/lane closure
h. map of surrounding area with information above (4.a through 4.g)

5. Internal Inspection Report for each location in hard copy (2) and PDF format, including:

   a. Pre-rehabilitation or pre-cleaning internal inspection logs and video (if required),

   b. Post-construction, post-rehabilitation, or post-cleaning internal inspections logs and video,

   c. Inspection Summary highlighting results of the investigations. All documentation shall be cross-referenced by footage meter device to enable the reviewer to identify a particular location being viewed.

      1. These records shall be in printed form showing: the Owner's name; type of project; Contractor's name; date; manhole location; depth to invert; section cleaned and televised; the number of lateral connections to the section televised; type (e.g. sanitary sewer, combined sewer, or storm drain); street address and type of all laterals connected to storm drain; diameter of pipe; length of section; exact location(s) of pipeline defects; type of equipment used; and any special remarks concerning the conditions of the pipe line, manholes, and separation plates.

6. Rehabilitation Report: If the Scope of Work consists of rehabilitation (cured-in-place lining) of existing pipe, the report includes:

   a. Details and documentation for areas in need of point repairs (as per pipe inspection firm, as directed by the Owner). Point repairs shall be completed before rehabilitation of the sewer or drain can commence.

   b. The post-rehabilitation inspection report shall detail the condition of rehabilitated items and describe recommendations for repair of any defects.

      i. All areas where the rehabilitated sewer or drain is defective due to, but not limited to, poor workmanship and/or chemical deterioration, shall be identified by the Contractor. Contractor shall make all the necessary arrangements to repair the defective area.

ii. Defective areas shall be repaired in accordance with the manufacturer's recommendations.

iii. All repaired areas shall be inspected by the Owner and/or a representative of the manufacturer. Closed-circuit television inspection results shall be provided to the Owner as specified.

iv. Once approval of repaired areas has been granted, the Contractor shall return all sewage and/or drain flows to normal, remove all equipment and debris, and restore all disturbed areas to their original conditions, as shown on the Drawings.

7. A sample Video showing the quality of work obtained by the proposed assembly prior to internal inspection work. The quality of work shall be acceptable to the Engineer.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. The sewerage and storm water systems to be cleaned and televised may be equipped with flow metering devices, telemetry hardware or other appurtenant equipment. It is the Contractor's responsibility to verify if this type of equipment is installed within the vicinity of the cleaning and televising operations. If the Contractor encounters this type of equipment, the Contractor shall notify the Owner, so that the Owner may remove this equipment before cleaning and televising operations begin. The Contractor will be responsible for the cost to replace or repair any flow metering devices, telemetry hardware or other appurtenant equipment damaged during his/her operations.

C. There may be common manholes within the scoped infrastructure (common manholes are defined as one manhole providing access to both the storm drain and sanitary sewer when they are constructed in the same horizontal alignment separated by 6 to 12 inches vertically). Common manholes have a separation plate placed in the invert of the storm drain for access to the sanitary sewer. This physical arrangement may have a bearing on the methods and equipment used for cleaning, since the access opening to the sewer may not be as wide as the sewer itself for large diametered sewers. The contractor shall remove the separation plate when necessary, replace, and secure the separation plate at the end of the day. If a separation plate is already removed and placed off to the side of the manhole, the Contractor shall contact a City representative and reinstall the plate if instructed. If the separation plate is missing, the exact location of that manhole will be noted in the records and a City representative shall be notified.

D. All personnel shall be trained in the use of equipment and have experience performing work on sewer and storm water systems of similar sizes and ages, and constructed of similar materials.

E. All inspections shall be performed by personnel who are PACP and MACP trained and certified (current standing).

F. The cleaning and inspection of the infrastructure may require manned entry in the sewer or drain to place or remove equipment, or to facilitate manual cleaning of the pipeline. All confined space entry procedures must be in compliance with OSHA regulations.

PART 2 – MATERIALS (Not Used)

PART 3 – EXECUTION

3.1 PIPE AND MANHOLE CLEANING

A. The purpose for cleaning of the sewer or drain is to facilitate the inspection and/or rehabilitation of the sewer or drain, or to increase pipe capacity.

B. It is the intent of this Contract that sewers or drains be cleaned by either hydroflushing with jetting and vacuum truck, or manual scouring using pressure washing and vacuum truck.

1. Hydraulic equipment shall consist of high velocity type equipment, capable of jetting up to 2,000 psi and 125 gpm of water. No hydraulic equipment that operates under a “head of water” or that would cause excessive internal pressure shall be permitted without written approval of the Engineer.

2. When the Contractor makes four or more passes to clean a section pipe, it shall be considered a heavy cleaning.

3. For pipes 54 inches in diameter or greater, manual scouring of deposits using a velocity gun or manual tools may be required due to the limitations of the jetting equipment. A 2-person team may be required to complete the pipe cleaning.

C. Indicated manhole and catch basin sumps shall be cleaned using a hydraulic clamshell for immediate placement in self contained truck bed or adjacent dump truck. In circumstances where mechanical equipment could damage existing manhole material or where access does not permit, sumps shall be cleaned using manual means.

D. The sewer or drain shall be cleaned using mechanical, hydraulically-propelled, and/or high-velocity pipe cleaning equipment, which does not exert internal

pressures great enough to damage sewer or drain pipe and manholes. Selection of the cleaning equipment shall be based on the condition of the sewer or drain at the time work commences based on the Pre-rehabilitation/cleaning inspection. The equipment and methods selected shall be reviewed by the Owner.

E. Satisfactory precautions shall be taken to protect the sewer or drain from damage that could be inflicted by improper use of cleaning equipment. Any damage inflicted upon the sewer or drain due to improper use of cleaning equipment, regardless of the technique used, shall be repaired by the Contractor to the satisfaction of the Owner, at no additional cost to the Owner.

1. If areas of misalignment of pipe, dropped joints, infiltration, structural failures, or other obstructions are suspected during cleaning operations, and confirmed during exploratory televising, the Contractor shall record the approximate location of the defective area and notify the Owner.

F. All sludge, dirt, sand, rocks, grease, and other solid or semi-solid materials that may cause an obstruction in the sewer or drain or impair the inspection or rehabilitation of the sewer or drain shall be removed from the sewer or drain and site during cleaning operations (at least once each work day) in suitable watertight containers, and disposed of in a manner acceptable to the Engineer and in strict conformance with all applicable federal, state, and local laws and regulations, at no additional cost to the Owner. It shall be the responsibility of the Contractor to secure a legal dump site for the disposal of the material.

1. The Contractor shall collect all data required by all permits or their issued conditions. It shall consist of periodic sampling and analysis of system effluents and discharge quantities.

G. Clean-up operations shall include all removal of debris out of manholes and off the ground around manholes and access pits. The Contractor shall not be allowed to accumulate debris and cleaning discharge materials on the project site unless stored in totally enclosed watertight containers approved by the Engineer.

H. Acceptance of the sewer or drain cleaning shall be made upon the successful completion of the television inspection and shall be to the satisfaction of the Engineer. For the purposes of these specifications cleaning shall be considered complete when eighty-five percent (85%) of the interior pipe surface area is visible during internal inspection in flow or limited flow conditions. Bypass pumping may be required to measure compliance with this standard. If the television inspection indicates that the cleaning has not been completed in accordance with these Specifications, the Contractor shall be required to re-clean and re-inspect the sewer or drain line until the cleaning is shown to be satisfactory, at no additional cost to the Owner. The Engineer may require the Contractor to pull a double squeegee (with each squeegee the same diameter as the sewer or drain) through each manhole section as evidence of adequate

cleaning. Particular attention should be given to the adequacy of the cleaning to provide for the proper installation of the lining system.

I. The Contractor shall be responsible for locating and uncovering all known buried manholes required to complete the work at no additional cost to the Owner.

J. Maintain flow around the work in a manner that will not cause excessive surcharging of sewers or drains, and that will protect the public and private property from damage and flooding. Bypass pumping may be required to comply with this task. Refer to Section 02761 – FLOW BYPASS for the anticipated flow through the system.

K. No debris, equipment, tools, or other foreign matter shall be left in the sewers, drains and manholes, or at the work sites, as a result of the Contractor's operations.

1. A manhole may be used as a temporary collection point for debris. The debris shall be completely removed from the manhole by a vacuum truck, clamshell or other mechanical means before televising any type of pipe. Sandbags, or suitable equal, may be required to prevent flushed material from continuing downstream.

2. Any debris that migrates past the Contractor’s efforts to collect the loosed material and then deposits in downstream MWRA interceptors shall be removed from the MWRA pipes at no additional costs to the Owner per Section 01500 – TEMPORARY FACILITIES AND CONTROLS.

L. All amounts of sludge, dirt, sand, rock, roots, grease, and other solids or semi-solid material shall be removed from the pipe interior with a collective device and disposed of by the Contractor at no additional cost to the Owner. All such material, may cause an obstruction or impair in the inspection or rehabilitation of the sewer or drain, and shall be flushed downstream and removed at each downstream manhole of the reach being cleaned with a collection device.

M. All of Contractor's personnel shall be thoroughly familiar with all phases of sewer or drain line cleaning to ensure optimum performance, without causing damage to the sewer, drain, manholes, and appurtenances.

N. When water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed at any time, nor shall a hydrant be used for the work described in these Contract Documents, unless a reduced pressure backflow preventor is provided by the Contractor and prior approvals have been obtained from the City of Cambridge Water Department for use of the fire hydrant. Use of the backflow prevention device shall be in accordance to Massachusetts Department of Environmental Protection (DEP) Regulation 310. CMR 22.22 and the Cambridge Water Department Cross Connection Control Program..

The Contractor shall be responsible for all related charges for the set-up, including the water usage bill. All expenses shall be considered incidental to the cleaning of the existing sewer or drain.

O. During the course of cleaning, when obstructions are encountered, an attempt shall be made to clean from both the upstream and downstream manholes. Should the obstruction(s) prevent the line from being cleaned, the Engineer shall be immediately notified. If, in the opinion of the Engineer, a repair is required to facilitate cleaning, cleaning shall be completed upon satisfactory completion of the repair. The repair may be completed by the Owner or completed by the Contractor as a change order. No additional compensation will be paid to the Contractor for any portion of the sewer/drain, which requires re-cleaning after successful completion of the repair.

P. Approved type of equipment for pipe cleaning shall include, at a minimum, the following:

1. High velocity equipment shall have a minimum of 800 feet of high-pressure hose and carry its own water tank, auxiliary engines and pumps and hydraulically driven hose reel. Install a gauge to indicate working pressure on the discharge of high-pressure water pumps.

    a. For unmanned jetting method, two or more high velocity nozzles shall be available. The nozzles shall be capable of producing a scouring action for 15° to 45° in all size lines designated to be cleaned. All controls shall be located so that the equipment can be operated above ground.

    b. For manned pipe and manhole cleaning method, a high velocity gun shall be capable of producing flows from a fine spray to a long distance solid stream. Hand tools or intrinsically safe power tools may also be required.

2. Mechanical cutting device suitable for root removal shall be available for use as necessary.

3. Footage metering devices shall be used for location of all equipment, devices, points of reference, on measuring target that is known at all times at the ground level. Footage metering device shall be designed so that distance recorder can be set at zero when equipment or device is at entrance of pipe inside manhole. Entering device shall have an occurrence of not less than one-tenth of a foot. Marking of cable, or similar means, that require interpolation of depth of manhole shall not be permitted. The accuracy of the metering devices shall be checked daily by the Contractor by the use of a walking meter, roll-a-tape, or other suitable device.

Q. The Contractor shall be responsible for removal of any equipment that may become lodged or hung up in the system being cleaned. The Contractor will

not be reimbursed for work, including television inspection, required to retrieve lost equipment.

R. The walls and inverts of all manholes within the reaches of lines shall be cleaned thoroughly with a high velocity water spray.

S. Upon completion of the cleaning of each section or in a flooded condition, a full sized brush or scraper shall be pulled through the line to insure complete removal of all debris from the line. Dumping or forcing of debris into a larger diameter line or receiving water body is not permitted.

T. Do not allow solids removed in the cleaning process to be released onto streets or into ditches, surface waters, catch basins, cleanouts, storm drains, or sewer or drain manholes.

U. Acceptance of sewer and storm drain cleaning work is subject to review by the Engineer. If visual inspection or internal television inspection shows solids, soil, sand, grit, or other debris remaining in the line, cleaning will be considered unsatisfactory. Repeat cleaning, and inspection of the storm drain line until the Engineer judges cleaning satisfactory.

V. Repair manholes dismantled or damaged during the cleaning process, and replace manhole frames and covers damaged during the cleaning process.

3.2 CLOSED CIRCUIT TELEVISION

A. The method of Technicolor internal inspection of pipelines and manholes is dependent on pipe size. The height of the camera shall be a level that is within the middle third of the pipe, preferably at the springline to equally capture the crown and invert of the pipe. The camera shall be at a level that can look up the first 12 inches of service laterals.

1. Where permitted, the preferred method of inspection shall be by use of a robotic camera vehicle assembly, capable of being controlled from an aboveground command center.

2. For larger pipes where the height of the camera crawler can’t not be adjusted to the middle of the pipe, the inspection shall be obtained by use of manned entry and “walking the pipe”.

B. The Contractor shall follow all OSHA standards or other applicable regulations related to work in confined spaces.

C. The Contractor shall provide to the Owner two external hard drives to transfer the video data of all internal inspections (PACP database, video recordings, photographs) with the inspection reports. The Contractor shall submit one (1) hard copy and PDFs of inspection report. Inspections shall be of the full length of the sewer between each manhole as well as each manhole.

1. All field videos must be submitted in a casing with the names of all streets displayed on the front and side cover with field reports.

2. D. The reporting of observations during the TV inspection of sewer and drains from one manhole to the next, and the database shall follow the format published in the Pipeline Assessment and Certification Program (PACP) as developed by the National Association of Sewer Service Companies (NASSCO). The Owner may require additional database fields.

1. At the beginning and end of each continuous pipeline inspection, the total pipeline shall be described by the narrator stating the size, type, start and end location, street name, intersecting street, invert elevation, and limits of each pipe section.

F. The Contractor shall utilize the City's manhole identification numbering system when reporting the results of TV inspections. Manhole IDs are provided on the Contract Drawings for pipes to be rehabitated or shall be otherwise provided by the Owner. Contractor shall also provide written description or site map of each manhole such that the location of the manhole is clearly defined and retrievable. If a buried manhole is discovered during the televising of any mainline, the Contractor should allocate a new manhole number (supplied by Owner) and record it.

3.3 PROCEDURES

A. It is the intent of the Scope of Work to inspect the full length of sewer between each manhole, but there may be occasions during the CCTV inspection of a sewer line section when the camera will be unable to pass an obstruction even though flow is continuing. If, during the inspection operation, the television camera will not pass through the entire pipe section, set up the CCTV equipment so that the inspection can be performed from the opposite manhole. No additional payment shall be made for reverse set-ups required due to an obstruction. Reverse setups must be noted in the CCTV database submittal in a separate database field to indicate that the inspection was performed in the reverse direction of flow as specified by PACP guidelines.

B. CCTV video recordings shall be submitted in one continuous video section from manhole to manhole, and not in multiple files, unless specifically approved by Owner.

C. Prior to the internal inspection work, the Contractor shall be responsible for diverting all flows from the area to be inspected. Prior review and approval by the Owner of the Contractor's intended methods shall be required for any flow control, diversion, bypassing, or dewatering activities.

D. During the internal inspection of pipelines, the Owner shall be able to view the pipe interior as it is being inspected on a TV monitor set up in the command center.

E. Perform all CCTV inspections using personnel who are trained and certified (current standing) in the use of NASSCO's PACP and MACP.

F. Move the camera through the line in either direction (direction versus flow must however be noted) at less than or equal to 30 feet per minute rate, stopping when necessary to permit proper documentation of the construction features and pipe condition. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

G. When manually operated winches are used to pull the television camera through the line, use telephones or other suitable means of communication set up between the two manholes of the section being inspected to ensure good communications between members of the crew.

H. Obstructions that cause a stuck camera are the responsibility of the Contractor, and the retrieval of equipment or cameras is the responsibility of the Contractor and will be performed at the Contractor's expense.

I. Adjust the camera height such that the camera lens is always centered in the pipe being televised.

J. Do not float the camera unless permitted by the Owner or their designated representative.

K. The camera must be stopped at all service laterals and pan such an angle that an internal view of the service lateral is available. Digital photographs must be made of any of any service lateral or deficiency observed in the sewer line and the photograph itself must contain a brief description of the issue. The descriptions must also be noted in the inspection condition record within the database. Where other pipe deficiencies are noted, stop the camera to observe the condition, record information and take digital photographs. All digital photos must be cataloged in the CCTV database and linked to the specific length along the inspection via linkage to the defect record in the database.

L. Provide a complete television inspection for the upstream and downstream manholes. The CCTV operator shall pan and zoom up the manhole from the invert for each manhole and obtain the best possible image of the manhole including cone and corbel sections. In addition, 3 still digital photos shall be taken for each pipe connection within each manhole. The CCTV operator shall zoom in on each pipe connection, so the photos capture the each pipe connection's size, location, and approximate elevation

M. The camera and vehicle assembly shall be an industry standard for internally inspecting pipelines.

1. The camera shall be a Radial View Camera (RVC) able to view 360° and has the capability to pan and tilt in any direction. Picture quality

shall be such as to produce a continuous 600-line resolution picture showing the entire periphery of the pipe. Picture quality and definition shall be such that the interior of the pipe can be clearly seen in detail.

2. The camera and appurtenances shall be capable of operation in 100 percent humidity conditions.

3. The camera shall be capable of being moved through the sewer or drain pipe in either direction at uniform slow rate by means of manual cable winches, motorized mechanical equipment of indirect drive type, or carried by Confined Space Certified personnel.

4. The camera vehicle assembly shall be capable of slowing down or stopping at areas of interest.

5. At areas of interest, the camera shall be capable of rotating its lens to obtain a clearer, more direct viewing angle.

6. The camera vehicle assembly shall also have a high intensity light (50 to 100 foot-candles) feature so as to provide the proper amount of light for recording purposes.

7. When a mechanized crawler or floats are used, measurement along the pipeline shall be accurate to 0.10 feet. For large pipes that required personnel to transport the camera, measurement along the pipeline shall be accurate to 1.0 foot.

8. The television inspection equipment shall have an accurate footage counter that shall display on the monitor the exact distance of the camera from the centerline of the starting manhole. The Contractor shall, in the presence of inspector, calibrate the camera footage every week with above ground tape measure and simultaneous CCTV footage counter.

N. All video recordings must, by electronic means, display continuously and simultaneously generated transparent digital information to include the date of recording, street name, pipe diameter, access manholes ID number, and the linear footage of the television crawler location. Below, is a sample of the text to be displayed on the screen.

Example: Albany Street S25COM0305 → S25COM0205
8" SS

07-13-2005 156' 37"

O. All video recordings of manholes and structures shall have a time, date, and location display, as detailed in paragraph 3.3.D of this Section.

P. All inspections shall be documented on USB drives. The USB drive shall be capable of being played on a laptop.

Q. During the inspection, the camera shall be stopped at the points where one or more of the following conditions are observed:

1. Infiltration/Inflow Sources

2. Lining Defects

3. Structural Defects, including broken pipe, collapsed pipe, cracks, and all other structural abnormalities.

4. Abnormal joint conditions, such as root intrusion, protruding pipes, in-line pipe size changes, mineral deposits, grease, obstructions, etc.

5. Pipe Connections

6. Obstructions, offset joints, misalignments, or other conditions that may affect pipe bursting, slip-lining or cured-in-place pipe rehabilitation operations.

All such conditions shall be recorded and shall be considered a point repair if the conditions inhibit rehabilitation work. Color photographs of all questionable conditions shall be taken and labeled as to location, condition, and date for subsequent review and be named.

R. The Contractor will take and label still pictures for all extruding laterals, any locations where sections of the sewer pipe are missing or the pipe is near collapse or whenever directed by a City Representative. The Contractor shall provide a sketch showing tie distances from at least three permanent features to the starting and ending manhole. A distance between the starting and ending manhole, as measured on the ground, shall be provided**.**

S. For large pipe that exceed the limits of the mechanical crawler and required manned entry to "walk the pipe", intrinsically safe 2-way communication must be maintained between entrant(s) and spotter(s) and also between entrant(s) and command center to facilitate procedure in Paragraphs 3.3.G and 3.3.H of this Section.

1. Care shall be taken to accurately measure the footage throughout the inspection. If measurements recorded via cable length is inaccurate due to slack created while "walking the pipe", distances shall be obtained by alternate means (e.g. intrinsically safe laser measuring) and recorded in the written logs as such. Verbal correction on the audio track shall override any conflicting digital footage on the video display.

T. The Contractor shall be responsible for access to the sewer or drain system, including; locating, uncovering, and opening manholes, flow control diversion

bypassing and/or dewatering within manholes, or pipe reaches, dewatering, surface restoration, and all other work required to perform the specified work to the Engineer's satisfaction.

3.4. DYE TRACING

A. In the event that a building or catch basin lateral requires dye tracing confirmation during the time of the television inspection, the Contractor shall coordinate the private property access with the television operations.

B. The Contractor shall introduce the dye into the system (e.g. catch basin, internal plumbing) and be responsible for recording the test result and providing to the City.

3.5 ACCEPTANCE

A. Internal inspection operations, both pre- and post-construction/cleaning, shall be considered for approval upon receipt by the Owner of the following:

1. Internal inspection report including all items detailed in Section 1.2 Submittals and as required by the contract documents.

B. Pre-CIPP lining repairs shall be considered for approval upon receipt by the Owner of the following:

1. Rehabilitation report including all items detailed in Section 1.2 Submittals and as required by the contract documents.

3.6 NOTIFICATIONS

A. Notify the Owner:

1. On a weekly basis of scheduled work for the upcoming week. Scheduled work shall be in accordance with approved work plan specified in 1.2 Submittals. Provide at least 24-hour notice for deviations from the approved work plan unless caused by weather or natural causes in which case the Owner shall be notified as soon as possible.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for CCTV inspection are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Inspection crews shall immediately notify the Owner and/or on-site inspector of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown in Owner supplied GIS data. The notification shall include a diagram in PDF format clearly indicating the location of structures in relation to immediately adjacent structures.

7. If any obstructions are found within an easement, even if not impacting work.

3.7 DATA DELIVERY REQUIREMENTS

A. All pipe, manhole and lateral inspections reports and submittals shall adhere to the most current NASSCO PACP, MACP and LACP ("NASSCO Program") Exchange format standards.

B. The Contractor shall provide a NASSCO Program compliant rating of each pipe.

C. The Contractor shall provide inspection data on a monthly basis with the database and other associated documentation (NASSCO export database, NASSCO database export log, videos, photographs, inspection reports, weekly logs) on an external hard drive (Refer to Section 3.5.A). The submittals shall be cumulative (i.e. each successive database delivery will include previous deliveries as well). Data to be submitted shall include: 1) Database files in NASSCO Program Exchange format (.mdb), 2) JPEG (.jpg) files (still photos), 3).mpg or .mp4 files (videos) for each pipe segment and 4) individual files for all inspection reports (.pdf).

D. All CCTV video files must be collected with a minimum bit rate of 4,500 kbps.

E. Databases, video files, digital photographs and supporting documentation (PDF, spreadsheets) shall be placed in separate folders on the external hard drive. All videos, digital photographs, etc., of the same file type should be placed in a single folder on the external hard drive in order to provide a single location to access the data. Separate subfolders shall not be used for each pipe segment.

F. The CCTV equipment/software shall be capable of producing digital still images of all sewer line defects, and sewer line service connections in JPEG (.jpg) image format. Contractor shall take digital still images of each defect, with a minimum of one independent photo file per defect, construction features and service connections to clearly depict it. More images may be necessary depending upon the condition of the pipe. The digital images shall have a minimum size/resolution of 620x480. The screen captures or digital images shall include an onscreen display with date, sewer main reach number, footage,

and type of defect/NASSCO Program Code. The filename of each JPEG (.jpg) shall be in accordance with these specifications.

G. A final, compiled version of the inspection database in NASSCO Program Exchange format must be delivered at the end of the project to the Owner. The final database must include all inspection records previously delivered in the individual inspections as well as incorporate all requested changes by the Owner. The database filename will use the following format using upper case letters:

P_5974_ YYYYMMDD.MDB

Where P = PACP database; 5974 = Contract number; YYYYMMDD = 8 digit date.

H. All database inspection records must be linked to the Owner's unique pipe numbering system which is based on the upstream and downstream structure asset numbers for the pipe end structures (manhole, outfall, cleanout, etc.). The unique pipe identifier must take the form of UPSTREAM FACILITY ID and DOWNSTREAM FACILITY ID separated by an underscore (_). For example: S71SMH8080_S71SMH8081 would be the pipe between manhole number S71SMH8080 and S71SMH8081. These values are available within the Owner's GIS database, however; if additional intermediate structures are located in the field, the naming convention described below must be used.

I. During the inspection work, if a previously unknown manhole not shown in the GIS is found, the letter "A" will be added to the end of the upstream manhole ID (no spaces or special characters allowed) to form a new manhole ID in the inspection records. The data / video files shall then be re-named to include the new manhole ID, and a new CCTV inspection shall be started from the new manhole ID. If more than one unnamed manhole is found between two named manholes, subsequent new manhole IDs will be formed using the letters "B", "C" etc. The Contractor will provide a sketch of the location of each new manhole structure found so that the Owner can update the GIS database. The newly located manholes must be added to the manhole inspection database using the same new identification codes.

Example file names for pipe segments that may be encountered while performing inspections include:

a. Example file name for pipe segment between an Upstream structure and Downstream structure:

S71SMH8080_S71SMH8081_YYYYMMDD.MPG(.MP4)

Where S71SMH8080 = the upstream asset ID, S71SMH8081 = the downstream asset ID, and YYYYMMDD = 8 digit date.

b. Example file name for pipe segments associated with a relief sewer or double barrel sewer, facing downstream towards the downstream asset:

S71SMH8080_S71SMH8081_(1,2 or 3)_YYYYMMDD.MPG(.MP4)

Where S71SMH8080 = the upstream asset ID, S71SMH8081 = downstream asset ID, 1,2 or 3 represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date.

c. Example file name for pipe segment between an Upstream structure and Downstream structure where the structure had previously not been known to exist between manholes S71SMH8080 and S71SMH8081:

S71SMH8080A_S71SMH8081_YYYYMMDD.MPG(.MP4)

Where S71SMH8080A = the asset ID for the newly located upstream manhole found between manholes S71SMH8080 and S71SMH8081, S71SMH8081 = the downstream asset ID, and YYYYMMDD = 8 digit date.

J. There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by "_1", "_2" etc. for additional files that do not use a reverse camera direction.

Examples:

Initial file name: S71SMH8080_S71SMH8081_YYYYMMDD.MPG (.MP4)

Additional file name(s):
S71SMH8080_S71SMH8081_YYYYMMDD_1.MPG(.MP4)

Reverse setup name(s):
S71SMH8080_S71SMH8081_YYYYMMDD_R.MPG(.MP4)

Where S71SMH8080 = upstream asset ID, S71SMH8081 = downstream asset ID, YYYYMMDD = 8 digit date, 1 = a subsequent video of the same sewer pipe should multiple inspections be performed on the same date.

The direction of camera pull versus the pipe flow must be noted in the inspection record in the database in the 'Direction" field based on the starting direction. For inspections that subsequently require CCTV from the opposite direction, i.e. a reverse pull, these should have file naming conventions that end

with an R to indicate the reverse pull. Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation.

K. The name of each digital still image shall be based on the video / data file name of the sewer reach in which the image was taken. The name shall be recorded as follows:

Examples:

S71SMH8080_S71SMH8081_HSV_37 _2_YYYYMMDD.jpg

S71SMH8080_S71SMH8081_R_MCU_113_7_YYYMMDD.jpg

Where S71SMH8080_S71SMH8081 is the pipe asset ID, R is a reverse pull indication, HSV and MCU are PACP defect codes, 37 and 113 are the footage counts for the defect locations along the pipe, 2 and 7 are the sequential defect photo numbers along the pipe, and YYYYMMD is the 8 digit date of the inspection.

L. Digital files of all field data collection forms (if used by the Contractor) shall be delivered in PDF format and shall have file names that include the same unique identifier as the database submittal so that they can easily be related to the database and digital photograph/video submittals, if a naming convention is not specified.

M. The Contractor shall submit all digital videos, digital photographs, evaluation reports, and databases in NASSCO Program (PACP, MACP and LACP) Exchange format of most current version to Owner on a portable, self-powered external hard drive of adequate size, but no less than 5 terabyte, which is dedicated to the Contract. This drive shall be labeled with the contract number, the contract name and the City of Cambridge.

N. If digital videos are of such poor quality that Owner is unable to evaluate the condition of the sewer and drain system infrastructure, locate the service connections, or verify the cleaning, the Contractor shall be required to re-televise the section and provide new digital videos of good quality, at no additional cost to the Owner.

O. All digital data shall become the property of the Owner.

-END OF SECTION 02760-

SECTION 02761

FLOW BYPASS

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing a temporary system to bypass the flow of the existing combined sewer infrastructure around the work in accordance with these Specifications.

2. Maintaining flow from main pipelines without interruption of service, and maintaining flow in lateral connections with minimal interruption of service.

3. Performing the work in a sequence that is the least disruptive to vehicular and pedestrian traffic and in a manner that shall protect the public from damage to persons and property.

B. Contractor shall design the bypass flow handling system.

1.2. RELATED TECHNICAL SECTIONS

A. Section 01500 – TEMPORARY FACILITIES AND CONTROLS

B. Section 02555 – MANHOLE LINING

C. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

D. Section 02767 – CURED-IN-PLACE PIPELINING AND SEGMENTAL LINING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop drawings and/or manufacturer's descriptive literature indicating materials, equipment and methods to complete bypass flow handling operations.

2. Work plan including the following items:

a. Location, configuration and routing of bypass flow handling pipes.

b. Staging area(s) for pumps and other equipment.

c. Upstream flow collection location and/or bulkheads.

d. Downstream discharge location.

e. Method of protecting structures that accept discharge flows.

f. Traffic Management Plan.

g. Roadway crossing details including hose ramps or trench details.

h. Noise Pollution Abatement Plan.

3. List of 24-hour emergency telephone numbers at which the Contractor may be reached.

B. Contractor shall submit a Certificate of Design (refer to SECTION 01300 – SUBMITTALS) for the bypass flow handling system and shall be responsible for the design of the following system components:

1. Pumps,

2. Generators and power sources,

3. Suction and discharge piping,

4. Temporary pipe supports and anchoring,

5. Pipe plugging and bulkheads,

6. Noise control equipment,

7. Calculation of average and maximum daily flows,

8. Calculations of static lift, friction losses, flow velocity and flow rate,

9. Systems testing and start-up,

10. Maintenance of system for off-construction hours,

11. Contingency plan and equipment for system failures,

C. Contractor shall submit complete documentation of qualifications as specified herein.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. The Contractor designing and installing the bypass flow handling system shall have completed at least five (5) projects of similar size and complexity as this project in the United States within the past three (3) years. Contractor may employ the services of a subcontractor that specializes in this work to fulfill this requirement.

C. Rejection of any subcontractor and/or manufacturer by the Engineer due to insufficient qualifications shall not be grounds for modifications to the Contract Documents such as change in scope, time of completion or contract amount.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 EQUIPMENT

A. The bypass flow handling equipment shall be of sufficient size and material to convey existing flows from one access structure to at least the next access structure immediately downstream of the work without overflow, spillage or discharge to the surrounding environment.

B. Contractor shall be fully equipped to operate and respond to any repair or replacement of the system (24 hours per day and 7 days per week) while the bypass flow handling system is in use.

C. The Contractor shall have adequate standby equipment available and ready for immediate operation and use in the event of emergency or breakdown. One standby pump for each size pump utilized.

D. Contractor shall incorporate noise reduction equipment to minimize impact on the surrounding environment. Such measures shall include insulated enclosures, hospital grade silencers or mufflers, equipment modifications and/or special equipment to limit noise to eighty (80) dBA at seven (7) feet or sixty (60) dBA at the nearest residence or business.

2.2 DESIGN CRITERIA

A. Contractor shall verify flow conditions in the existing system prior to the commencement of construction. The Contractor shall have no claim for additional compensation by reason of delay or inconvenience in adapting its operations to the need for maintaining existing flows.

B. Estimated flows are as follows. Flows are estimated from hydraulic models. Actual flows might vary and shall be verified by the Contractor.

		Peak Flow (MGD)	
Location	**Gravity Main**	**1y6h**	**10y24h**
Harvard St @ Davis St	Sewer	3.6	3.2
	Drain	6.7	9.0
Washington St @ Portland St	Sewer	2.8	2.8
	Drain	8.3	8.8
Bishop Allen Dr @ Main St	Sewer	0.1	-
	Drain	8.4	9.3

PART 3 – EXECUTION

3.1 PREPARATION

A. Contractor shall perform all work in accordance with municipal, state and federal requirements.

B. Contractor shall obtain all permits required to perform work prior to the commencement of construction, at no additional cost to the Owner.

C. Prior to the commencement of construction, Contractor shall perform all possible preparatory work. The Contractor shall, at all times, conduct operations to interfere as little as possible with existing flows.

D. Prior to start-up of bypass flow handling system, Contractor shall notify, in writing each property owner whose service shall be shutdown albeit temporarily. Contractor shall prepare notifications in accordance with Owner's requirements.

E. The Contractor shall protect water resources, wetlands and other natural resources.

3.2 GENERAL

A. Contractor shall design the layout and routing of the bypass flow handling system to minimize disturbance to public and private land and to maintain access for pedestrians and traffic. Traffic shall be maintained throughout the bypass operations according to applicable standards and local requirements.

B. If excavation is required across roadways, all work shall be performed in accordance with municipal and/or state requirements.

C. Contractor shall furnish, install, maintain and operate all temporary facilities such as dams, pumping equipment, conduits and all other labor and equipment

necessary to intercept the flow before it reaches points where it would interfere with the work.

D. Contractor may utilize pipelines in an existing parallel system as an alternative to installing a full bypass flow handling system pending approval by the Engineer and the Owner. Contractor shall submit a Certificate of Design prior to utilizing the parallel system and shall restore the parallel system to pre-construction conditions upon completion of construction.

E. Contractor shall design, furnish and install individual bypass flow handling systems for flowing lateral connections or high occupancy buildings.

F. The Contractor shall protect existing facilities from damage, during pumping activities.

G. Plugging or blocking of flows shall incorporate a primary and secondary plugging device. When plugging is no longer required for performance of the work, it is to be removed in a manner that permits flows to slowly return to normal without surge, surcharge or other major disturbance.

-END OF SECTION 02761-

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02767

CURED-IN-PLACE PIPELINING AND SECTIONAL LINING

PART 1 – GENERAL

1.1 DESCRIPTION

A. This section includes furnishing all plant, labor, equipment, and materials necessary for completing cured-in-place pipelining (CIPP); complete in place. Work shall include light pipe cleaning and Closed Circuit Television (CCTV) inspection of the existing sewer and/or drain lines, as specified in Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION, flow handling and/or bypass pumping of existing flows as specified in Section 02761 – FLOW BYPASS, preparatory-type work inside the pipes, CIPP lining, service connection reinstatement, final CCTV pipe inspection, and all restoration work required for structures, pipes, or surface features.

B. Work shall be performed in a sequence that is the least disruptive to vehicular and pedestrian traffic and in a manner that shall protect the public from damage to persons or property. Additionally, work shall be sequenced to optimize the integrity of connections where CIPP lining transitions to adjacent infrastructure as directed by the Engineer and Owner.

C. CIPP lining in proximity to sensitive abutters shall be performed during evening and weekend work hours only. Refer to the general sheet notes on the Civil plan/profile drawings for these locations.

D. The Port Internal Inspection Logs from previous CCTV work are provided in the Appendix for information only.

E. Refer to Section 02761 – FLOW BYPASS for estimated wet weather flow rates at key junctions in the collection system. Contractor may consult the Engineer for estimated flows at specific locations.

1.2 RELATED WORK

A. Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION

B. Section 02761 – FLOW BYPASS

1.3 SUBMITTALS

A. For the cured-in-place pipelining method(s) of pipe rehabilitation, the Contractor shall submit the following information specific to the proposed project within ten (10) days after the Notice to Proceed:

1. Name(s) of all supervisory personnel to be directly involved with each cured-in-place pipelining method of pipe rehabilitation for this project. Supervisory personnel shall have a minimum of five (5) years experience and two completed projects for the installation of cured-in-place pipelining within the past five (5) years. Attach resumes of each person named. Resume information shall include, as a minimum, educational background, the number of years in a supervisory capacity and a list of projects worked on within the past five years, describing the type of construction, project description, complexity, and contract amounts.

2. Describe the pipe rehabilitation method(s) proposed on this Contract, including, but not limited to, the following:

   a. Name, business, address, and telephone number of each cured-in-place pipelining manufacturer of the pipe rehabilitation method proposed; a description of each method, proposed locations of inversion manholes; and any variances that the Contractor may be proposing from the specified methods.

   b. Any surface activities, including access and staging locations, that will be required and any mitigative measures that will be used to reduce surface impacts as part of each rehabilitation method proposed.

3. The Contractor must submit a complete work plan including: preferred hours of operation, sequencing of work description, number of shifts, number of crews, and expected time to complete the work for each rehabilitation method proposed. Based on the Work plan, the Contractor may be granted a variance by the Owner to perform the cured-in-place pipelining operations outside the restricted working hours of 7:00 AM to 4:00 PM. The Contractor may also be directed by the Owner to perform the CIPP operations outside the restricted working hours if the Engineer determines a better product will result.

4. The Contractor shall submit plan for maintaining vehicular and pedestrian access, avoiding damage to existing trees, preventing leakage from hoses, and minimizing noise from pumps.

5. The Contractor shall sign and date the information provided and certify that to the extent of his knowledge, the information is true and accurate, and that the supervisory personnel and method(s) of pipe rehabilitation proposed will be directly involved with and used on this project, respectively. Substitutions of personnel and/or methods will not be allowed without written authorization of the Engineer.

B. Prior to CIPP construction, the Contractor shall submit shop drawings, details, and descriptions to include construction methods and equipment, process

description, access locations, inversion/installation and receiving manhole locations, flow handling, bypass pumping, flow diversion, and or dewatering methods, and design calculations to assure that the work can be accomplished as specified. Construction method(s) and equipment used to penetrate blockages and/or partially collapsed sections of the existing pipeline. Method(s) for repair for each location requiring a point repair. Description of techniques used to determine purpose and source of all lateral connections using such methods as smoke testing, dye testing, internal inspection and/or building investigation. Manhole connection details, end seal for the cured-in-place lining system, water source(s), method of water discharge, cleaning methods, traffic management plan, and pre- and post-construction video documentation shall be provided to the Engineer.

C. The Contractor shall provide design submittals to indicate conformance to the applicable subsections of this section. At a minimum, this submittal shall include structural design calculations for the cured-in-place liner. The design calculations shall provide a cured-in-place liner that shall withstand all loadings subject to the sewer and/or drain independent of the existing pipeline. The submittal shall provide documentation supporting the basis of the values used in the design calculations. The above calculations shall be prepared under and stamped by a Registered Professional Engineer in Massachusetts. Submit to Engineer, for review and approval, the curing schedule for the proposed resin system which will become a permanent part of the work under this Contract.

D. The Contractor shall submit the following documentation:

1. Material Safety Data sheets (MSDS's) for all materials used during preparation and installation.

2. Certification stating that the Contractor is fully licensed by the liner manufacturer (if different).

3. Description of odors anticipated as a result of the curing process and detailed action plan and description of techniques and equipment used to mitigate odors and prevent migration outside of the pipeline.

4. Confined Space Entry Certifications for all Contractor's personnel entering pipeline or access structures.

5. Contractor shall provide a certification stating that the source of all lateral connections identified during internal inspection have been investigated within the pipeline as well as in adjacent building and structures and that the Contractor has secured these connections to prevent the migration of odors.

E. The Contractor shall submit the method(s) and equipment he proposes to use for repairs of any uncured areas, defects, test sample section repairs, or other

deformities in the completed liner pipe. Such repairs shall be in accordance with the liner manufacturer's recommended written procedures and techniques.

F. Contractor shall submit curing logs within 24 hours of cool-down completion for each inversion indicating temperature readings at sensors in intervals of at least ½ hour.

G. Contractor shall submit final CIPP testing reports as specified herein.

1.4 QUALIFICATIONS

A. The Contractor shall provide documentation supporting the qualification criteria specified herein.

1. The Engineer reserves the right to request, inspect, examine, and review information pertaining to a Contractor's proposed method(s) for compliance with the Contract Specifications.

B. The qualifications of the Contractor shall be submitted so as to demonstrate that the Contractor meets or exceeds the minimum requirements specified herein. Any Contractor whose qualifications do not meet the minimum qualifications shall be rejected and shall not be permitted to participate in the construction of work specified herein.

C. It is the responsibility of the Contractor to confirm that any subcontractor or manufacturer proposed for performance of the work under this Section of the Specifications can demonstrate the minimum requirements specified herein. Rejection of any subcontractor and/or manufacturer shall not be grounds for modifications to the Contract Documents. No change in contract time of completion or contract cost will be allowed as a result of such rejection of a subcontractor and/or manufacturer to meet the minimum requirements specified herein.

D. The Contractor shall meet the minimum qualifications as specified below for the cured-in-place liner.

1. The Contractor installing the CIPP shall have been in a similar type of CIPP installation business for the past two years.

2. The Contractor installing the cured-in-place lining shall have successfully completed at least five projects in the past three years, totaling a minimum of 3,000 feet, in the United States of America, which included the following provisions:

a. CIPP installation lengths of at least 300 continuous linear feet for pipes ranging 6-inch to 60-inch diameter
b. Circular and non-circular pipes that were 15-inch across or greater

c. Design of the liner tube wall thickness based on a fully-deteriorated condition.

E. The manufacturer of the CIPP system shall have been in the business of manufacturing cured-in-place linings of equal or greater size for the past two years in the United States.

F. Designated supervisory personnel shall be directly involved with and used on this project. Substitutions of personnel will not be allowed without written authorization of the Engineer.

G. All Contractor's personnel entering pipeline or access structures shall be Confined Space entry trained per OSHA, Title 29 CFR 1910.46 and shall have a copy of their certification available on site at all times.

PART 2 – MATERIALS

2.1 CURED-IN-PLACE PIPELINING

A. The liner shall be a smooth, hard, strong and chemically inert internal surface closely following the contours of the existing pipe.

B. The CIPP shall be designed and constructed in accordance with ASTM F1216 "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube", and these Specifications.

C. The liner shall be fabricated to a size that, when installed, will neatly fit the internal circumference of the sewer and/or drain to be lined. Allowance shall be made for circumferential stretching during insertion.

D. The Contractor shall be fully licensed by the lining process system manufacturer, if different. A copy of this certification shall be submitted to the Engineer.

E. The liner shall consist of one or more layers of flexible needled felt, or an equivalent non-woven or woven material, or a combination of non-woven or woven materials, capable of carrying resin, withstanding installation pressures, and curing temperatures. Upon curing, the liner shall form a continuous, hard, impermeable, tight fitting lining between each installed reach.

F. The Contractor shall furnish a general purpose, unsaturated, styrene-based resin and catalyst system, an epoxy resin and hardener, or an epoxy vinyl ester resin and catalyst system, or other approved material compatible with the inversion/installation process, that provides cured physical strengths and corrosion resistance properties specified herein.

G. Service laterals indicated on the Drawings shall be CIPP lined from where the lateral is cut to be connected to the new sewer connection to a cleanout located as close to the property line as possible. If no clean out exists, the Contractor shall install a new clean out at the back of sidewalk as close to the property line as possible. The Contractor shall be responsible for locating the connection point in the street and the service where it crosses the property line. Contractor shall contact the property owner for permission to enter private property, if necessary and to locate the cleanout.

H. The lateral liner shall provide a watertight seal and structural repair providing the required strength to carry 100% of the design load with less than 5% deflection. The Contractor shall verify the length and diameter of the liner required in the field prior to impregnation of the resin.

2.2 DESIGN CRITERIA

A. The following design requirements shall be met by the Contractor for this method of construction:

1. The cured-in-place liner shall have sufficient structural strength to support all dead loads, live loads, and groundwater load imposed, including 100-year flood elevation requirements, with the assumption that the existing pipe is fully deteriorated and cannot share any loading or contribute to structural integrity of the liner. All cured-in-place liners shall have a wall thickness tested by the parallel plate deflection method in accordance with ASTM D2412. The liner, when cured, shall have the following minimum values:

Property	**ASTM Test Method**	**Initial[1] psi**	**Long-Term[2] psi**
Flexural Strength	D790	4,500	N/A
Flexural Modulus	D790 and D2990	300,000	150,000

Notes:
[1]Initial values are determined by ASTM D790.
[2]Long-term value is defined as 50 years and is determined by ASTM D2990 test method.

a. The Contractor shall provide certified copies of all test reports on the properties of the selected resin by the material manufacturer indicating that the supplied materials conform with the above criteria.

b. The CIPP shall be designed such that the lining shall not fail, collapse, buckle, crack, or delaminate under load. The maximum long-term (50 years) calculated deflection under all loads shall not

exceed five percent (5%). For glass, fiber-reinforced liner pipe, the bending strain (50 years) developed shall not exceed the higher of the minimum long-term value in ASTM D3262 for the pipe stiffness supplied, or that substantiated by long-term strain tests done in accordance with ASTM D3681 using 1.0 *N* sulfuric acid.

c. The following design parameters shall be used:

Depth of Cover[1]	Varies (refer to Drawings).
Depth of Groundwater Above Pipe	At Ground Surface.
Specific Weight of Soil	120 lbs./ft.
Wheel Load[2]	16,000 lbs.
Design Temperature	80°F
Deflection Lag Factor, D_L	1.5 (50 years)
Modulus of Soil Reaction E'	1,000 psi
Ovality Correction Factor	Higher of initial ovality of deteriorated condition (2%) or long term deflection.
Long-Term Modulus of Elasticity	50 years under constant stress, when submerged in water, to be used for constrained buckling resistance design for combined external loads from groundwater and earth cover.
Minimum Safety Factor	2.0, unless otherwise specified (not applicable for maximum bending strain)
Shape Factor	6
Bedding Deflection Coefficient	0.103

Notes:

[1]Design of the CIPP shall be based on prism load on the liner pipe, using the outside diameter of the liner in the calculations.

[2]Impact factors to be included when depth of cover is less than 3 feet, per values recommended by AASHTO.

2. The minimum thickness of the cured-in-place liner to be installed shall be as determined for the design conditions imposed. Calculations for the determination of the required liner pipe stiffness shall be the largest pipe stiffness for each CIPP installation reach (inversion/installation manhole to termination point), as determined by calculations provided for the following parameters:

   a. Maximum Deflection;

   b. Minimum Pipe Stiffness;

   c. Ring Bending Strain; and

d. Constrained Buckling Resistance Using Long-Term Modulus of Elasticity

3. For pulled in systems, submit design calculations for the maximum allowable pulling force on the liner tube.

4. The rehabilitation of the sewers and/or drains shall be performed with minimum excavation and demolition of existing structures, and the Contractor shall re-establish connections and minimize the disruptions to neighboring homes, traffic, and wetlands. Excavation for point repairs or emergencies shall be permitted, but only as approved by the Owner and permitting agencies.

5. The rehabilitated sewers and/or drains shall have a no visible and/or measured leakage or infiltration.

PART 3 – EXECUTION

3.1 GENERAL

A. Contractor shall perform all work in accordance with municipal, state, and federal requirements.

B. Contractor shall obtain all permits required to perform work, including permits that may be needed from the MWRA, prior to the commencement of construction.

C. The length of the CIPP shall equal the length indicated on the Drawings unless otherwise directed by the Engineer. The Contractor shall verify the lengths in the field prior to liner impregnation.

D. The CIPP shall be performed with minimal excavation or demolition of existing structures. Excavation for point repairs or emergencies shall be permitted, but only as approved by the Owner. The Contractor shall minimize the disruptions to neighboring homes, traffic, and surrounding areas

E. Individual inversions/installations may be performed via one or more existing access structures as determined by the contractor and as approved by the Engineer. For convenience, contractor may install additional access structures if approved by the Owner and Engineer after inversion/installation of the CIPP system. Additional access structures, if approved, shall be installed at no additional cost to the Owner and the Engineer.

F. Contractor shall review all existing conditions data prior to the commencement of construction, including TV logs attached in the appendices of these Specifications provided for information only. The Contractor shall still be

responsible for performing additional inspections as necessary to properly assess pipe condition and locations of all service laterals and connecting pipes.

G. Contractor shall commence CIPP operations at the beginning of a period of at least three (3) days of anticipated dry weather and as directed by the Engineer.

H. The Contractor shall provide notifications as specified in Paragraph 3.6 Notifications.

I. The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.

3.2 INSTALLATION

A. It is the intent of this portion of the Specifications to provide for the reconstruction of the sewer and/or drain lines by the installation of a resin-impregnated, flexible felt tube inverted/installed into the existing sewers and/or drains utilizing a vertical inversion standpipe and hydrostatic head method, air pressure inversion method, pulled in and inflate method, or other method approved by the Engineer. The Contractor shall submit information providing details of the procedure and the steps to be followed for the installation of the CIPP. Submittal information shall include: wet out of tube, insertion method and procedure, curing system, and cool down procedure. Submit process/techniques to be used to progressively round the tube to remove all trapped water between the liner and the existing pipe.

B. STAGING / SETUP / INTERNAL INSPECTIONS

1. The Contractor shall designate the locations where the reconstruction tube will be vacuum impregnated prior to installation. The Contractor shall allow the Engineer and the Owner to inspect the materials and "wet-out" procedure. A catalyst system compatible with the resin and reconstruction tube shall be used.

2. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes, unless otherwise specified. The Contractor shall verify the lengths in the field before impregnation. Individual inversion/installation runs can be made over one or more manhole sections, as determined in the field by the Contractor and approved by the Engineer.

3. Inspection of pipelines or laterals shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by videotaping. The interior of the pipeline shall be carefully inspected to determine the location of any conditions that may prevent proper installation into the pipelines or laterals, and it shall be noted so that

these conditions can be corrected. A videotape and suitable log shall be kept for later reference by the Owner. The Contractor shall also produce and provide copies of pre- and post-service connection photographs. The Contractor shall remove and dispose of all debris in the sewers and/or drains to be rehabilitated. The Contractor shall be advised of the possibility of encountering obstructions in the pipe to be rehabilitated, including but not limited to wooden floor boards being uplifted, piles protruding through the invert, heavy erosion, and/or large amounts of exposed aggregate.

4. The Contractor shall provide light cleaning of the pipes prior to lining. Light Cleaning is described as 1 to 2 passes with a standard jetter nozzle. Any non-hazardous debris removed from the pipe will be dumped in a container provided by the Contractor, which will be located at a site provided by the Owner.

5. It shall be the responsibility of the Contractor to clear the line of obstructions, such as solids, dropped joints, loose gaskets, protruding service connections, or collapsed pipe, that will prevent the installation. If inspection reveals an obstruction that cannot be removed by conventional sewer/drain cleaning equipment, then the Contractor shall immediately contact the Owner. All repairs and removal of obstructions must be performed from inside the pipe. In the event an obstruction in the pipe is the result of the Contractor's action, it is the Contractor's responsibility to remove or repair the obstruction following requirements by the Owner.

6. The Contractor, when required, shall provide for flow handling and/or bypass pumping around the section or sections of pipe designated for rehabilitation, and sequence work activities in accordance with Section 02761 – FLOW BYPASS. The bypass pumps shall be positioned to reduce noise and muffled to further minimize noise as directed. The bypass piping shall be in good condition and shall be maintained to avoid leakage. The piping must not restrict vehicular or pedestrian traffic. When possible, complete the work during non-precipitation periods such that minimal bypass is required.

C. CIPP INSTALLATION

1. The reconstruction tube shall be inserted through an existing manhole, access pit or cleanout, by approved techniques/process of the installer or the Contractor. It is anticipated that the top of the manhole will be removed prior to insertion of the liner tube. Tubes that are pulled in-place shall be done in a manner that will not damage the tube. The winch shall be equipped with a dynometer to record the pulling forces required during installation. Pull forces shall not exceed manufacturer's recommendations, which shall be based on a maximum longitudinal stretch of five percent (5%) of the total tube

length. Inversion heads for tubes that are inverted in place shall not exceed manufacturer's recommendations, so as not to overstress the tube material or exceed 5% longitudinal stretch. Progressive rounding of the liner shall be performed, prior to curing, to eliminate all trapped water between the liner and the existing pipeline.

D. CIPP CURING

1. After inversion / installation is complete, curing shall be accomplished by circulating hot water, or other approved methods, to cure the resin into a hard, impermeable pipe. The equipment shall be capable of delivering hot water/steam throughout the section by means of a pre-strung hose to uniformly raise the water/steam temperature above the temperature required to effect a cure for the resin. This temperature shall be determined by the lining process system manufacturer and based on the resin/catalyst system employed. When cured, the new material shall extend over the length of the inversion/installation reach in a continuous, tight fitting, watertight pipe-within-a-pipe. The hot water used during the curing process shall not be discharged into the surrounding water bodies or wetlands.

2. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water/steam supply. Another such gauge shall be placed between the impregnated reconstruction tube and the pipe invert at the pipe ends to determine the temperatures during cure. Water/steam temperature in the line during the cure period shall be recommended by the resin manufacturer.

3. The Contractor shall submit procedures and details on the method(s) to be used to obtain water for the installation.

4. When water from fire hydrants is necessary to avoid delay in normal work procedures, the water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed at any time, nor shall a hydrant be used for the work described in these Contract Documents, unless a reduced pressure backflow preventor is provided by the Contractor and prior approvals have been obtained from the Cambridge Water Department for use of the fire hydrant. The Contractor shall be responsible for all related charges for the set-up, including the water usage bill.

5. The Contractor must coordinate notifications to the public and verify multi-family homes. No water services may be shut off without the approval of the Cambridge Water Department and the Engineer.

6. Initial cure shall be deemed to be completed when inspection of the exposed portions of cured pipe appear to be hard and sound, and the

remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin manufacturer, as modified for the cured-in-place process, during which time the recirculation of the water/steam and cycling of the heat exchangers to maintain the temperature continues.

7. The Contractor shall cool the hardened pipe to a temperature below 100^{o} F before relieving the static head. Cool-down may be accomplished by the introduction of cool water into the inversion standpipe to replace water being drained from a small hole made in the downstream end. The Contractor shall not be allowed to discharge this drained water (through the hole in the downstream end) to any storm drain or water body. Care shall be taken in the release of the static head so that a vacuum will not be developed that could damage the newly installed pipe. Contractor shall verify with the Owner that discharging the cure-water directly into the existing system is acceptable. If deemed unacceptable, Contractor shall collect and pump cure-water to a location to be determined by the Owner.

E. ODOR ABATEMENT

1. The Contractor shall mitigate all odors onto public or private property due to renewal operations immediately after notification from the Owner or the Engineer including, but not limited to, forced-air ventilation and/or chemical cleaning of buildings at no additional cost to the Owner.

2. If odors persist on public or private property to a point that air sampling and/or associated testing is required by the Owner, the Engineer or a regulatory agency, the Contractor shall perform this work at no additional cost to the Owner.

F. FINISHING / FINAL INSPECTION

1. The finished pipe shall be continuous over the entire length of an inversion/installation run, and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delamination.

2. The CIPP shall make a tight fitting seal with the existing pipe(s) in the manhole. The top half of the pipe shall be neatly cut off at least 4 inches away from the walls. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Channel cross-sections shall be U-shaped.

3. The Contractor shall internally inspect the sewer and/or drain, as specified in Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION, after rehabilitation work is complete. If uncured areas, defects, bulges, or other deformities are present, as determined by the pipe lining manufacturer or the Engineer, after rehabilitation work is complete after each pipe reach, the Contractor shall repair the defective areas, at no extra cost to the Owner.

4. The Contractor shall provide a standard 1-year warranty from date of installation.

3.3 SYSTEM REINSTATEMENT

A. Once a section of liner has been cured completely, the Contractor shall reinstate all access structures located along its alignment. For intermediate access structures, the Contractor shall cut the top portion of the liner to match the opening in the riser section providing a smooth, clean cut and continuous transition. At inversion/installation or termination access structures, the Contractor shall extend the liner a sufficient distance into the structure to allow for a smooth, clean cut to match the configuration of the riser and base sections.

B. The Contractor shall minimize the time that an inversion/installation manhole remains open at a particular site. Consideration shall be provided to complete and coordinate all work including cleaning, pre-installation internal inspection, pipe rehabilitation, post-installation internal inspection, and acceptance, so as to minimize surface disruptions.

C. Upon acceptance of the rehabilitation work by the Engineer, the Contractor shall restore the project area affected by his operations by diverting bypassed flows, including landscaping and clean up, as indicated on the Contract Drawings and in these Specifications.

D. Service lateral connections shall be reinstated by Remote-Controlled Televised or manually operated Cutting Device and shall be made by experienced operators so that no blind attempts or holes are made in the pipe liner. Exact locations or service laterals shall be determined during internal inspection and re-verified carefully with pre-construction videotapes for accuracy, especially where dimples are not defined or clearly ascertained. The Contractor shall reconnect all lateral connections to the liner pipe, including those unoccupied, abandoned, or from vacant lots, unless otherwise directed by the Engineer. The remote cut shall be smooth and circular in nature with no jagged edges, as seen by a 360-degree television camera. The hole shall be a maximum of 100 percent and a minimum of 95 percent of the service pipe inside diameter. It shall be properly aligned and be concentric to the existing connection. Excess wrong holes or trial cuts shall not be made and must be repaired at no cost to the Owner.

3.4 LATERAL LINING

A. The property owners serviced by the sewer shall be notified of the Work.

B. Excavate access pit at the appropriate upstream point on the service lateral as shown on the Drawings and approved by the Engineer.

C. The Contractor shall clean and CCTV inspect the lateral line immediately prior to reconstruction and determine the overall structural condition of the lateral, as well as the suitability of the lateral for CIPP lining. All roots, debris, and other protrusions shall be removed prior to lining, if required. The Owner shall receive a video recording of the inspection and a written report documenting the inspection. All costs associated with lateral cleaning and surface preparation shall be considered incidental to the Work.

D. Inspect the liner tube for torn or frayed sections. The tube shall then be vacuum impregnated with the thermoset resin.

E. No open pans or uncontrolled open-air pouring of resin shall be allowed during tube saturation. All resin shall be contained within the inflation bladder during vacuum impregnation and insertion. No public or private property shall be exposed to contamination by liquid resin compounds or components.

F. The saturated tube along with the inflation bladder shall be inserted into the launching device and the end closed. The entire launching device is placed in the service lateral access pit and aligned with the exposed end of the service lateral.

G. The resin and tube shall be completely protected during the placement. The resin shall not be contaminated or diluted by exposure to dirt, debris, or water during the placement.

H. The tube shall be inverted out of the launching device by controlled air or water pressure. The inversion shall be stopped when the tube protrudes into the collector pipe. The tube is held tightly in place against the wall of the host pipe by the pressure until the cure is complete.

I. When the curing process is complete, the pressure shall be released and the inflation bladder reverted back into the launching device, and the launching device shall be removed from the pit.

J. No barriers, coatings, or any material other than the cured tube/resin composite, specifically designed for desirable physical and chemical resistance properties, shall be left in the host pipe. Any materials used in the installation other than the cured tube/resin composite shall be removed from the pipe by the Contractor.

K. Any cured tube/resin composite pipe left protruding from the service connection shall be trimmed back using a hydraulic-powered robotic cutting device specifically designed for cutting cured-in-place pipe made from these materials.

L. A second CCTV inspection shall be performed to verify the proper cure of the material, the proper trim of service connection, and the integrity of the seamless pipe. The Owner shall receive a video recording of the final inspection and a written report documenting the inspection. All costs associated with the final CCTV inspection shall be considered incidental to the Work.

M. Service flows shall be restored to normal flow conditions. The service lateral pipe shall be coupled together, and the excavation properly backfilled. The property owner of the service connection shall be informed when the work is complete.

N. All cut surfaces shall be treated and/or sealed with additional application of resin material or as otherwise directed. All rehabilitated laterals that are connected into mainline sewer pipelines shall be sealed to ensure that groundwater is not permitted to enter the pipeline via the interface between the lining and the existing host pipe at the connection of the lateral to the mainline.

O. Deviations: If the pre-installation inspection reveals conditions in the sewer to be substantially different than those used in the design of the liner wall thickness, tube construction, tube length, or resin system, then the Contractor shall request appropriate changes, supporting such request with a video recording of existing conditions and design data.

P. Following the installation, curing, testing and inspection of liners in service laterals, the Contractor shall connect the existing lateral to a new connection on the sewer as shown on the Plans. Any access pits shall be backfilled as specified and the cleanout and connection to existing lateral completed and backfilled at the property line. Private and public property shall be restored to pre-existing conditions or as specified.

3.5 TESTING

A. For each separate length of CIPP installed, the Contractor shall prepare at least one (1) “flat plate” sample in accordance with ASTM F1216, Section 8.1.1 for testing at a laboratory approved by the Engineer. For each separate length of CIPP installed, the Contractor shall also prepare at least one (1) “restrained” sample in accordance with ASTM F1216 Section 8.1.1, Section 8.1.2 for testing at a laboratory approved by the Engineer.

B. Samples tested in accordance with ASTM F1216, Section 8.1.1 shall be considered as passing if the arithmetic mean of the samples, as defined in ASTM D790, is greater than or equal to parameters set forth in this Section after the arithmetic means is reduced to 80% of its original calculated value.

C. Samples secured as specified shall be tested to verify that the pipe flexural modulus and flexural strength of the CIPP is at least equal to that required by the approved design submittal, and the wall thickness is at least equal to that required in the approved design submittal.

D. If any sample fails the verification tests specified, the Contractor shall take five (5) additional samples throughout the length of the inversion/installation and retest to ensure the specified criteria has been met. If any sample fails these retests, the entire inversion/installation length shall be rejected.

E. Any rejected inversion/installation shall be relined or replaced by the Contractor at no additional cost to the Owner. The Contractor shall submit method of repair of the rejected inversion/installation length for review and approval by the Owner prior to construction any repair work. Any samples taken from within the final completed liner pipe shall be repaired by the Contractor, in accordance with the shop drawings, at no expense to the Owner.

3.6 ACCEPTANCE

A. Pipeline shall be true to line and grade, with no visual bulges, sages, protrusions, deflections, offset joints, leaking joints, or other visible infiltration, or other defects that would impair the intended use of the completed pipeline.

B. Contractor shall perform a post construction internal inspection in accordance with Section 02760 – PIPELINE CLEANING AND INTERNAL INSPECTION. Final acceptance of rehabilitation work shall not be granted until all defective areas are repaired to the pipe lining manufacturer's and Engineer's satisfaction.

C. Contractor shall perform testing as specified. Final acceptance of the work shall not be granted until the appropriately formatted testing results have been reviewed and approved by the Engineer.

D. Any repairs required by the Engineer as a result of the post construction internal inspection shall be performed by the Contractor, at the Contractor’s expense.

3.7 NOTIFICATIONS

A. Notify the Owner:

1. On a weekly basis of scheduled work for the upcoming week. Scheduled work shall be in accordance with approved work plan. Provide at least 24-hour notice for deviations from the approved work plan unless caused by weather or natural causes in which case the Owner shall be notified as soon as possible.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for CCTV inspection are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Inspection crews shall immediately notify the Owner and/or on-site inspector of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown in Owner supplied GIS data. The notification shall include a diagram in PDF format clearly indicating the location of structures in relation to immediately adjacent structures.

7. If any obstructions are found within an easement, even if not impacting work.

B. Notify the public (business and residential properties):

1. A minimum of one week prior to the inspection of any line segment, distribute door-to-door an Owner-approved Public Notification door hanger describing the work to be performed, schedule and impacts to water usage.

2. No less than 24-hours prior to the start of the work, the Contractor shall provide a final notification in person. Residential properties require notification after 5pm, when occupants are more likely to be present. For example, if the work is to start on a Monday morning, in person notifications should be attempted after 5pm the previous Thursday. If there is no response, the Contractor may leave a second door hanger as a final reminder.

3. The Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work Clearing and other costs related to gaining access (including restoration) should be included in Contractor's

pricing.

4. The Contractor to notify Property Owner of any trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. The Contractor to coordinate with the Owner on each obstruction found before proceeding.

-END OF SECTION 02767-

SECTION 02890

TRAFFIC SIGNALS

PART 1 - GENERAL

WHERE REFERENCE IS MADE HEREIN TO THE "MASSDOT STANDARD SPECIFICATIONS", THIS SHALL BE CONSTRUED TO MEAN THE LATEST EDITION, INCLUDING STANDARD SPECIAL PROVISIONS AND SUPPLEMENTAL SPECIFICATIONS, OF THE MASSACHUSETTS DEPARTMENT OF TRANSPORTATION HIGHWAY DIVISION STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES (English Units Version).

Work under the above items shall be performed according to the provisions of Section 800 of the MassDOT Standard Specifications, as well as the Advanced Transportation Controller (ATC) 5201 Standard v06.25 (or later) and the Advanced Transportation Controller (ATC) Cabinet 5301 Standard v02.02 (or later), as published by the American Association of State Highway and Transportation Officials (AASHTO), the Institute of Transportation Engineers (ITE), and the National Electrical Manufacturers Association (NEMA). Traffic signal work includes the following intersections:

- Harvard Street @ Prospect Street
- Harvard Street @ Columbia Street
- Harvard Street @ Windsor Street

The work consists of furnishing and installing traffic control signals at the intersections listed above complete and ready for operation, as shown on the plans.

Included in the work is the furnishing and installing of traffic control signal equipment, local traffic controller, cabinet and foundation, signal housings, backplates, red, amber, and green signal modules including bicycle signals, posts and bases, anchor bolts and foundations, service connections, wire and cables, conduit, pull boxes, hand holes, ground rods, saw cuts, electrical connections, and providing all incidental materials necessary for operating and controlling the traffic control signal, as shown on the plans and specified herein.

PARTS 2 & 3 – PRODUCTS AND EXECUTION

3 Inch Electrical Conduit Type NM – Plastic (UL)

The 3-inch Electrical Conduit, Type NM shall be installed as indicated on the plans and as directed by the Engineer.

Conduit to be installed into signal bases, pull boxes, traffic signal control box foundations, and mast arm foundations shall be installed in accordance with the plans and details shown on the MassDOT Standard Drawings.

Conduit in grass or in planted areas

Where new conduits are installed in grass and planted areas, work shall include placement of a minimum of 6 inches of loam borrow, seed, and any other materials replaced in kind to restore disturbed areas to their original condition. Any existing plants (bushes, flowers, etc.) removed or damaged as a result of this project shall be replaced in kind. No separate payment shall be made for this work, but all costs in connection therewith shall be included in Item 2890.4

Conduit under sidewalk

Where conduit is installed in sidewalk areas, the work shall include excavating and restoring the existing surface in kind. No separate payment shall be made for this work, but all costs in connection therewith shall be included in Items 2890.6.

Conduit in Roadways

Trenches in existing bituminous concrete pavements shall be sawcut to 18 inches wide. The existing pavement shall be sawcut through its full depth and the pavement removed.

Trench bed shall be prepared in accordance to MassDOT and City standards. After conduit installation, the trench shall be backfilled with controlled density fill (CDF). CDF shall be Type 2E and shall be as specified in Section M4.08.0 of the MassDOT Standard Specifications. The finished grade of the CDF shall be 4 inches below existing pavement surface or at the sidewalk subgrade elevation, as appropriate. Two 2-inch lifts of hot mix asphalt (top course material) shall be placed over the CDF when hardened in roadway locations.

Traffic Signal Pull Boxes – SD2.022 and SD2.031 (Traffic)

Work under this section shall consist of furnishing and installing traffic signal handholes in accordance with the Contract Drawings, as specified in these Specifications, and as directed by the Engineer.

Materials and methods shall comply with Section 801.40 and 801.61 of the MassDOT Standard Specifications with the exception of excavation. All excavation relative to these items shall be included as part of Items 2890.5 and 2890.6. Units shall be precast concrete as shown on MassDOT Standard Drawings SD2.022 and SD2.031. Handhole covers shall be clearly marked “TRAFFIC”.

Construction Methods

No work shall commence until the shop drawings are approved.

Conduit installations shall be per Subsection 02890.

Pull box installations shall be per Subsection 02890.

Foundation installations shall be per Subsection 02890. The top of the foundation shall be ¼” to 1” proud of the sidewalk and chamfered at 45 degrees. Gaps between the sidewalk and foundation shall be no larger than ¼” and grouted with preformed joint filler.

Equipment grounding shall be per Subsection 02890.

Service connection shall be per Subsection 02890. Contractor shall be required to pay all costs associated with the utility connection until final acceptance of the system. Upon acceptance, the contractor shall notify the City of Cambridge in writing with the account number and meter number in order to transfer payment of the account.

The Contractor shall diagnose and replace any part of the pedestrian activated warning system that is found to be defective in workmanship, material, or manner of functioning within six months of final acceptance by the Engineer. This requirement does not supersede the one-year warranty period on materials specified in Subsection 02890.

Traffic Signal System

A list of the major traffic signal items required is included on the plans.

The top of the concrete base for the control cabinet shall be 18 inches above grade. The top of all other foundations not in sidewalk or paved areas shall be a minimum of 2 inches above grade. The top of all foundations in sidewalk areas shall be located 3 inches ± below finish grade. The top of each mast arm foundation shall not be exposed in the sidewalk.

Within 30 days following execution of the Contract, the Contractor shall submit shop drawings for signal supports, a list of equipment, and manufacturer's equipment specifications to the Engineer in accordance with the relevant provisions of Section 815.20 of the MassDOT Standard Specifications. Unless otherwise specified by the City of Cambridge, all signal equipment shall conform to the latest version of the MassDOT Qualified Traffic Control Equipment (QTCE) list.

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

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

Flashing Operation

Changes from automatic flashing to stop-and-go operation and from stop-and-go to automatic flashing operation shall occur as set forth in Sections 4D.28 through 4D.31 of the MUTCD.

Controller and Cabinet

The controller cabinet foundation shall not obstruct a sidewalk or crosswalk so that passage by physically challenged persons is impaired. Anchor bolts shall be internal to the cabinet.

A slide-in/slide-out shelf or swing-out/swing-in shelf appropriate for the size and load of a laptop computer shall be installed in each controller cabinet to allow maintenance personnel to work in the cabinet in a safe, effective, and comfortable manner.

ATC Controller:

The ATC controller shall conform to ATC 5201 v06.25 or later and the MassDOT Standard Specifications. The controller and cabinet assemblies shall be supplied in an ATC cabinet configuration. The traffic controller unit shall have Peer-to-Peer (P2P) capabilities to communicate with controllers at adjacent intersections, and shall be capable of being operated in the fully actuated mode, in the free mode and as semi-actuated in the coordinated mode.

The ATC controller shall also conform to the following:

1. Controller Unit Housing
    - Rack- mounted configuration
    - Display model, serial number, and program information on exterior in an easy to find location.

2. ATC Engine Board
    - Provide the following minimum memory:
        i. Minimum of one hundred twenty-eight (128) MB of DRAM memory for application and OS program execution.
        ii. Minimum of sixty-four (64) MB of FLASH memory for storage of OS software and user applications.
        iii. Minimum of one megabyte (1MB) of SRAM memory for non-volatile parameter storage.

3. USB Ports
    - Minimum of two (2) USB 2.0 ports to be used for updating software, uploading or downloading configurations, or uploading logged data via USB flash drives.

4. Label the IP address on the timer unit using the ANSI/TIA-606-B standard as a guideline and the following:
    - Laminated
    - High strength
    - Resistant to extreme environmental conditions such as UV fading, high temperature fluctuations, and high humidity
    - Adheres to aluminum, polycarbonate, and other materials standard in roadside cabinet environment
    - Text is bold, legible, and fade resistant

5. Firmware Options
    - Provide the ability for peer-to-peer (P2P) communication once per second minimum between controllers of the same model type using Ethernet protocol communication.
    - Such communication will not require the use of any external device or software, and will not require routing to or from any external program.

- Configuration and saving of P2P setup information will not require restart of the controller to take effect.
- Provide controller capable of acting as either the source or the destination of Boolean & Peer statements.
- Provide a minimum of twenty-four (24) P2P statements available to the user at each controller.

6. Connected Vehicle Requirements
    - Provide a controller capable of broadcasting signal phasing and timing status every 1/10 of a second in SPaT format using SAE J2735 messaging to a user-configurable IP address via a user-configurable UDP port.

ATC Cabinet Assemblies:

The ATC cabinet and internal components (including, but not limited to, Cabinet Monitor Units (CMUs), Auxiliary Display Units (ADUs), Serial Interface Units (SIUs), High Density Switch Packs (HDSPs), High Density Flasher Units (HDFU), High Density Flash Transfer Relays (HDFTRs), Power Supply (PS), and all other ancillary traffic signal control components shall meet the requirements of ATC 5301 v02.02 or later. The cabinet shall also be wired with a normally closed switch connected to a user defined input to the controller for remote monitoring of the control cabinet's door open status. Controller cabinet shall be size "P" type box, with dimensions conforming to size six (6) dimensions as specified in Table 7.3-1 of the National Electrical Manufacturers Association (NEMA) TS 2 Standards.

The controller cabinet foundation shall not obstruct a sidewalk or crosswalk so that passage by physically challenged persons is impaired. Anchor bolts shall be internal to the cabinet.

The Contractor shall furnish the appropriate type and number of SIUs, HDSPs, HDFUs, and HDFTRs and place unutilized units in the control cabinet for future use. In addition to the convenience outlet as described under Subsection 815.41, a lamp with an on/off switch shall be installed in the controller cabinet.

The ATC controller shall also conform to the following:

1. LED light bars, 800 lumens minimum.

2. Sliding aluminum "laptop shelf" with piano hinged lid capable of holding the cabinet manuals and intersection condition diagram.

3. IP-addressable Cabinet Monitor Unit (CMU).

4. Fan and Vents:
    i. Fan and vent system providing 100 cubic feet of free air delivery per minute for single rack enclosure. Provide fan and vent system providing 200 cubic feet of free air delivery per minute for double rack enclosure
    ii. Vents equipped with standard-size, replaceable fiberglass filters.
    iii. Vents that prohibit the entrance of rain or snow.
    iv. Cabinet equipped with an adjustable thermostat connected to control the fans.

v. Manually adjustable thermostat with a calibrated scale. Thermostat adjustable within the range of at least 55 to 140 degrees Fahrenheit.
vi. Thermostat with contacts rated for at least eight amperes at 120 volts AC.
vii. Thermostat capable of turning the fan on at the set temperature and turning the fan off when the temperature is five degrees below the set temperature. The activation temperature shall be set by the cabinet manufacturer based on their recommendations.
viii. A temperature sensor to provide an alarm for cabinet overheating. Activate the alarm at 150 degrees Fahrenheit

5. One NEMA L5-30P receptacle for external generator connection.

6. An automatic transfer relay to engage the generator power.

7. Component and cable labels conforming to the following:
   i. Laminated
   ii. High in strength
   iii. Manufactured for extreme environmental conditions with respect to UV, temperature, and humidity.
   iv. Capable of adhering to all types of surfaces.
   v. Bold, legible and fade resistant text.
   vi. Band or flag type.

8. Clear plexiglass cover/protection on any open area with live electrical feed

9. Components that have a five-year manufacturer's warranty beginning from the date of installation.

10. One rack-mounted IP-addressable rear-facing six-outlet (minimum) power strip (120V 15-amp, capable of resetting upon failed IP ping or via remote web interface).

11. A rack-mounted test button panel that allows calls to be placed on each individual vehicle and pedestrian phase.

12. Auxiliary Display Unit (ADU)

13. Cabinet D Connector interface

14. One front-facing duplex convenience receptacle (120V, 15amp), or two receptacles integrated to the front of the power supply.

15. Full cabinet electrical schematic(s) including all location-specific field terminal connections

16. Detector mapping information to indicate which detector is on which channel and phase

17. A police cord of at least twelve feet in length in the police switch compartment.

Bus Interface Units

The Bus Interface Unit (BIU) shall comply with Section 8 of the NEMA TS 2 Standard. The BIU shall be fully interchangeable with any other manufacturer's unit and interchangeable in a NEMA TS 2 Type 1 cabinet assembly. In addition to the number of BIU's required for the detector racks, and terminals and facilities, two (2) spare Bus Interface Units shall be supplied with each controller cabinet.

The BIU shall perform the interface function between Port 1 at the controller unit, the malfunction management unit, loop detector rack assembly, and the backpanel terminal and facilities.

At a minimum, two (2) LED indicators shall be provided on the BIU front panel. One indicator shall serve a dual use; as a power on indication and as a diagnostic indicator for proper operation of the device. The second indicator shall serve as a transmit indicator illuminating each time data is transmitted.

Note Well: 2 Spare BIU's shall be provided for each location.

ATC Cabinet Power Supply

A separate power supply shall be supplied and installed in the ATC cabinet. The unit shall be 120 VAC line powered and provide regulated DC power, unregulated AC power, and a line frequency reference for all auxiliary cabinet equipment as required. At a minimum, the power supply shall meet all requirements of the ATC 5201 v06.25 Standards.

The power supply shall be either shelf mounted or wall mounted utilizing keyhole slots for ease of replacement or installed as part of the rack assembly.

Testing of Grounding System

The Contractor shall perform testing of the equipment grounding system in the presence of the Engineer in accordance with the Standard Specifications. A ground rod shall be installed in each controller cabinet.

Data Base Programming

Each programmable local hardware component shall be initially programmed by the Contractor based on information contained on the plans. Three (3) sets of hard copy programming per device shall be supplied and stored in the controller cabinet. In addition, at least two (2) sets physical data keys, programming cables, corresponding software and applications, and all other accessories required to monitor or modify controller programming shall be provided to the City at no additional cost.

Upon acceptance of the signal system by the City, the Contractor shall, at no additional cost, provide a minimum of 24 hours of training to the City on maintenance of the ATC signal

controller and cabinet, and shall be available for on-site assistance on an on-call basis for a period of one (1) year following acceptance by the City of the signal system.

Labels

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

Vehicle and Bicycle Signal Heads

All proposed vehicle and bicycle signal heads shall be aluminum. When, in the judgment of the Engineer, the visibility of existing or proposed signal faces will be obstructed by trees and other vegetation, the Contractor shall clear the obstructions for proper sight distance. Any clearing necessary shall be done within the City layout, and as directed by the Engineer.

Pedestrian Signal Heads, Indications, and Appurtenances

All pedestrian signal heads shall be LED types with the ITE international symbolic displays, including the hand symbol for *flashing don't walk* and *don't walk* indications and the walking person for *walk* indications.

Each pedestrian push button shall be equipped with a tactile indicator to provide visually impaired pedestrians with an indication of pedestrian actuations. In addition, the pedestrian pushbutton shall be equipped with an indicator light, provided through the use of an LED, which will provide pedestrians with confirmation of a pending pedestrian phase. The confirmation LED shall meet or exceed the specifications of the model PPB-LED or approved equal.

Tactile pedestrian push buttons shall be 4-wire accessible pedestrian signal with vibro-tactile and directional (right or left) arrow with Red LED confirmation light, ped head control unit and 12' harness – painted yellow with rapid tock walk sound. The assembly shall include a saddle to accommodate a 5"x7" standard sign providing guidance on pedestrian signals, including in Braille for visually impaired persons.

Each visual pedestrian indication shall be complemented by an audible pedestrian indication. The audible indication shall meet or exceed the specifications for the BPC type indication.

1. Each separately phased pedestrian movement shall have its own distinctive audible emanation in order for visually impaired pedestrians to discriminate which phase is appropriate given his or her destination and/or direction of travel.
2. The audible emanation shall be a cowbell type sound. No buzzer or ringing type sounds will be acceptable. The output level of the audible pedestrian signal shall vary in intensity with significant fluctuations in ambient noise conditions. At a minimum, the output level shall vary in intensity from daytime to nighttime operations.
3. The housings of both the visible and audible pedestrian indicators shall be painted matte black.

Each visual pedestrian indication shall be complemented by a time display indication. Each time display indication shall be self-programming and microprocessor based, with red LEDs used in the display. The time display will countdown the amount of time remaining in each *walk* and *flashing don't walk* time interval for viewing by the ambulatory public. The time display pedestrian indication shall meet or exceed the specifications of the TASSIMCO Countdown Pedestrian Signal.

Red, Amber and Green LED Vehicle Signal Modules

All Red, Amber and Green signal housings with the exception of optically-programmed and fiber optic housings shall conform to the following:

The LED signal module shall conform to "Interim LED Purchase Specification of the Institute of Transportation Engineers, Vehicle Traffic Control Signal Heads - Part 2: Light Emitting Diode (LED) Vehicle Traffic Signal Modules", July, 1998, or most current version, Institute of Transportation Engineers (ITE), 1099 14th St., N.W., Suite 300 West, Washington, DC 20005-3438, Telephone: (202) 289-0222, FAX: (202) 289-7722, and shall conform to the following: (In the case of a conflict, the following special provision shall overrule.)

An independent laboratory shall certify that the LED signal module complies with Section 6 Quality Assurance of the above stated ITE LED Purchase Specification.

LED signal modules must be type-tested and approved by the Department according to the requirements of Subsection 815.21 of the Standard Specifications for Highways and Bridges.

On the backside of the LED signal module there shall be a permanently marked "up" arrow to aid in the proper orientation of the module during installation.

The manufacturer's name, trademark, serial number and other necessary identification shall be permanently marked on the backside of the LED signal module.

Physical and Mechanical Requirement

LED signal modules shall fit without modifications into existing traffic signal housings conforming to "Vehicle Traffic Control Signal Heads" (VTCSH) published in the Equipment and Materials Standards of the Institute of Transportation Engineers. The LED signal module shall be a single, self-contained device, not requiring on-site assembly for installation. The LED signal assembly construction shall conform to the applicable ASTM specifications for the materials used to fabricate the module.

Each LED signal module shall comprise a smooth surfaced red, amber, or green UV stabilized polycarbonate outer shell, multiple LED light sources, a power supply, and a polycarbonate back cover assembled in a gasketed or silicon sealed unit.

Optical and Light Output Requirements

The minimum luminous intensity values and light output shall be maintained within the rated input voltage of 117 Volts AC. LED signal modules shall not be allowed to fall short of the minimum intensity values at any of the 44 measuring points of the standard when lamp is turned on cold for measurements and after a 30 minute warm-up time period at 100% duty cycle.

Electrical

The maximum wattage for 12" ball shall be 20 Watts and 10 Watts for the 12" arrow.

The LED sources shall not be powered above 70% of the manufacturer's specified rated load. This shall be clearly shown in layman's terms through calculations, schematics, catalogue cuts, etc.

Red and Yellow LED sources shall be made of the AlInGaP (Aluminum Indium Gallium Phosphide) type shown clearly in a catalogue cut or similar literature.

Green LED sources shall be made of the InGaN (Indium Gallium Nitride) type shown clearly in a catalogue cut or similar literature.

Warranty

The LED signal module will be replaced or repaired by the manufacturer if it exhibits a failure due to workmanship or material defects within the first 60 months of field operation.

The LED signal module will be replaced by the manufacturer if it exhibits any partial outage before the final inspection or it exhibits either a greater than 40 percent light output degradation or a fall below the minimum intensity levels within the first 36 months of field operation.

Backplates

Backplates shall have a louvered profile. Backplates shall have a 5 inch border width and a dull flat black color. Only backplates that are listed in the latest MassDOT QTCE List will be used on this project.

Mast Arm Poles and Foundations

Mast arm poles and foundations shall be fabricated and constructed in conformance with the MassDOT Standard Drawings, dated December 2015.

All mast arm poles shall be galvanized steel monolevers with shoe bases.

Acceptance of Type II mast arm poles will be contingent upon review and approval of shop drawings submitted by the Contractor. Long-hand design calculations shall be submitted by the Contractor with the shop drawings for all Type II mast arm poles.

The lump sum prices bid should assume the dimensions shown on the MassDOT Standard Drawings for a three and a half foot (3.5') diameter foundation for all mast arms forty feet (40') long or shorter, and for a four foot (4') diameter foundation for all mast arms greater than forty feet (40') and less than fifty feet (50'). Soil exploration borings shall be conducted by the Contractor and paid for under Item 2210.1. The lump sum bid prices should assume loose wet sandy soil.

Where soil conditions are such that, in the opinion of the Engineer, the typical foundation design is not suitable, the Engineer will provide a modified design for the foundation.

Mast arm foundations shall not obstruct a sidewalk or crosswalk so that pedestrian accessibility is impaired.

Posts and Bases

All traffic signal posts and bases shall be aluminum. Bases shall be of the square shape and include a cast iron threaded insert for strength. Signal post foundations in grass areas shall be exposed ± 2 inches. In sidewalk or paved areas, the top of all signal post foundations shall not be exposed.

Video Detection System

The video detection (VD) system shall be Miovision Smartview 360 or approved equal.

The VD system shall detect vehicles, buses, and bicycles on approach roadways utilizing advanced, omni-directional, vehicle tracking algorithms along with three-dimensional vehicle modeling to supply accurate and consistent stop line detection.

The VD system shall include all necessary software and hardware to allow the end user to program, setup, and/or modify detection zones within the video camera image. The Contractor shall also supply any necessary cables, interface devices and software for monitoring video detection via laptop computers.

The cameras shall be mounted on the mast arm, as shown on the plan or as directed by the Engineer. The cameras shall be within 75 feet of the center of the intersection and within 150 feet from all stop bars.

The VD system shall create reports that will upload daily to a cloud server. The reports shall be exportable from the cloud in PDF, Microsoft Excel, Rich Text format, TIFF, and Web Archive. The reports shall include:

- Volume Reports (including average and summation)
- Turning Movement Count Reports (including average and summation)
- Vehicle Classification Reports
- Incident Reports
- Raw Data Export
- Performance Reports
    - Seven Day Volume
    - Green Occupancy
    - Red Occupancy
- Future Reports

The VD system shall allow the user to specify that any of the above reports be sent via email to the user. The VD system shall send alerts regarding system events to the cloud on a daily basis.

At a minimum, the VD shall meet the following requirements:

Camera

a. Power: 5W

b. Connections: Cat5e cable

c. Communications: DCAM I/F

Video Processor Unit

a. 110 VAC

b. Video Output: MJPEG

c. Detector I/O: 24 optically isolated I/0, SDLC interface

d. Status Indicators:
   Primary Video Input Power Status
   Detection Outputs

e. Communications: TCP/IP

General

a. Environmental:
   a. -40F to +122F
   b. 10% to 90% humidity non-condensing

b. Warranty: 3 years limited warranty

c. Regulatory: ATC compliant

The VD system shall be installed in accordance with the manufacturer's recommended procedure for installation.

The VD system shall be installed by factory certified installers and as recommended by the manufacturer and documented in installation materials provided by the manufacturer. Proof of factory certification shall be provided. Installation includes connecting the VD to the traffic signal controller and power supply in the associated controller cabinet assembly. When the setup is complete and the VD system is ready for operation, the values of all parameters that were set during the process shall be delivered to the Engineer in printed and computer readable form. All equipment such as software, laptop computer, tools and cables, needed for setup work shall be provided by the Contractor.

The Contractor shall be responsible for the proper programming of the VD, orientation of the VD, and all other work necessary to provide a complete vehicle detection system. The Contractor may be required to field adjust the location of the VD system in the presence of the Engineer to properly detect approaching vehicles.

The cabinet documentation (box prints) shall show all wiring between the VD system and the controller cabinet.

Meter Boxes
The meter boxes shall include a by-pass meter switch.

Intersection Wiring
All cable shall meet the requirements of IMSA Specifications or 20-1 and shall be twisted copper conductors. A minimum of five spare conductors shall be installed to all signal heads.

Wiring Diagrams
Five sets of wiring diagrams with both internal and external wiring for the control cabinet and all accessories as actually used in the field shall be furnished, including one mylar reproducible copy for the control cabinet when installed. All actual and potential terminal strip connections shall be shown. Accessory equipment includes all components internal to the cabinet. All identification on the diagrams shall be as installed, and all field labeling shall be consistent with the diagrams. Before acceptance of the job, four copies of all operation and maintenance manuals and complete, accurate parts lists shall be supplied.

Service Connection
The service connection shown on the plans is approximate only. The contractor shall determine the exact location from the servicing utility, arrange and coordinate with the utility company to complete the service connection, and be responsible for all charges incidental thereto. The underground service connection to the traffic controller shall terminate in an underground handhole prior to entering the meter socket. The handhole shall be Eversource Catalog ID 521914, 30”x17”x18” H20 rated composite handhole, unless otherwise approved or directed by Eversource or the Cambridge Electrical Department.

Electric Service
An approved meter socket shall be mounted on the side of the cabinet of the controller. The Contractor shall furnish and install the meter socket and the utility company shall furnish and install the meter. The conduit between the service handhole and the meter socket shall not enter the traffic control cabinet and shall be rigid galvanized steel where exposed. The controller cabinet foundation shall be sized so that the conduit riser to the meter socket emerges from the foundation, and not directly from the adjacent sidewalk or landscape surface. A separately fused, 60 amp, grounded duplex outlet and a light receptacle shall be installed. A separate fused disconnect switch shall be provided with lightning protection. Adequate 120 VAC power terminals shall be provided within the controller cabinet.

Cooling Fan
The thermostatically controlled fan shall be sized and set as to limit the upper interior cabinet temperature to a difference of 30 degrees Fahrenheit above the exterior ambient temperature.

Duplex Convenience Receptacle
The duplex receptacle container within the controller cabinet shall be rated for 120 vac, 15 amp and shall be of the Ground Fault Circuit Interrupter (G.F.C.I.) Type.

Work Light

The work light contained within the controller cabinet shall be toggle switch controlled. This toggle switch shall be mounted on the inside of the cabinet door.

Painting

Vehicle signal housings, Visors	-	Black
Signal housing supports (posts)	-	Black
Mast Arms, posts and bases	-	Black
Controller cabinet (exterior) & Meter Socket	-	Black
Controller cabinet (interior)	-	Aluminum
Front of Signal Housings, and Backplates	-	Flat Black

Keys

Two controller cabinet door keys and police door keys shall be supplied for each controller cabinet on the project.

Removing and Stacking Existing Signal Equipment

Existing traffic signal equipment within the project limits shall be removed and stacked by direction of the Engineer. Existing traffic signal equipment to be removed and stacked shall include, but not be limited to, traffic signal heads, backplates, pedestrian push buttons, signs and saddles, traffic signal posts, mast arms, traffic signal controller, cabinet, loop detector amplifiers, hangers or brackets, and any other materials not necessary for the final signal operation.

All traffic signal equipment to be removed and stacked shall be delivered to the City of Cambridge DPW yard, or an alternate location as designated by the Engineer.

As-built Traffic Layout Plans

It will be the responsibility of the Contractor to provide the Design Engineer with as-built traffic signal layout plans at a scale of 1"=20' indicating all changes made during the construction. The plans shall indicate the final location of all traffic signal equipment installed including detectors, signal posts, mast arms, pedestrian and vehicular signal heads, controller cabinets, conduit, pull boxes, hand holes and service connections. The plans shall also indicate the final as-built timing and sequence, major item list, power pole number and meter number. Upon receipt of the above as-built information from the Contractor, the Design Engineer will field verify the as-built information and plans. Following field verification, the Design Engineer will prepare the as-built Traffic Signal Layouts and/or Permits for submission to the City of Cambridge Traffic Engineer prior to the final acceptance of the project.

Miscellaneous Requirements

Because this is often overlooked, the Contractor's attention is drawn to the requirements of the following sections of the MassDOT Standard Specifications: Section 813.60C Splicing, relative to four optional methods of splicing in signal bases, Section 813.40C Ground Electrodes, relative to Requirement 1 - connection to a water piping system, and Section 813.61 Equipment Grounding.

The Contractor shall make all necessary arrangements with the electric company for the service connections or for any main power cut off when necessary, and bear all charges incurred thereby.

When removal of existing traffic signal equipment and appurtenances is called for, the order of work shall be as directed by the Engineer.

Removal of existing traffic signal equipment and their accessories shall be done in a manner that will not damage reusable material. All signal posts and bases shall be separated from one another without damage to either unit (4-in. shaft unscrewed from base). When stipulated, existing material shall be utilized in the construction of the new installation. Material to be installed shall be thoroughly cleaned before reinstallation. All reinstalled material, after cleaning and spot coating, shall receive two brush coats of paint to all parts as specified for new installations. Paint shall be applied after material is in place. The Contractor shall furnish and install all necessary materials and equipment, including new foundations, etc. required to complete the reinstallation. All traffic signals, and pedestrian signals to be reinstalled shall be relamped with new lamps of the size and type required for new installations. Existing material removed and not utilized in the new installation shall be salvaged and transported by the Contractor to the Department Storeroom. Underground conduit, conductors, foundations and detector frames not reused shall be removed from the project, except if not interfering with other construction, they may with written approval of the Engineer be abandoned in place.

END OF SECTION 02890

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02900

LANDSCAPING

PART 1 – GENERAL

1.1 SUMMARY

A. The work of this Section consists of providing all labor, equipment, materials, incidental work, and construction methods necessary to perform all planting, seeding and sodding work and related items as indicated on the Contract Documents and as specified in this Section and includes, but is not limited to, the following:

1. Shrubs
2. Perennials and grasses
3. Restoration planting for back of sidewalk improvements
4. Grades and standards of plants
5. Root systems for all plants
6. Mycorrhizal fungal inoculant
7. Fertilizer
8. Mulch
9. Water
10. Antidessicants
11. Limestone

1.2 RELATED WORK

A. Section 01630 – RESTORATION OF GROUNDS AND CLEANING UP
B. Section 02100 – SITE PREPARATION AND TREE PRUNING
C. Section 02901 – PLANTING SOILS
D. Section 02902 – STRUCTURAL PLANTING MEDIUM
E. Section 02950 – BACK OF SIDEWALK RESTORATION

1.3 SHOP DRAWING SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 - SUBMITTALS:

1. Certify, invoice, and order plants for each shipment grown, free of disease and insect pests. Submit certificates to Engineer.

2. Prior to placement of any mulch, deposit, at a location on site suitable to Engineer, 1/2 cu. yd. sample of mulch for examination. After mulch sample is reviewed by the Engineer, provide mulch conforming to accepted sample.

3. Submit to Engineer project literature for each type of fertilizer, anti-desiccant and mycorrhizal fungal inoculant.

4. Submit with seed, certificates concerning seed mixture, purity, germinating value, and crop year identification.

5. Submit test samples of loam to a certified soils consultant to determine fertilizer and lime requirements and return two copies of results for implementation.

6. Submit list of plant material to be used and source.

7. Prior to end of maintenance period, furnish two copies of written maintenance, instructions for maintenance and care of installed plants and lawn areas.

1.4 QUALITY ASSURANCE

A. Investigate sources of supply and make assurances that plants will be supplied as indicated in Schedule of Plant Material in sizes, variety and quality noted and specified before submitting bid. Failure to take this precaution will not relieve responsibility for furnishing and installing plant material in accordance with Contract requirements and without additional expense to Owner.

B. Upon delivery and before planting, Engineer will observe plants. Evaluation and approval by Engineer of plants is for quality, size and variety only and in no way impairs the right of rejection for failure to meet other requirements during progress of work.

C. General:

1. Provide only nursery grown plants having been transplanted at least once and growing in a nursery for at least two years. Allow Engineer to determine fitness of any plant.

2. Provide container-grown stock in containers long enough for root system to develop sufficiently to hold soil together firm and whole when removed from container. Use no plants loose in the container.

3. Check plant material prior to commencing of planting operations. Plant no material prior to inspection by Engineer. Notify Engineer at least 48 hours in advance of all planned planting operations and identify specific material and its location.

4. Furnish suitable quantities of water, hose and appurtenances.

5. Use loam, having prior vegetative growth that did not contain toxic amounts of either acid or alkaline elements.

6. Begin maintenance after each portion of lawn is seeded and continue for minimum of 45 days.

7. Correct defective work as soon as possible within guarantee period. Repair or replace seeded areas, plants, and shrubs which, in judgment of Engineer, have not survived and grown in a satisfactory manner, for a period of one year after acceptance.

8. Provide as specified seedings or plantings replacements of the same type and size as specified.

9. Dry loam test samples to constant weight at temperature of 230 deg. F, plus or minus 9 degrees.

10. The Engineer reserves the right to test and reject any material not meeting specifications by utilizing tests in accordance with methods adopted by the Association of Official Agricultural Chemists. Costs for these tests shall be paid by the Contractor.

D. The landscape contractor and crew leader responsible for turf or native grass establishment shall be certified as a Massachusetts Certified Landscape Professional or Horticulturist.

1.5 STORAGE AND HANDLING OF MATERIALS

A. Store plants in ground or other acceptable media if not to be planted within 4-hrs. Protect roots of plant material from drying or other possible injury. Water plants as necessary until planted.

B. Do not drop plants. Do not pick up container or B & B (ball and burlap) plants by stem or trunks.

1.6 WARRANTY

A. Provide as specified.

B. Guarantee new plant material through one full growing season after plants are installed. Guarantee plants replaced under this for one full growing season from date of replacement.

C. Repair damage to plants or lawns during plant replacement. Guarantee lawn areas for duration of one full year after seeding to be alive and in satisfactory growth at end of guarantee period.

D. For purpose of establishing an acceptable standard, scattered bare spots, none of which is larger than 1 sq. ft. will be allowed up to a maximum of 3% of lawn area.

1.7 COORDINATION WITH RESTORATION SEEDING

A. For all areas requiring restoration seeding, the Contractor shall comply with the following requirements in addition to this Section:

1. Seedbed preparation, seeding methods, and maintenance for turf or native grass areas shall be performed as specified below.

2. Only certified seed mixes shall be used, with all submittals and certifications provided for approval prior to use.

3. Maintenance of seeded areas, including watering, mowing, reseeding, and removal of invasive species, shall be performed for a minimum of one full growing season or until final acceptance, whichever is longer.

4. Acceptance of seeded areas will be based on full establishment, absence of bare spots, and control of invasive species.

PART 2 – PRODUCTS

2.1 SHRUBS

A. Species as noted and specified in the PLANT SCHEDULE.

B. All shrubs shall meet the following standards

1. All shrubs shall be healthy and vigorous plants which are very well shaped, heavily branched, densely foliated, and true to form for the variety.

2. Canes or Trunk(s) and Branches:

a. Well formed and sturdy.

b. Branching shall be uniformly distributed close to the ground.

c. Scars shall be free of rot and not exceed 1/4 the diameter of the wood beneath in greatest dimension unless completely healed (except pruning scars).

d. Pruning scars shall be clean cut and shall leave little or no protrusion from the trunk or branch.

e. Graft unions shall be completely healed.

f. No suckers or water sprouts.

g. Contain no dead wood.

h. Free of cracks, splits, or cambium peeling.

3. No shrub with pest or mechanical damage will be accepted.

4. Shrubs shall show no signs of frost or winter damage to the foliage. Foliage shall not be in a state of drought stress. Leaves or needles shall show no signs of wilt or desiccation due to weather stress at any season of the year.

2.2 PERENNIALS, GRASSES AND FERNS

A. Species as noted and specified in the PLANT SCHEDULE.

B. All perennials, grasses and ferns shall meet the following standards:

1. Perennials, grasses and ferns shall be healthy and well cared for, with no evidence of insects or diseases present. Insect-ridden or diseased plants shall be rejected. Plants shall have a deep green foliage and dense, compact growth. Perennials, grasses and ferns shall have multi-stemmed bases and shall be two year potted stock minimum, one year in cutting bench and one year in pots.

2.3 RESTORATION SEEDING

A. Seed for restoration seeding shall be fresh, clean, and of the previous year's crop, with a minimum 75% Pure Live Seed (PLS) for each seed lot.

B. Seed mixes shall be certified and conform to project requirements for species composition and seeding rates.

C. All seed shall be delivered in sealed, properly labeled containers, and accompanied by Certificates of Compliance.

D. Seed that is wet, moldy, or otherwise damaged shall not be used.

E. Seed Mix shall be low maintenance, grass seed mix similar to Allen's seed mix or, approved equal.

Common Name	Proportion By Weight
Kentucky Bluegrass (at least three improved varieties to be approved by Owner's Representative)	30%
Creeping Red Fescue or Chewings Fescue (varieties to be approved by Owner's Representative)	40%
Perennial Rye	30%

1. Bluegrass and rye grass varieties shall be within the top 50 percent and 25 percent respectively, of varieties tested in National Turfgrass Evaluation Program, or currently recommended as low maintenance varieties by University of Massachusetts or the University of Rhode Island.

2. Seeding rate shall be 5 pounds per 1,000 square feet for new seeding and 4 pounds per 1,000 square feet for overseeding.

2.4 GRADES AND STANDARDS OF PLANTS

A. The Contractor shall furnish all plants shown on the Contract Documents, as specified, and in quantities listed on the PLANT SCHEDULE. No substitutions will be permitted, without written approval by the Landscape Architect. All plants shall be nursery grown unless specifically authorized to be collected as noted on the PLANT SCHEDULE.

B. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. Only plant stock grown within Hardiness Zones 1 through 6b, as established by the USDA Plant Hardiness Zone Map, latest edition, will be accepted.

C. Plants shall be in accordance with ASNS Standards of the American Association of Nurserymen except as noted in this Section. Botanical plant names shall be in accordance with plant designations included in Hortus III.

D. If, at any time during the performance of the Contract, any plant shows signs of graft incompatibility, as determined by the Landscape Architect, then the shrub and all other similarly grafted plants of the same Genus/Species/Variety shall be rejected and removed from the site. Visual symptoms of graft incompatibility as cause for rejection include:

1. Development of over-growths by rootstock or scion resulting in the development of shoulders or inverted shoulders.

2. Suckering of the rootstock combined with poor growth or dieback of scion.

3. Any mechanical weakness between scion and rootstock.

4. Any marked difference in bark pattern and structure between scion and rootstock.

2.5 ROOT SYSTEMS FOR ALL PLANTS

A. Each plant shall have an extensive, symmetrically balanced fibrous root system. Any root ball which shows signs of asymmetry, injury, or damage to the root system shall be rejected.

B. Curling or spiraling of the roots along the walls of rigid containers will not be accepted.

C. All parts of the fibrous root system of all plants shall be moist and fresh with a white color when washed of soil. When the plant is removed from the container, the visible root mass shall be healthy with white root tips. The root systems of all plants shall be free of disease, insect pests, eggs, or larvae.

D. All shrubs which are not grown in containers must be moved with the root systems as solid units with balls of earth firmly wrapped with untreated 8 ounce natural, biodegradable fabric burlap, firmly laced with stout, natural biodegradable cord or twine.

E. The diameter and depth of the balls of earth must encompass the fibrous and root feeding system necessary for the healthy recovery of the plant. Minimum root ball diameters and depths shall be in accordance with ASNS standards.

F. No plants shall be loose in the container.

G. Container grown plants which have roots growing out of the container will be rejected.

2.6 PLANTING SOIL MIX

A. Planting soil mix shall be an approved amended native soil specified, provided, installed and paid for under Section 02901 PLANTING SOILS, and that has been pH adjusted according to particular planting applications and improved through the addition of organic matter as directed below. Planting soil shall conform to the following pH levels:

1. For broad-leaved evergreens requiring an acid soil, planting soil mix shall have a true pH of 4.5 to 5.5. Planting soil mix shall be amended by the Contractor at his own expense to the proper pH range by mixing with sulfur as specified, provided, installed and paid for under Section 02901 PLANTING SOILS. Broad-leaved evergreens include but are not limited to the following genuses: Kalmia and Ilex.

2. Planting soil mix for general planting of non-acid loving plants shall have a true pH value of 6.0 to 6.5. Planting soil mix shall be amended by the Contractor at his own expense to the proper pH range by mixing with dolomitic limestone as specified, provided, installed and paid for under Section 02901, PLANTING SOILS.

3. The amount of either sulfur or limestone required to adjust the planting soil mix to the proper pH range shall be approved by the Landscape Architect on the basis of soil tests as specified, provided, installed and paid for under Section 02901 PLANTING SOILS.

2.7 SOIL ADDITIVES

A. Soil additives shall be specified, provided, installed and paid for under Section 02901 PLANTING SOILS.

2.8 MYCORRHIZAL FUNGAL INOCULANT

A. Mycorrhizal fungal inoculant shall be live spores packaged in plastic packets. At a minimum each packet of inoculant shall contain the following:

1. Live spores of VA Endomycorrhizal fungi: Vesicular-Arbuscular mycorrihizae fungi, minimum of 8 species.

2. Live spores of Ectomycorrhizal fungi: including *Pisolithus tinctorius*.

B. Mycorrhizal fungal inoculant shall be manufactured by:

1. Plant Health Care Incorporated, 440 William Pitt Way, Pittsburgh, PA 15238, telephone: (800) 421-9051;

2. Horticultural Alliance, 2946 Louise Street, Sarasota, FL 34237, (800) 628-6373;

3. BioPlex Organics, 2213 Huber Drive, Manheim, PA 17545 (800) 441-3573,

4. Or approved equal.

2.9 FERTILIZER

A. Fertilizer shall be the unique feeder 16-8-16 controlled, slow-release fertilizer packets (8 yr), as manufactured by Osmocote, or approved equal.

2.10 MULCH

A. Mulch shall be high quality, 50/50 blend of shredded or double-ground, premium bark mulch and a high quality, nutrient rich compost consisting of clean, organic plant material. Mulch shall be “Performance Mulch” by Agresource, Inc, 110 Boxford Road, Rowley, MA 01969, 978-388-5110, info@agresourceinc.com or approved equal.

B. Shall be uniform in color, a good brown color. The composition of the shredded pine bark and compost material shall not exhibit a noticeable degree of any color change characteristics when wet.

C. The mulch must be free of dirt, insects, disease and extraneous debris that would be harmful to all trees and plants being installed.

D. The shredded pine bark mulch material shall not have an unpleasant odor.

E. Bark Mulch shall be a well-graded material conforming to the following:

1. pH between 4.0 – 8.0
2. Particle size 100% passing a 50mm (2 inch) screen
3. Soluble salt content < 4.0 mmhos/cm
4. Contain 0% water soluble phosphorus and < 1% total available phosphorus.

F. Prior to the Contractor ordering shredded pine bark mulch material, the Contractor shall submit to the Owner's Representative, at the Contractor's expense, one cubic foot sample of the mulch material. The Contractor shall not order any delivery of the mulch material until the Contractor's sample has been inspected and approved by the City Arborist.

G. If the Owner's Representative disapproves of the sample submitted by the Contractor, then the Contractor shall continue at no expense to the City, to obtain other sources of mulch material as specified until the Contractor's sample of such material, meets with the Owner's Representative's approval.

2.11 WATER

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

2.12 ANTIDESICCANTS

A. Antidesicants shall be emulsions or other materials which will provide a protective film over plant surfaces permeable enough to permit transpiration and specifically manufactured for that purpose. Manufacturer of antidesiccant shall be subject to the Landscape Architect's approval and shall be used only after approval by the Landscape Architect. Antidesiccant shall be delivered in containers of the manufacturer and shall be mixed and applied according to the manufacturer's instructions.

2.13 LIMESTONE

A. Ground limestone for adjustment of loam borrow pH shall contain not less than 85 percent of total carbonates and shall be ground to such fineness that 40 percent will pass through 100 mesh sieve and 95 percent will pass through a 20 mesh sieve. Contractor shall be aware of loam borrow pH and the amount of lime needed to adjust pH to specification in accordance with testing lab recommendations.

PART 3 – EXECUTION

3.1 GENERAL

A. It is the intent of this specification that existing trees within grading and seeding limits, not disturbed by building operations, be saved and protected, except where specified to be removed. Tree clearing, protection, and planting shall be performed based on the applicable specification sections and as indicated in the drawings or by the Engineer. Engineer requires variations required in grading on the job.

3.2 PLANTING

A. Furnishing and planting of plant material shall include, but shall not be limited to, the digging of planting pits and plant beds, amendment of loam as required to produce planting soil mix, provision of soil additives required to adjust for pH requirements of specific plants, furnishing the plants as specified as well as the labor of planting, fertilizing, and maintenance.

B. Prior to spreading of loam, subgrades shall have been tested to determine if they are too compact to drain water as specified, performed and paid for under the work of Section 02901, PLANTING SOILS, of this Specification.

C. The Contractor shall locate plant material sources and ensure that plants are shipped in timely fashion for installation.

D. Contractor shall locate all existing underground utilities that are within 10 feet of the proposed planting pits and notify the Landscape Architect of any conflicts prior to digging plant pits.

E. Seasons for Planting:

1. Spring: Deciduous materials - March 31 through June 15; Evergreen materials - April 27 through June 15.
2. Fall: Deciduous materials – August 15 through October 1; Evergreen materials - August 15 through November 30.

F. Plant Material Inspection:

1. At least one month prior to the expected planting date, the Contractor shall request that the Landscape Architect provide a representative to select and tag stock to be planted under this Section 02900, LANDSCAPING. The Contractor shall pay for the transportation, subsistence and overnight accommodations, if necessary, for the Landscape Architect's representative during the period of time required to select and tag the plant material.

2. The Contractor shall be responsible to certify the availability of quality plants in specified sizes from his/her sources of supply prior to requesting that the Landscape Architect make plant source inspections. In the event that plants at the inspection location are found to be unavailable or of insufficient size, the Contractor shall be liable to reimburse the Owner for all costs of the Landscape Architect's hourly services which are incurred during unproductive inspection trips.

3. Unless specifically designated otherwise, a representative of the Contractor shall accompany the Landscape Architect on all plant material selection field trips.

4. Representative samples only of shrubs and ground cover plants may be tagged or marked for approval as an "Approved Typical Sample" and shipped to the site. Any shrub or groundcover plant that arrives at the construction site that does not meet the Approved Typical Sample will be rejected by the Landscape Architect.

5. Inspection and approval of plants at the source shall not impair the right of subsequent inspection and rejection upon delivery to the site, or during the progress of the work if the Landscape Architect finds that plants do not meet the requirements of the PLANT SCHEDULE or this Contract, have declined noticeably due to handling abuse, lack of maintenance, or other causes. Cost of replacements, as required, shall be borne by the Contractor.

G. Placement of Loam for planting soil shall be specified, performed and paid for under the work of Section 02901, PLANTING SOILS, of this Specification. Obtain Landscape Architects written approval of work of rough grading and finish grading prior to starting the work of planting.

H. Planting:

1. Notify the Landscape Architect three working days prior to the proposed arrival of plant material on the site. If not planted within 24 hours of delivery to the site, all plants shall be maintained in an on-site nursery. Container grown shrubs stored on site shall be shaded from direct sunlight at all times and shall not be stored directly on paved surfaces. All plants delivered to the site and not planted within 24 hours of delivery shall have their root balls covered with mulch and

shall be watered on a daily basis such that root balls are kept moist throughout.

2. Locations for all plants and outlines for planting areas shall be staked on the ground by the Contractor for approval by the Landscape Architect before any plant pits or plant beds are dug. Notify the Landscape Architect no less than 3 days prior to desired date of inspection of staking to schedule site visit.

3. All plant pits dug with a machine shall have the sides of the holes scraped with hand shovels to prevent glazing or compaction of the sides of the hole. Remove and stockpile excavated loam for reuse as backfill for plant pit. All subsoil excavated from the bottoms of planting pits shall be removed from the site.

5. Plant pits shall be dug to the dimensions shown on the Contract Documents.

    a. Plant pits for shrubs shall be 2 feet greater in diameter than the diameter of the root ball. Place root ball directly on subgrade.

    b. Shrub planting beds shall be excavated and backfilled with planting soil mix to a minimum uniform depth of 24 inches below final grade, or as shown on the Contract Documents.

    c. Plant pits shall be dug to the depth of the rootball to be planted. Remove all soil from around the root flare of the stem of the plant and from the top of the rootball to determine the true depth of the rootball. All plants that have been planted and have root flares that are buried will be rejected.

6. Perennial, grass and fern beds:

    a. Perennial, grass and fern beds shall be dug to a continuous depth of 1 foot below final grade, or as shown on the Contract Documents. Place sufficient planting soil mix to provide 1 foot deep beds. Remove groundcover and perennials from their pots immediately before planting. Handle plants carefully to prevent damaging roots. Place each plant in individual hole and firm the planting mix around the roots. Water thoroughly and mulch as shown on the Contract Documents. Groundcover plants may be planted after the planting mulch is placed.

7. All plant roots and earth balls must be damp and thoroughly protected from sun and wind from the beginning of the digging operation, during transportation, and at the site until the final planting.

8. Remove container plants from containers prior to planting.

9. Shrubs shall be placed in the center of plant pits, plumb, with the crown of their roots exposed and located above the surrounding finish grade.

11. Contractor shall 'butterfly' the root system for all container grown perennials immediately prior to planting them. Butterflying shall consist of vertically cutting the containerized root ball with a spade

through the bottom half of the rootball followed by gently pulling the rootball open at the cut while placing it into the planting hole. The butterflied root system shall be placed over a small ridge of soil in the planting pit in order to assure as much soil to root ball contact as possible and to keep the halves apart.

12. Planting soil shall be backfilled in layers of not more than 6 inches. Compact each layer of planting soil by foot tamping prior to placing next layer of planting soil backfill. Eliminate all air pockets in the backfill material. Enough planting soil shall be used to bring the finished surface of the planting pit to 2 inches above finished grade at plant stem when planting soil backfill has settled.

13. Fertilizer shall be spread over the plant saucer or plant bed between the saucer and the edge of the rootball. Till the fertilizer into the soil to a depth of four inches prior to the placement of the planting mulch. Fertilizer shall be provided, spread and paid for under the Section 02901, PLANTING SOILS, of this Specification. Do not mulch until placement of the fertilizer has been verified by the Landscape Architect. Fertilizer application rates shall be as determined by soil testing, analysis, and testing laboratory recommendations specified, performed and paid for under the Section 02901, PLANTING SOILS, of this Specification.

I. All plants shall be watered immediately following planting as necessary to thoroughly moisten rootball and plant pit loam and thereafter shall be inspected frequently for watering needs and watered, as required, to provide adequate moisture in the planting pit.

J. Mulch material shall be placed over entire saucer areas of individual shrubs and over the entire area of planting beds to a depth of 3 inches after settlement, not later than one week after planting. Do not apply mulch prior to the first watering of plant materials. Do not apply mulch prior to placement of surface applied fertilizer and verification of placement by the Landscape Architect.

L. Antidesiccant shall be applied to all evergreen and broadleaf evergreen plants in December and again in February, according to manufacturer's application recommendations and as directed by the Landscape Architect.

N. If planting is done after turf and grass preparation or installation, proper protection of seeded areas shall be provided. Any damage resulting from planting operations shall be repaired immediately at no cost to the Owner.

N. In the event that rock or underground construction work or obstructions are encountered in any plant pit or bed excavation work, alternate locations will be selected by the Landscape Architect. Relocation of plant pits or beds shall be provided at no additional cost to the Owner. Provide the Landscape Architect with no less than 48 hours notice of obstruction so that a site visit can be scheduled to establish new locations for plants.

O. Absolutely no debris may be left on the site. Repair any damage to site as directed by the Landscape Architect, at no additional cost.

P. All replacements shall be plants of the same kind and size specified in the PLANT LIST. The cost shall be borne by the Contractor, except for possible replacements due to vandalism or neglect on the part of others.

3.4 RESTORATION SEEDING EXECUTION

A. Seedbed preparation

1. Prior to seeding, all seedbeds shall be free of weeds and debris.

2. Tillage: Perform two tillage operations to an average depth of 3–5 inches, allowing 2–3 weeks between tillage for weed seed germination and destruction.

3. Grade the seedbed to eliminate irregularities greater than 2 inches per linear foot.

B. Seeding

1. Obtain written acceptance of bed preparation from the Owner's Representative before seeding.

2. Apply seed at the specified rates using hand broadcasting, mechanical broadcast seeding, or hydroseeding (for turf mixes only), as approved.

3. Incorporate seed into the soil to a depth of 0.10–0.25 inches and roll the seedbed to ensure firm seed-to-soil contact.

C. Maintenance

1. Begin maintenance immediately after seeding and mulching, and continue for a minimum of 12 months or until final acceptance.

2. Maintenance includes watering, mowing, reseeding, removal of invasive and noxious species, and replacement of mulch or fencing as needed.

3. Water seeded areas for the first 6–8 weeks after seeding and as needed thereafter to maintain moist soil to a depth of at least 2 inches.

4. Reseed all areas that fail to show a uniform stand of grass or wildflowers until satisfactory growth is achieved.

5. Mow native grass areas to a height of 3 inches when growth reaches 6 inches; mow lawn areas to maintain a uniform height of 1-1/2 to 2 inches.

3.4 PLANT MAINTENANCE

A. Maintenance shall begin immediately after each plant is planted and shall continue for a minimum 30-day Monitoring Period and until the end of the fall planting season following Final Acceptance.

1. Plants shall be inspected for watering needs at least twice each week and watered to promote plant growth and vitality during the 2-year Guarantee Period. The following watering rates assume that the soil is free draining. If the on site conditions do not ensure a free draining soil, then notify the Landscape Architect in writing of this condition. Watering rates for shrubs, ground cover, vines and perennials in free draining soils are presented here as guidelines to ensure that the top six inches of plant bed soil remains moist at all times. Actual watering rates may vary depending upon soil conditions. Guideline rates shall be as follows:

Shrubs:

Up to 2 ft. height	10 gallons
2 - 4 ft. height	20 gallons
4 - 6 ft. height	30 gallons
6 - 8 ft. height	40 gallons

Perennials, Grasses and Ferns: 5 gallons

a. Water shall be applied by 1 inch diameter hose with an attached metering gauge.

3. Stakes shall be kept plumb and neat in appearance. Guys, wires and anchoring cables shall be tightened and repaired weekly.

4. Planting beds and individual plant pits shall be kept free of weeds, and mulch shall be replaced as required to maintain the specified layer of mulch. Beds and individual pits shall be neat in appearance and maintained to the designed layout.

5. Plants that die during the maintenance period shall be removed and replaced by the Contractor within one week of notification and replaced during that growing season, unless directed otherwise by the Landscape Architect.

6. Spraying of insecticides or herbicides shall be done by State-licensed professionals. Spraying for insects, pests and diseases shall conform to the National Arborist Association Standards under the section entitled "Standards for Pesticide Application Operations", as currently adopted and as approved by the Landscape Architect. All insecticides, pesticides, and herbicides shall be EPA-approved and shall conform to the requirements MCRG: Massachusetts Control Recommendation Guide for Insect, Disease, and Weed Pests of Shade Trees and Woody Ornamentals, latest edition, University of Massachusetts, Amherst, College of Food and Natural Resources.

7. Work of pruning, fertilizing, spraying, and similar activities shall be undertaken only by Certified Arborists and licensed chemical applicators, as pertinent to the work being performed.

B. During the maintenance period, any decline in the condition of plantings shall require the Contractor to take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional arborists and/or horticulturalists to inspect plant materials and to identify problems and recommend corrective procedures. The Landscape Architect shall be immediately advised of such actions. Inspection and recommendation reports shall be submitted to the Landscape Architect.

3.5 PLANT ACCEPTANCE

A. Upon completion of all planting work, the Contractor shall request in writing that the Landscape Architect formally inspect the planting work.

B. If plant materials and workmanship are acceptable, the Landscape Architect will issue a written Certificate of Conditional Acceptance to the Contractor.

C. Following the issuance of the Certificate of Conditional Acceptance to the Contractor, the Contractor shall maintain the plants for a minimum 30 day Monitoring Period. At the end of the Monitoring Period, the plant material will be inspected by the Landscape Architect to determine whether or not all planting work has been performed to the requirements of this Section 02900, LANDSCAPING.

D. Acceptance Standards at end of the Monitoring Period: If plant material is reviewed when it is in full leaf, leaves shall be plump with water with a shape indicative of the species and shall be free of insect, pest and disease damage. Twigs shall have living cambium for their full length. Twigs and branches shall have a full bud set for their full length, including terminal buds. Trunks and branches shall be free of frost cracks; sun scald; damage due to insects, pests, and disease; structural defects; and damage resulting from machinery or tools. Plant material inspected and reviewed when the plants are not in full leaf

shall have twigs, branches and trunks meeting the above requirements. All plants regardless of the season of review shall have a minimum of 75 percent healthy, balanced branching structure with a healthy terminal leader(s) with viable terminal bud(s).

E. If any numbers of plants do not meet these Acceptance Standards at the time of inspection, or if in the Landscape Architect's opinion, workmanship is unacceptable, written notice will be given by the Landscape Architect to the Contractor in the form of a punch list, which itemizes necessary planting replacements and/or other deficiencies to be remedied. The Contractor's responsibility for maintenance of all plants shall be extended until replacements are made or other deficiencies are corrected. All plants that do not meet these Acceptance Standards shall be removed from the project within seven days of receipt of the punch list. Replacements shall conform in all respects to the Specifications for new plants and shall be planted in the same manner

F. Following the correction of all Punch List deficiencies, the Contractor shall request in writing that the Landscape Architect formally inspect the planting work. If plant materials and workmanship are acceptable, the Landscape Architect will issue a written Certificate of Final Acceptance to the Contractor.

3.6 PLANT GUARANTEE

A. The date of the Certificate of Final Acceptance shall establish the beginning of the maintenance period and the commencement of the required **one-year guarantee** and establishment period for planting work.

B. At the end of the guarantee and establishment period, a final inspection will be held to determine whether any plant material replacements are required. Each plant shall be plumb, shall have a character that is natural for its species as determined by the Landscape Architect, and shall conform to the Acceptance Standards described in this Section 02900, LANDSCAPING. Plants found to be unacceptable shall be removed promptly from the site and replaced according to this Section 02900, LANDSCAPING. A final inspection will be made after the replacement plants have lived through one year.

3.7 CLEAN-UP

A. Remove soil or similar material which has been brought onto paved areas, keeping these areas clean. Upon completion of planting, remove excess soil, stones and debris which has not previously been cleaned up and legally dispose of off-site.

B. Prepare lawns and planting areas for final inspection. Protect slopes and embankments against erosion until work is accepted. Repair eroded portions of seeded areas by refilling, remulching and reseeding as required by condition

and as required by the Engineer. Protection may be by installation of sod strips or other methods.

END OF SECTION 02900

SECTION 02901

PLANTING SOILS

PART 1 – GENERAL

1.1 SUMMARY

A. The work of this Section consists of providing all labor, equipment, materials, incidental work, and construction methods necessary to supply and place planting soils as indicated on the Contract Documents and as specified. Supplying and placement of planting soils shall include, but not be limited to:

1. Sampling and testing of loam borrow
2. Sampling and testing of existing on-site topsoil
3. Modifying, screening, placing, spreading and grading of loam borrow
4. Modifying, screening, placing, spreading and grading of existing, on-site topsoil
5. Providing all other sampling, testing, supplying, placing, spreading and grading of planting soils as required by this Section
6. Mulch

A. Related work:

1. Section 01560 – TEMPORARY ENVIRONMENTAL CONTROLS

2. Section 02100 – SITE PREPARATION AND TREE PRUNING

3. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

4. Section 02902 – STRUCTURAL PLANTING MEDIUM

1.2 REFERENCES

A. Commonwealth of Massachusetts Department of Transportation (MassDOT): Standard Specifications for Highways and Bridges latest edition.

B. American Society for Testing and Materials (ASTM): D75, D422, D1557

C. A.O.A.C.: Association of Official Agricultural Chemists.

D. USDA, MADEP Bio Solids Reference Sheets.

1.3 SAMPLING, TESTING, AND SUBMITTALS

A. At least 30 days prior to ordering materials, the Contractor shall submit to the Owner's Representative samples, certifications, manufacturer's product data and certified test results for materials as specified below for approval. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner's Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner's Representative reserves the right to reject, on or after delivery, any material that does not meet these Specifications. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Existing Topsoil: Sample and test the stockpiled soils. The Contractor shall sample the soils of the construction site in the following manner:

a. The Contractor shall provide a one cubic foot representative sample per each 1,000 cubic yard on-site stockpile of existing topsoil for testing. All stockpile sampling shall be per ASTM D 75 and Appendixes for securing samples from stockpiles.

b. Stockpiles shall be as described in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING, and labeled in the field with a numbering system referenced in all soil samples and test results.

c. Preparation of Samples: Contractor shall take one cup of soil from each representative sample and dry it at room temperature (do not dry samples in an oven or on a stove or radiator). Once soil is dry, place soil in sandwich size zip-type plastic bag and close it tightly. Label each sample on outside of bag, identifying sample by reference number. Provide an approved site plan showing locations of stockpiles cross-referenced to soil samples and test results.

B. Testing will be at the Contractor's expense. Contractor shall deliver all samples to testing laboratories via overnight courier and shall have the testing report sent directly to the Owner's Representative. Perform all tests for gradation, organic content, soil chemistry and pH by UMASS Soil and Plant Tissue Laboratory, West Experiment Station, North Pleasant Street, University of

Massachusetts, Amherst, MA 01003, (413) 545-2311, or another professional testing laboratory approved by the Owner's Representative. Testing reports shall include the following tests and recommendations. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Owner's Representative from the Soil and Plant Tissue Laboratory. Testing reports shall include the following tests and recommendations.

1. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System. Sieve analysis shall be by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D 422 after destruction of organic matter by H_2O_2. To facilitate review and approval of sieve analysis, provide a computer-generated gradation curve from UMASS Soil & Plant Tissue Laboratory.

2. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples minus #10 material shall be oven-dried to a constant weight at a temperature of 450 degrees Fahrenheit.

3. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, extractable Aluminum, Lead, Zinc, Cadmium, Copper, Soluble Salts, pH, and buffer pH. A Conductivity Meter shall be used to measure Soluble Salts in 1:2 soil/water (v/v). Except where otherwise noted, nutrient tests shall be for available nutrients.

4. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish planting work as specified.

5. If biosolid compost (Massachusetts Department of Environmental Protection-permitted material) is used as an organic component of the proposed planting soil mixture, the amount of organic material used shall not exceed agronomic rates for nitrogen and phosphorus for trees and shrubs, or herbaceous material for wetland plantings. Provide certificates of agronomic rates from vendor for organic matter used in Upland Planting Soil manufacturing process. Biosolid compost shall be tested by an approved testing laboratory to determine that the compost is mature, stable and suitable for use in a growing medium.

6. Leaf Mulch: Submit a one cubic foot sample and supplier's certification of contents.

7. Limestone: Submit supplier's certification that the limestone being supplied conforms to these Specifications.

8. Acidulant: Submit supplier's certification that the acidulant being supplied conforms to these Specifications.

9. Gypsum: Submit manufacturer's product data and one (1) pound sample.

10. All additives needed to amend the existing soils in order to meet these specifications.

11. Prior to placement of any mulch, deposit, at a location on site suitable to Engineer, 1/2 cu. yd. sample of mulch for examination. After mulch sample is reviewed by the Engineer, provide mulch conforming to accepted sample.

1.4 EXAMINATION OF CONDITIONS

A. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the Contract Documents. Provide a written report to the Owner and the Engineer that the subgrade has been placed to the required elevations and that the subgrade drains water at the rates specified under the required percolation tests specified, performed and paid for under Section 02901 – PLANTING SOILS. Perform no work of placing and spreading of planting soils until elevations have been confirmed and written report has been accepted by the Engineer.

1.5 QUALITY ASSURANCE

A. Planting Soils Supplier: Soil mixes shall be supplied by a firm that specializes in the production of mixes of planting soils and have at least 5 years experience in providing soil mixes soils to projects of similar size and scope to this Contract.

B. Soil Testing Laboratory Qualifications: The testing laboratory shall specialize in agricultural soil testing and be a member of the Soil Science Society of

America's, North American Proficiency Testing Program (NAPT). Testing results for soil particle size shall be reported using USDA sizes for sand, silt, and clay.

1.6 DELIVERY, HANDLING AND STORAGE

A. Weather: Do not mix or deliver soil when frozen or muddy.

B. Planting soil delivered to the site shall be protected from weather, erosion, chemicals, dust and debris at all times. Materials shall be spread immediately. Otherwise, materials that stored on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to the Engineer and surrounded by silt fence as specified under the work of Section 01560 – TEMPORARY ENVIRONMENTAL CONTROLS, of this Specification and installed and paid for under the work of Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING, of this Specification.

C. All manufactured packaged products and material shall be delivered to the site in unopened containers and stored in a dry enclosed space suitable for the material and meeting all environmental regulations. Biological and chemical additives shall be protected from extreme humidity, cold or heat. All products shall be freshly manufactured and dated for the years in which the products are to be used. Chemical amendments shall have the original labels intact and legible, stating the guaranteed chemical analysis.

1.7 POST-INSTALLATION SOIL TESTING AND ACCEPTANCE

A. General Requirements

1. After installation of planting soils and prior to planting, the Contractor shall engage an independent, accredited laboratory specializing in agricultural soil testing to perform post-installation soil tests.
2. The laboratory shall be the same as that used for original soil mix testing, unless otherwise approved by the Owner’s Representative.

B. Sampling Procedures

1. Collect composite soil samples from various locations across each installed soil area, at depths and frequencies as determined by the Landscape Architect.
2. Minimum of one sample per 5,000 square feet, or as directed.

3. Sampling methods shall comply with ASTM D75 and project specifications.

C. Testing Parameters

1. Mechanical gradation (sieve analysis) per USDA Soil Classification System.
2. Percent of organics by loss on ignition of oven-dried samples.
3. Chemical analysis for pH, soluble salts, organic matter, and nutrient levels (N, P, K, Ca, Mg, etc.).
4. Additional tests as required by the Owner's Representative or project specifications.
5. Compare results to specified ranges in Section 2 – Products.

D. Acceptance Criteria and Corrective Action

1. Submit certified test reports to the Landscape Architect within 10 days of soil installation and prior to planting operations.
2. No planting shall commence until soil test reports have been reviewed and accepted by the Landscape Architect.
3. If test results indicate non-compliance with specified soil properties, the Contractor shall remove, amend, or replace soil at no additional cost to the Owner until compliance is achieved.
4. Retesting shall be performed as necessary, at the Contractor's expense.

E. Documentation

1. Maintain records of all soil amendments and corrective actions.
2. All documentation shall be submitted for approval prior to planting

PART 2 – PRODUCTS

2.1 LOAM – GENERAL

A. The Contractor shall provide sufficient loam borrow to complete all loaming operations required of the Contract Documents, as specified, provided, installed and paid for under Section 02901 – PLANTING SOILS, and as directed by the Engineer. Loam Borrow shall be obtained from one of the following sources:

1. On-site topsoil stripped, stockpiled and amended to meet the requirements of Section 02901 – PLANTING SOILS.

2. A commercial facility specializing in the stockpiling and/or manufacturing of loam.

3. On-site granular material stripped and stockpiled on the site may be used as the base for an on-site, manufactured loam. Submit method and schedule of manufacturing process to the Engineer for review and approval.

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

2.2 PLANTING SOIL

A. Planting Soil shall be loam borrow as amended for planting trees, shrubs, groundcover, and perennials. Planting Soil shall be used at the following planting areas:

1. Planting areas, but excluding bioretention basins

2. Street Trees

B. Planting Soil shall be one of the following sandy loams; “course sandy loam “, “sandy loam”, and “fine sandy loam”: determined by mechanical analysis (ASTM D 422) and based on the "USDA Classification System" and as defined in this Section. It shall be of uniform composition, without admixture of subsoil.

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

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

1. Maximum size shall be one and one quarter inches largest dimension. The maximum retained on the #10 sieve shall be 25% by weight of the total sample.

2. The ratio of the particle size for 80% passing (D_{80}) to the particle size for 30% passing (D_{30}) shall be 6.0 or less. ($D_{80}/D_{30} < 6.0$)

C. Organic content and pH for specific planting use shall be as follows:

1. Top 18 inches of areas planted with trees, shrubs and herbaceous groundcovers as described in Section 02900 – LANDSCAPING:

   a. pH: 5.5 through 6.5 for non-acid loving plants

   b. pH: 4.5 through 5.5 for acid-loving plants

   c. Organic Content 4.0 - 6.0 percent as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours)

2. Below 18 inches in tree or shrub plantings above when details call for depths of loam borrow to exceed 18 inches:

   a. pH: 5.5 through 6.5 for non-acid loving plants

   b. pH: 4.5 through 5.5 for acid-loving plants

   c. Organic Content 1.0 - 3.0 percent as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours)

D. Planting Soil shall be pH adjusted for particular planting applications and shall be adjusted prior to delivery to the Project sites as recommended by UMASS Soil & Plant Tissue Laboratory test results.

1. When pH of loam borrow is equal to or greater than 7 use aluminum sulfate to adjust pH downward to required levels.

2. When pH of loam borrow is less than 7 use either sulfur or ferrous sulfate to adjust pH downward to required levels.

3. When pH of loam borrow must be raised to the required levels use limestone.

4. Regardless of amendment Contractor chooses to use, Contractor, not the Owner, shall be responsible for obtaining specified pH by seeding and/or planting time.

E. Planting Soil shall be free of plants and their roots, debris and other extraneous matter. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The electrical conductivity (EC2) of a 1:2 soil-water suspension shall be equal to or less than 1.0 milliohms/cm. (Test minus sieve #4 material.) Loam borrow shall not have levels of extractable aluminum greater than 200 parts per million except for acid-loving plants.

F. Planting Soil may be the manufactured product of a commercial processing facility specializing in the production of manufactured soils and loam borrow. Loam borrow shall be manufactured from sands, silts, clays, and biosolids as specified, performed and paid for under the work of this Section. Loam borrow may be manufactured outside the project area and delivered to the project for spreading or the component soils and organics may be delivered to project site and mixed in situ.

1. Manufactured loam borrow shall be manufactured sufficiently in advance of spreading on the project so that ammonium, pH, soluble salts and the Carbon/Nitrogen ratio will have stabilized at the time of sampling and testing by the Contractor. On-site testing of manufactured loam borrow will be performed by the Contractor to verify that delivered material meets the requirements of this Section.

2. Manufactured loam borrow shall contain equal amounts of biosolid compost and leaf mulch to establish the required organic levels.

G. On-site topsoil stripped, stockpiled, and paid for under the work of Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING, may be re-used if, with or without amending or blending with other material, it meets the above requirements. On-site topsoil and amendments shall be tested in accordance with requirements for loam borrow and submittals shall be made for review and acceptance as specified, performed and paid for under this Section. The Contractor shall provide additional loam borrow as required to complete the required work.

H. All loam borrow proposed for use shall be tested for conformance to the Specifications.

I. The Engineer reserves the right to reject on or after delivery to the project site any material which does not, in her/ his opinion, meet these Specifications.

2.3 BIORETENTION BASIN SOIL

A. Bioretention Basin Soil shall be loam borrow amended for planting stormwater management areas. Bioretention Basin Soil shall be used at the following planting areas:

1. Biobasins

B Bioretention Basin Soil shall have a sandy loam/loamy sand texture per USDA textural triangle. Maximum clay content is 5%. The soil shall be a uniform mix, free of stones, stumps, roots or other similar objects larger than one and one-quarter inches in diameter. No other materials or substances shall be mixed or dumped with the Bioretention Basin Soil that may be harmful to plant growth, or prove a hindrance to the planting or maintenance operations. The planting soil shall be free of Bermuda Grass, Quackgrass, Johnson Grass, Mugwort, Nutsedge, Poison Ivy, Canadian Thistle, Tearthumb, or other noxious weeds. Planting soil components for the Bioretention Basin Soil shall have the following grain and size distribution for material passing the #10 (2.0 mm) sieve:

		Percent Passing by Weight	
Sieve No.	Sieve Size (mm)	Maximum	Minimum
10	2	------	100
18	1	100	95
35	0.5	91	85
60	0.25	80	70

140	0.10	60	50
270	0.05	50	30
	0.002	5	2

1. Maximum size shall be one and one quarter inches largest dimension. The maximum retained on the #10 sieve shall be 25% be weight of the total sample.

C. Bioretention Basin Soil shall have the following values:

Parameter	Value
pH range	5.5 – 6.5
Organic Matter (Dry weight)	2-3%
CEC	>10 meq/100 mL

Nutrient	Percent Dry Basis
Phosphorous (P-Index)	10-30 mg/kg using Mehlich-3 extraction

1. Infiltration rate of Bioretention Basin Soil shall range between 3” and 5” per hour. Adjustments to the infiltration rate can be made by adding or subtracting the #200 sieve size material.

2. Compaction rate shall be 75% of maximum dry density to replicate typical field conditions of a lightly compacted basin that is not subject to foot traffic.

3. In addition to soil testing requirements outlined in Section 1.05.B, Bioretention Basin Soil shall be laboratory tested for infiltration rate using ASTM D 2434 Constant Head Permeability Test. Infiltration rate will be converted to inches/hour and will be tested with sample at 95% compaction. Professional testing laboratories that provide this service include Geo Testing Express, Inc. 125 Nagog Park, Acton, MA 01720, 978-635-0424, www.geocomp.com and American Engineering & Testing Inc., 14 Rocsam Park Road, Braintree, MA 02184, 781-848-5184, www.americantestingne.com or approved equal.

D. Materials for the amending and manufacturing of Bioretention Basin Soil that remain stockpiled on site for more than 24 hours shall be treated to prevent erosion in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

2.4 SOIL ADDITIVES

A. General: Soil additives shall be used to counteract soil deficiencies as recommended by the soils analysis and as supplements for lawn construction as specified herein.

B. Acidulant for adjustment of loam borrow pH shall be commercial grade flours of sulfur, ferrous sulfate, or aluminum sulfate that are unadulterated. Acidulants shall be delivered in unopened containers with the name of the manufacturer, material, analysis and net weight appearing on each container.

C. Ground limestone for adjustment of loam borrow pH shall contain not less than 85 percent of total carbonates and shall be ground to such fineness that 40 percent will pass through 100 mesh sieve and 95 percent will pass through a 20 mesh sieve. Contractor shall be aware of loam borrow pH and the amount of lime needed to adjust pH to meet the requirements of the testing lab recommendations.

D. Organic component of the manufactured loam borrow shall be compost. Compost shall be a stable humus-like material produced from the aerobic decomposition of organic residues. The residues, if biosolids, shall consist of compost meeting MA-DEP Type 1 requirement or approved equal. The residues shall be dark brown or black in color, with no visible free water or dust and no unpleasant odor, meeting the following criteria certified by the producer.

1.	carbon-nitrogen ratio	minimum 10:1 maximum 25:1
2.	stability CO_2 evolution test or Dewar self-heating test or Woods End Laboratory's Compost Test Kit	<10 mg CO_2 - C/g BVS/day <10 degrees C above room temp.
3.	organic content	40 percent minimum dry weight (Loss on Ignition; minus #10 Sieve, 430 degrees C)
4.	particle size	90 percent passing 0.5 inch

		screen, 100 percent passing one-inch screen
5.	inorganic debris (dry	1 percent maximum weight)
6.	pH	minimum 5.5 - maximum 8.0
7.	Soluble Salts	>2 and <4.0 mmhos/cm (ds/m)
8.	density	850-1,050 lb./cy

E. Peat moss shall not be used.

F. Sand, as required for mixing with topsoil to meet Specification requirements shall be uniformly graded coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock and free from loam or clay, surface coatings, mica, other deleterious materials with the following gradation.

		Percent Passing by Weight	
Sieve No.	Sieve Size (mm)	Maximum	Minimum
4	4.8	-------	100
10	2	100	80
18	1	86	58
35	0.5	50	18
60	0.25	24	7
140	0.10	0	10
270	0.05	0	4.5
	0.002	0	0.3

1. The ratio of the particle size for 70% passing (D_{70}) to the particle size for 20% passing (D_{20}) shall be 4.0 or less. ($D_{70}/D_{20} < 4.0$)

PART 3 – EXECUTION

3.1 FILLING AND COMPACTION:

A. Subsoil or ordinary borrow shall have been excavated and filled as required by the Contract Documents and specified and paid for under Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING, of this Specification. Do not damage the work previously installed. Maintain all

required angles of repose of materials adjacent to the planting soils as shown on the Contract Documents. Do not over excavate compacted subgrades of adjacent pavement or structures during the installation of planting soils.

B. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the Contract Documents. Provide a written report to the Owner and the Engineer that the subgrade has been placed to the required elevations and that the subgrade drains water at the rates specified under the required percolation tests specified, performed and paid for under this Section. Perform no work of placing and spreading of planting soils until elevations have been confirmed and written report has been accepted by the Engineer.

C. Clear the subgrade of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout or other material harmful to plants have been spilled into the subgrade material, excavate the soil sufficiently to remove the harmful material. Such construction debris, trash, rubble and foreign material shall be removed from the site and disposed of in a legal manner. Fill any over excavation with approved fill and compact to the required subgrade compaction levels.

D. Do not proceed with the installation of planting soils until all utility work in the area has been installed.

E. Protect adjacent walls, walks and utilities from damage or staining by planting soils. Use 0.5-inch plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.

3.2 INSTALLATION OF PLANTING SOILS:

A. Immediately prior to dumping and spreading planting soils, the subgrade shall be cleaned of all stones greater than 2 inches and all debris or rubbish. Such material shall be removed from the site, not raked to the edges and buried.

B. After removal of all stones greater than 2 inches in size is completed, the subgrade shall be “scratched” to a depth of 4 inches with a backhoe to break up compaction caused by construction vehicles. Notify the Engineer that the

subsoil has been cleaned and “scratched” to request his/her attendance on site to review and approve subgrade conditions prior to spreading of loam borrow.

C. Planting soil delivered to the site shall be protected from erosion at all times. Materials shall be spread immediately. Otherwise, materials that stored on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to the Engineer and surrounded by silt fence as specified under the work of Section 01560 – TEMPORARY ENVIRONMENTAL CONTROLS, of this Specification and installed and paid for under the work of Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING, of this Specification.

D. No planting soil shall be handled, planted, or seeded in any way if it is in a wet or frozen condition. A moist loam borrow is desirable.

E. Soil additives shall be spread and thoroughly incorporated into the layer of planting soil by harrowing or other methods reviewed by the Engineer. The following soil additives shall be incorporated:

1. Ground limestone or acidulant as required by soil analysis to achieve the required pH as described in this Section. Spread limestone at the rate required by soil analysis up to a maximum limit of 200 pounds per 1,000 square feet.

2. Biosolid compost, sand or other soil amendments as required by soil analysis.

F. After planting soils and required additives have been spread, carefully prepare the planting soils by scarifying, harrowing, or tilling the soil to integrate soil additives into the top six inches (6”) of the soil. Remove all large stiff clods, lumps, brush, roots, stumps, litter and other foreign matter. Remove from unscreened soils all stones over 1 inch in diameter from the top 6 inches of the planting area. Planting soils shall also be free of smaller stones in excessive quantities as determined by the Engineer.

G. Sufficient grade stakes shall be set for checking the finished grades. Stakes must be set in the bottom of swales and at the top of slopes. Deviation from indicated elevations that are greater than one-tenth of a foot shall not be permitted. Connect contours and spot elevations with an even slope. Finish grades shall be smooth and continuous with no abrupt changes at the top or bottom of slopes.

H. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional planting soils and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades.

I. The Contractor shall install the planting soils in successive horizontal lifts no thicker than 12 inches in plant bed areas to the desired compaction as described in this Section. The Contractor shall install the soil at a higher level to anticipate any reduction of planting soil volume due to settling, erosion, decomposition, and other similar processes during the warranty period. The Engineer will ensure that the full twelve inches (12") of planting soil are obtained by digging holes in the placed soils at the same frequency as for compaction testing.

J. Select equipment and otherwise phase the installation of the planting soils to ensure that wheeled equipment does not travel over subsoil, placed fills or ordinary borrow or already installed soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Engineer. If it is determined by the Engineer that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened and uncompacted as the work progresses or place one-inch thick steel plate ballast (or equivalent ballast approved by the Engineer) over the length and width of any travel way to cover planting soils to protect it from compaction.

K. Compact each lift sufficiently to reduce settling but not enough to prevent the movement of water and feeder roots through the soil. The planting soils in each lift should feel firm to the foot in all areas and make only slight heel prints. At completion of the planting soils installation, the soil should offer a firm, even resistance when a soil sampling tube is inserted from lift to lift. After the placement of each lift, perform percolation tests to determine if the soil has been over compacted. Perform the following percolation test procedure:

2. Dig a hole in the installed soil that is a minimum of four inches (4") in diameter. Holes in twelve inch (12") lifts in plant beds shall be 8 inches deep. Do not penetrate through the lift being tested.

3. Fill the hole with water and let it drain completely. Immediately refill the hole with water and measure the rate of fall in the water level.

4. In the event that the water drains at a rate less than one inch per hour, till the soil to a depth required to break the over compaction.

4 Perform a minimum of one soil percolation test per 2,500 square feet of tree and shrub planting area as directed by the Engineer.

L. Compaction of Bioretention Basin Soils: Compact each lift of Bioretention Basin Soils to 75% of maximum Standard Proctor density according to ASTM D 698.

M. Contractor shall be responsible for maintaining all stockpiles of planting soils on the site until final placement. Upon written approval by the Engineer, Contractor shall remove all excess, unused planting soils and material excavated from the site and dispose of it in a legal manner.

3.3 ACCEPTANCE OF FINAL GRADES:

A. Confirm that the final grades of the planting soils are at the proper finish grade elevations. Adjust grade as required to meet the contours and spot elevations noted on the Plans. Request the presence of the Engineer to inspect final grade. Do not proceed with the remaining work of this Contract until the Engineer has given his/her written approval of the final grade.

3.4 FIELD QUALITY CONTROL OF BIORETENTION BASIN SOILS

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Compaction: Test bioretention basin soil compaction after placing each lift and at completion of each Bioretention Basin, Stormwater Planter, and Stormwater Tree Trench using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698.

3.5 PROTECTION OF PLANTING SOILS:

A. Protect areas of on-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
1. Storage of construction materials, debris, or excavated materials.
2. Parking vehicles or equipment.
3. Vehicular, pedestrian, and animal traffic.

4. Excavation or other digging unless otherwise indicated.

B. If planting soils or subgrade are over-compacted, disturbed or contaminated by foreign or deleterious materials or liquids, remove the soil media and contamination; restore the subgrade as directed by the Engineer, and replace contaminated planting soils with new planting soils.

END OF SECTION 02901

SECTION 02902

STRUCTURAL PLANTING MEDIUM

PART 1 – GENERAL

1.1 SUMMARY

A. The work of this Section consists of providing all equipment and materials and do all work necessary to supply and place structural planting soils in areas adjacent to new street tree plantings beneath new sidewalks, as indicated on the Contract Documents and as specified. Supplying and placement of structural planting medium shall include, but not be limited to:

1. Sampling and testing of Structural Planting Medium.

2. Sampling and testing of existing on-site topsoil.

3. Excavating for placement of Structural Planting Medium

4. Supplying, placing, spreading and grading of Structural Planting Medium system.

1.2 RELATED WORK UNDER OTHER SECTIONS

A. The following items of related work are specified and included in other Sections of the Specifications:

1. Section 02100 – SITE PREPARATION AND TREE PRUNING

2. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

3. Section 02524 – CURBS, WALKS, AND DRIVEWAYS

4. Section 02901 – PLANTING SOILS

1.3 REFERENCES

A. Commonwealth of Massachusetts Department of Transportation (MassDOT):

Specifications Standard Specifications for Highways and Bridges

B. American Society for Testing and Materials (ASTM):

D 75 Practice for Sampling Aggregates

D 422 Test Method for Particle-Size Analysis of Soils

D1557 Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10-lb Rammer and 18-in. Drop

C. A.O.A.C.: Association of Official Agricultural Chemists.

1.4 SUBMITTALS

A. At least 30 days prior to ordering materials, the Contractor shall submit to the Owner's Representative representative samples, certifications, manufacturer's literature and certified test results for materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner's Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner's Representative reserves the right to reject, on or after delivery, any material which does not meet these Specifications.

1. Existing On-Site Topsoil: Sample and test existing on-site topsoil. The Contractor shall sample the existing loam soils of the construction site in the following manner:

a. The Contractor shall provide a one cubic foot representative sample per each 1,000 cubic yard on-site stockpile of existing topsoil for testing. All stockpile sampling shall be per ASTM D 75 and Appendixes for securing samples from stockpiles**.** Stockpiles shall be separated into 1,000 cubic yard piles and labeled in the field with a numbering system referenced in all soil samples and test results.

b. Sampling Locations: Unless otherwise indicated, samples shall be taken at the following locations and frequency:
One (1) location under each designated tree on the site as directed by the Owner's Representative.

c. Preparation of Samples: Contractor shall place these soil slices into a large, clean plastic container and mix thoroughly. Contractor shall take one cup of soil mixture and dry it at room temperature (do not dry samples in an oven or on a stove or radiator). Once soil is dry, place soil in sandwich size zip-type plastic bag and close it tightly. Label each sample on outside of bag, identifying sample by soil type and acre. Provide an approved site plan showing locations of stockpiles cross referenced to soil samples and test results.

2. Base Loam, Sand and Compost for use in manufacturing Structural Planting Medium, and the final, manufactured Structural Planting Medium shall be sampled and tested in accordance with the following:

The Contractor shall provide a one cubic foot representative sample from each proposed source of Base Loam, Sand, Compost and the Structural Planting Medium for testing, analysis, and approval. Additionally, the Contractor shall provide one cubic foot representative samples of Structural Planting Medium delivered to the site and stockpile for use. Samples from on-site stockpiles of Structural Planting Medium shall be taken as directed by the Owner's Representative and packaged in the presence of the Owner's Representative.

Contractor shall deliver all samples to testing laboratories and shall have the testing report sent directly to the Owner's Representative. Perform all tests for gradation, organic content, soil chemistry and pH by UMASS Soil and Plant Tissue Laboratory, West Experiment Station, North Pleasant Street, University of Massachusetts, Amherst, MA 01003, (413) 545-2311. Testing reports shall include the following tests and recommendations. Contractor shall deliver samples to testing laboratories and shall have the testing report sent directly to the Owner's Representative. Testing reports shall include the following tests and recommendations.

a. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System. Sieve analysis shall be by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D 422 after destruction of organic matter by H_2O_2. To facilitate review and approval of sieve analysis, provide a

computer-generated gradation curve from UMASS Soil & Plant Tissue Laboratory.

b. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples minus #10 material shall be oven-dried to a constant weight at a temperature of 450 degrees.

c. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, extractable Aluminum, Lead, Zinc, Cadmium, Copper, Soluble Salts, and pH and buffer pH. A Conductivity Meter shall be used to measure Soluble Salts in 1:2 soil/water (v/v). Except where otherwise noted, nutrient tests shall be for available nutrients.

d. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish the planting work as specified.

3. If biosolid compost (Massachusetts Department of Environmental Protection-permitted material) is used as an organic component of the proposed planting soil mixture, the amount of organic material used shall not exceed agronomic rates for nitrogen and phosphorus for trees and shrubs, turf or ornamental perennials. Provide certificates of agronomic rates from vendor for organic matter used in loam borrow manufacturing process.

4. Peat Moss: Not allowable.

5. Limestone: Submit supplier's certification that the limestone being supplied conforms to these Specifications.

6. Crushed Stone: Provide mechanical gradation (sieve analysis) of crushed stone showing that the product meets the requirements of this Specification.

7. Acidulant: Submit supplier’s certification that the acidulant being supplied conforms to these Specifications.

8. Fertilizer:

a. Submit product data of planting fertilizer and certificates showing composition and analysis. Submit fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations as described in this Section.

b. Submit the purchasing receipt showing the total quantity purchased for the Project prior to installation.

c. All additives needed to amend a specific soil in order to meet these specifications.

1.5 EXAMINATION OF CONDITIONS

A. All areas of the existing site where topsoil is to sampled for testing shall be inspected by the Contractor before starting work and any issues that might inhibit or prevent the sampling operation shall be reported to the Owner's Representative prior to beginning this work.

B. The Contractor and any sub-Contractor responsible for the execution of the Work of this Section shall review and confirm in writing that the subsoil elevations have been brought to the proper subgrade elevations prior to proceeding with the spreading of Structural Planting Medium.

C. The Contractor shall be solely responsible for judging the full extent of work requirements involved, including but not limited to sampling and testing of on-site stockpiles of delivered off-site loam borrow prior to final planting installation.

PART 2 - PRODUCTS

2.1 BASE LOAM

A. Base Loam gradation shall be determined by the Soil and Plant Tissue Laboratory, University of Massachusetts, Amherst, using H_2O_2 to destroy organic matter.

Base Loam for mixing shall conform to the following grain size distribution for material passing the #4 sieve:

U.S. Sieve No.	Percent Passing by Weight	
	Maximum	Minimum
# 4	----	100
#10	85	100
#20	71	100
#40	60	85
#100	38	60
#200	28	40
0.002 mm	01	05

Maximum size shall be one inch largest dimension. The maximum retained on the #4 sieve shall be 20% by weight of the total sample.

The ratio of the particle size for 80% passing (D80) to the particle size for 40% passing (D40) shall be 5.0 or less. (D80/D40 < 5.0)

Tests shall be by combined hydrometer and wet sieving in compliance with ASTM D422 after destruction of organic matter by ignition.

The organic content shall be between 4.0 and 8.0 percent.

2.2 SAND

A. Sand gradation shall be determined by the Soil and Plant Tissue Laboratory, University of Massachusetts, Amherst, using H_2O_2 to destroy organic matter.

Sand for Structural Planting Medium shall be uniformly graded medium to coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock free from loam or clay, surface coatings and deleterious materials with the following gradation.

U.S. Sieve No.	Percent Passing by Weight	
	Maximum	Minimum
#4	----	100
#10	80	100
#20	50	85
#40	15	50
#100	0	15
#200	0	

Maximum size shall be one inch largest dimension. The maximum retained on the #4 sieve shall be 10% by weight of the total sample.

The ratio of the particle size for 80% passing (D80) to the particle size for 40% passing (D40) shall be 3.0 or less. (D80/D40 < 3.0)

2.3 COMPOST

A. Compost shall be a stable humus-like material produced from the aerobic decomposition of organic residues. The residues, if biosolids, shall consist of compost meeting MA-DEP Type 1 requirement or approved equal. The residues shall be dark brown or black in color, with no visible free water or dust and no unpleasant odor, meeting the following criteria certified by the producer.

1.	carbon-nitrogen ratio	minimum 10:1 maximum 25:1
2.	stability CO_2 evolution test or Dewar self-heating test or Woods End Laboratory's Compost Test Kit	<10 mg CO_2 - C/g BVS/day <10 degrees C above room temp.
3.	organic content	40 percent minimum dry weight (Loss on Ignition; minus #10 Sieve, 430 degrees C)
4.	particle size	90 percent passing one-half inch screen 100 percent passing one inch screen
5.	inorganic debris	1 percent maximum (dry weight)
6.	pH	minimum 5.5 - maximum 8.0
7.	Soluble Salts	>2 and <4.0 mmhos/cm (ds/m)
8.	density	850-1,050 lb./cy

2.4 STRUCTURAL PLANTING MEDIUM

A. In areas designated on the Contract Documents the soil underlying the pavement cross section and the granular base material has been designed to

structurally support the pavement slab and to promote root growth of trees planted in openings in the pavement. This soil will be called Structural Planting Medium in this Section and shall be a mixture of Sand, Base Loam and Compost. Structural Planting Medium shall be the manufactured product of a commercial processing facility specializing in the production of manufactured soils and loam borrow. Structural Planting Medium shall be manufactured from sands, loams and compost, in accordance with the requirements of this Section. Structural Planting Medium shall be manufactured outside the Project limits and transported onto the Project for placement.

B. The Structural Planting Medium shall consist of a blend of four parts by volume of Sand, one part by volume of Base Loam and one part by volume of Compost. Blending of the components shall be carried out with earth moving equipment prior to placement. The components shall be blended to create a uniform mixture as determined by the Owner's Representative.

Structural Planting Medium gradation shall be determined by the Soil and Plant Tissue Laboratory, University of Massachusetts, Amherst, using H_2O_2 to destroy organic matter. Structural Planting Medium shall conform to the following grain size distribution for material passing the #4 sieve:

U.S. Sieve No.	Percent Passing by Weight	
	Maximum	Minimum
#4	----	100
#10	81	100
#20	57	88
#40	27	57
#100	11	24
#200	08	12
.002mm	01	02

C. Structural Planting Medium shall not contain less than 1.5 percent nor more than 3.0 percent organic matter as determined by the loss on ignition of oven-dried samples passing #10 sieve (Muffle furnace temperature: 450 +/- 10 degrees C for 8 hours).

D. The acidity range of the Structural Planting Medium shall be pH 5.5 to 6.5. Structural Planting Medium shall have a starting pH of no lower than 5.0 at the manufacturing site.

E. Structural planting medium shall be pH adjusted as required for planting of trees and shall be adjusted prior to delivery to the Project sites in accordance with recommendations by UMASS Soil & Plant Tissue Laboratory.

1. When pH of loam borrow is equal to or greater than 7 use aluminum sulfate to adjust pH downward to required levels.
2. When pH of loam borrow is less than 7 use either sulphur or ferrous sulfate to adjust pH downward to required levels.
3. When pH of loam borrow must be raised to the required levels use limestone.
4. Regardless of amendment Contractor chooses to use, Contractor, not the Owner, shall be responsible for obtaining specified pH by planting time.

F. Structural Planting Medium shall be free of debris and other extraneous matter. It shall be uncontaminated by salt water, foreign matter and substances harmful to plant growth. The electrical conductivity (EC2) of a 1:2 soil-water suspension shall be equal to or less than 1.0 millimhos/cm. (Test minus sieve Number 10 material). Soil shall not have levels of Aluminum greater than 200 parts per million.

G. No Structural Planting Medium shall be delivered to the site until the review and approval of soil test results and recommendations by the Owner's Representative, but such approval shall not constitute final acceptance. The Owner's Representative will reject any material delivered to the site which, after on-site, post-delivery testing, does not meet these specifications.

2.5 SOIL ADDITIVES

A. General: Soil additives shall be used to counteract soil deficiencies as recommended by the soils analysis and as supplements for construction as specified herein.

B. Soil additives shall conform to Section 02901 – PLANTING SOILS.

PART 3 – EXECUTION

3.1 EXCAVATION, FILLING AND COMPACTION

A. Perform percolation tests on existing subsoils or placed fill prior to placing and spreading Structural Planting Medium:

1. Perform percolation testing of subsoil or placed fills to determine whether or not the subgrade will drain properly. Perform percolation tests in accordance with the requirements for percolation testing for each lift of loam borrow described in this Section.

2. In the event that percolation testing indicates that the subsoil, placed fills or ordinary borrow has been over compacted and will not drain, the Contractor shall loosen up the top 36 inches of the subsoil, ordinary borrow, special borrow or gravel borrow by ripping or other mechanical means. Re-compact the borrow by driving a small, tracked bulldozer over the area at low speeds so that the tracks of the bulldozer pass over the affected area and the soil is compacted to a density that will percolate in accordance with this Section.

3. Perform sufficient percolation tests in areas of poorly draining or compacted subsoil or compacted placed fills as directed by the Owner's Representative to ensure that these underlying soils do not drain. Likewise, perform sufficient percolation tests after ripping and loosening to ensure that the soils are no longer too compact to drain.

B. Excavate or fill subsoil or ordinary borrow as required by the Owner's Representative to achieve the elevations of the proposed subgrade. Maintain all required angles of repose of the adjacent materials as shown on the Contract Documents. Do not over excavate compacted subgrades of adjacent pavement or structures.

C. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations. Subgrade elevations shall slope parallel to the finished grade and or toward the subsurface drain lines as shown on the Contract Documents. Provide a written report to the Owner's Representative and the Owner's Representative that the subgrade has been placed to the required elevations and that the subgrade drains water in accordance with the required percolation tests. Perform no work of placing and spreading Structural Planting Medium until elevations have been confirmed and written report has been accepted by the Owner's Representative.

D. Clear the subgrade of all construction debris, trash, rubble and any foreign material. In the event that fuels, oils, concrete washout or other material harmful to plants have been spilled into the subgrade material, excavate the soil

sufficiently to remove the harmful material. Such construction debris, trash, rubble and foreign material shall be removed from the site and disposed of in a legal manner. Fill any over excavation with approved fill and compact to the required subgrade compaction levels.

E. Do not proceed with the installation of Structural Planting Medium until all utility work in the area has been installed.

F. Protect adjacent walls, walks and utilities from damage or staining by the Structural Planting Medium. Use one-half inch plywood and or plastic sheeting as directed to cover existing concrete, metal and masonry work and other items as directed during the progress of the work. Clean up all trash and any soil or dirt spilled on any paved surface at the end of each working day.

3.2 PLACEMENT OF STRUCTURAL PLANTING MEDIUM

A. Immediately prior to dumping and spreading the Structural Planting Medium, the subgrade shall be cleaned of all stones greater than 2 inches and all debris or rubbish. Such material shall be removed from the site, not raked to the edges and buried. Notify the Owner's Representative that the subsoil has been cleaned and request his/her attendance on site to review and approve subgrade conditions prior to spreading Structural Planting Medium.

B. Structural Planting Medium delivered to the site shall be protected from erosion at all times. Materials shall be spread immediately. Otherwise, materials that sit on site for more than 24 hours shall be covered with tarpaulin or other soil erosion system acceptable to the Owner's Representative and surrounded by silt fence installed in accordance with Section 01560 – TEMPORARY ENVIRONMENTAL CONTROLS, of this Specification.

C. Structural Planting Medium shall be sampled and tested in accordance with the requirements of this Section to verify application and incorporation of limestone, fertilizer and other soil amendments.

D. Soil additives shall be spread and thoroughly incorporated into the layer of Structural Planting Medium by harrowing or other methods reviewed by the Owner's Representative.

E. No Structural Planting Medium shall be handled or installed in any way if it is in a wet or frozen condition. A moist Structural Planting Medium is desirable.

F. Sufficient grade stakes shall be set for checking the finished grades. Deviation from indicated elevations that are greater than one-tenth of a foot shall not be permitted. Connect contours and spot elevations with an even slope. Finish grades shall be smooth and continuous with no abrupt changes at the top or bottom of slopes.

G. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional Structural Planting Medium and the surface shall be re-graded and rolled until presenting a smooth and even finish corresponding to the required grades.

H. Structural Planting Medium shall be spread in lifts not greater than 6 inches and compacted with a minimum of 2 passes of vibratory compaction equipment to a density between 92 and 94 percent Modified Proctor Maximum Dry Density in accordance with compaction standards of ASTM D1557 Method D. During the compaction process, all depressions caused by settlement or compaction shall be filled with additional Structural Planting Medium and the surface shall be regraded and rolled until presenting a smooth and even finish corresponding to the required grades.

1. Phase the installation of the Structural Planting Medium such that wheeled equipment does not have to travel over already installed soil. If it is determined by the Owner's Representative that equipment must travel over already installed Structural Planting Medium, provide one inch thick steel plate ballast over the length and width of travel to cover Structural Planting Medium and protect it from compaction.

I. Compact each lift sufficiently to reduce settling but not enough to prevent the movement of water and feeder roots through the soil. The Structural Planting Medium in each lift should feel firm to the foot in all areas and make only slight heel prints. At completion of the Structural Planting Medium installation, it should offer a firm, even resistance when a soil sampling tube is inserted from lift to lift. After the placement of each lift, perform percolation tests to determine if the soil has been over compacted. Perform the following percolation test procedure:

1. Dig a hole in the installed soil that is a minimum of 4 inches in diameter, 4 inches deep. Do not penetrate through the lift being tested.
2. Fill the hole with water and let it drain completely. Immediately refill the hole with water and measure the rate of fall in the water level.

3. In the event that the water drains at a rate less than one inch per hour, till the Structural Planting Medium to a depth required to break the over compaction.

4 Perform a minimum of one percolation test per location as directed by the Owner's Representative.

3.3 INSTALLATION OF SIDEWALK

A. Install sidewalks, including subbase, setting beds etc, per plans and contract details and as specified in Section 02524 – CURBS, WALKS, AND DRIVEWAYS

3.4 ACCEPTANCE

A. Confirm that the final grade of Structural Planting Medium is at the proper finish grade elevations. Adjust grade as required to achieve finished sidewalk elevations noted on the Plans. Request the presence of the Owner's Representative to inspect final grade.

END OF SECTION 02902

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02903

BIOCELL

PART 1 – GENERAL

1.1 SUMMARY

A. Biocell (bioretention) systems are small-scale Best Management Practices (BMPs) designed to manage and treat stormwater runoff through soil infiltration and plant root uptake.

B. Furnish and install biocell systems and related items as indicated on the Drawings and as specified herein, including, but not limited to the following:

1. Concrete Trench Drain Inlet

a. Cast Iron (CI) Frame and Grate

2. Polyvinyl Chloride (PVC) Drain Basin

a. Ductile Iron (DI) Frame and Dome Grate

b. High Density Polyethylene (HDPE) Hood

3. Non-Woven Geotextile

4. Perforated High-Density Polyethylene (HDPE) Pipe

5. Energy Dissipator (Types A and B)

C. Perform pre-construction test pits at locations indicated on the Drawings and as required by Owner or Owner's Engineer in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

D. Grade surfaces of biocell systems as indicated on the Drawings, in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING, and in accordance with Section 02524 – CURBS, WALKS AND DRIVEWAYS.

1.2 RELATED SECTIONS

A. Carefully examine all of the Contract Documents for requirements that affect the Work of this section. Other specifications that directly relate to the Work of the section include, but are not limited to the following:

1. Section 02010 – SUBSURFACE INVESTIGATION

2. Section 02080 – SOIL AND WASTE MANAGEMENT

3. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL

4. Section 02100 – SITE PREPARATION AND TREE PRUNING

5. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

6. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

7. Section 02500 – PAVING AND SURFACING

8. Section 02524 – CURBS, WALKS AND DRIVEWAYS

9. Section 02622 – POLYVINYL CHLORIDE PIPE

10. Section 02901 – PLANTING SOILS

11. Section 03300 – CONCRETE

1.3 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

1. ASTM A48: Standard Specification for Gray Iron Castings.

2. ASTM C55: Standard Specification for Concrete Brick.

3. ASTM C139: Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes.

4. ASTM D1557: Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures using 10-pound Rammer and 18-inch Drop.

5. ASTM A536: Standard Specification for Ductile Iron Castings

6. ASTM D4632: Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

7. ASTM D4533: Standard Test Method for Trapezoid Tearing Strength Geotextiles

8. ASTM D6241: Standard Test Method for Measuring Static Puncture Strength of Geotextiles and Geosynthetic-Related Products Using a 50 mm Probe

9. ASTM D4751: Standard Test Methods for Determining Apparent Opening Size of a Geotextile

10. ASTM D4491: Standard Test Methods for Water Permeability of Geotextiles by Permittivity

11. ASTM D4355: Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Zenon Arc-Type Apparatus

12. ASTM D5261: Standard Test Method for Measuring Mass per Unit Area of Geotextiles

13. ASTM F2648: Standard Specification for 50 mm to 1500 mm [2 in. to 60 in.] Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications

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

15. ASTM F2306: Standard Specification for 300 mm to 1500 mm [12 in. to 60 in.] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Non-Pressure Gravity-Flow Storm Sewer and Subsurface Drainage Applications

16. ASTM D3350: Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

17. Americans with Disabilities Act (ADA) Accessibility Guidelines

18. AASHTO H-20 Loading Requirements

19. AASHTO Class II Perforation Requirements

1.4 SUBMITTALS

A. Provide in accordance with Section 01300 – SUBMITTALS.

B. Submittals for Review:

1. Product Data: Submit product literature with technical data sufficient to demonstrate that the following products meet or exceed these specifications:

   a. Concrete Trench Drain Inlet
      i. Cast Iron (CI) Frame and Grate
   b. Polyvinyl Chloride (PVC) Drain Basin
      i. Ductile Iron (DI) Frame and Dome Grate
      ii. High Density Polyethylene (HDPE) Hood

c. Non-woven Geotextile
d. Perforated High-Density Polyethylene (HDPE) Pipe
e. Energy Dissipator (Types A and B)
f. Open-Graded Clean Washed ¾" Crushed Stone (per Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING)
g. Gravel Subbase (per Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING)
h. Granite BMP Curb (per Section 02524 – CURBS, WALKS, AND DRIVEWAYS)
i. Polyvinyl Chloride Pipe (per Section 02622 – POLYVINYL CHLORIDE PIPE)
j. Bioretention Soil Media (per Section 02901 – PLANTING SOILS)
k. Backfill (per Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING)
l. Mulch (per Section 02901 – PLANTING SOILS)
m. Bioretention Plantings (per Section 02900 - LANDSCAPING)
n. Landscape Fence (per Section 02900 - LANDSCAPING)

Only materials that are approved by the Engineer after review shall be used for construction.

2. Test and Evaluation Reports:

a. Submit test pit results for locations indicated on the Drawings and as required by Owner or Owner's Engineer.
b. Submit results of compaction testing required by the specifications for approval.
c. Include analysis of bulk materials including soils and aggregates, by a recognized laboratory that demonstrates that the materials meet the specification requirements.

3. Manufacturer Installation Instructions: For each type of product, submit manufacturer's written product installation instructions.

4. Certificate of Compliance: For each aggregate type proposed, submit certificate of compliance signed by the material manufacturer and by the Contractor certifying that the material meets or exceeds these specifications. The certificate of compliance shall include gradation tests.

C. Submittals for Project Closeout:

1. As-built Drawings: Accurately record actual locations, both horizontally and vertically, of all installed drain basins.

a. As-built drawings shall include three swing ties to existing

fixed points for each recorded area drain point.

b. As-built drawings shall be stamped by a Professional Land Surveyor.

1.5 QUALITY ASSURANCE

A. The Contractor shall fully inform themselves of existing site conditions before submitting their bid and shall be responsible for carrying out all site work required to execute the work of this Contract fully and correctly, regardless of the conditions encountered during the actual Work.

B. Comply with applicable requirements of the laws, codes, and ordinances of Federal, State and Municipal authorities having jurisdiction. Obtain necessary permits/approvals from these authorities.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

B. Protect all materials from damage during delivery, storage, and handling in accordance with this section and manufacturer recommendations.

1. Deliver packaged materials in original, unopened containers indicating weight, certified analysis, name and address of manufacturer, and indication of conformance with State and Federal laws, if applicable.

2. Do not deliver or place backfill, soils, or soil amendments in frozen, wet, or muddy conditions.

3. Provide protection including tarps, plastic, and/or matting between bulk materials and finished surfaces sufficient to protect the finish material.

4. All materials shall be examined for damage and defects prior to installation. Materials that are found to be damaged or defective from any cause and are determined to be unrepairable by the Engineer shall not be acceptable for installation and shall be replaced at no cost to the Owner.

C. Provide erosion control measures to prevent erosion or displacement of bulk materials and discharge of soil-bearing water runoff or airborne dust to adjacent properties, water conveyance systems, and walkways. Provide additional sediment control to retain excavated materials, backfill, soil amendments and planting mix within the project limits as needed.

1.7 FIELD CONDITIONS

A. Existing Conditions: Do not proceed with work when subgrades, soils, and planting soils are in a wet, muddy, or frozen condition.

B. Protection of Existing Improvements: Do not damage or disturb existing improvements or vegetation.

1. Provide suitable protection where required before starting the Work and maintain protection throughout the course of the Work.

2. Restore existing improvements damaged by construction, including existing paving on or adjacent to the site, to their original condition or better, and to the satisfaction of the Engineer and Owner at no additional cost.

C. Protection of Biocell Beds:

1. Biocell beds shall not be used for equipment or materials storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on surfaces.

2. The Contractor shall take any other necessary steps to prevent sediment from washing into beds during construction.

PART 2 – PRODUCTS

2.1 TRENCH DRAIN INLET

A. CONCRETE TRENCH DRAIN INLET

1. Description:

a. Trench drain inlets shall be installed only at the locations indicated on the Contract Drawings.

b. Trench drain inlet channels shall have a 22” wide opening and minimum 6” wide vertical walls on either side of the opening as indicated on the Contract Drawings.

c. Trench drain inlet channels shall be minimum 6” thick concrete and sloped at minimum 2% as indicated on the Contract Drawings.

d. Trench drain inlet lengths are variable and shall be as indicated on the Contract Drawings.

e. Trench drain inlet heights are variable based on adjacent curb heights and shall be as indicated on the Contract Drawings.

2. Technical Requirements:

a. Trench drain inlets shall be capable of supporting loads up to and including AASHTO H-20.

b. Trench drain inlets shall be cast in place.

3. Materials:

a. Cast-in-place cement concrete shall have a minimum compressive strength of 4,000 PSI at 28 days and shall otherwise conform to the specifications for Cement Concrete found in Section 03300 – CONCRETE.

B. CAST IRON (CI) FRAME AND GRATE

1. Description:

a. Trench drain inlet frames and grates shall be installed only at the locations indicated on the Contract Drawings.

b. Trench drain inlet covers shall be 24” wide as indicated on the Contract Drawings.

c. Trench drain inlet frames shall be sized to provide a 1” shelf on both sides of the inlet channel and to support the 24” wide cover as indicated on the Contract Drawings.

d. Trench drain inlet grate shall have a wavy pattern with no opening greater than ½” in conformance with ADA Accessibility Guidelines.

2. Technical Requirements:

a. Trench drain inlet frames and grates shall be capable of supporting loads up to and including AASHTO H-20.

b. Trench drain inlet grates on inclines less than 4% shall have a non-slip surface with a static coefficient of friction between 0.60 and 1.0. Grates on inclines 4% or greater shall have a coefficient of 0.80 to 1.0.

3. Materials:

a. Trench drain inlet frames and grates shall be cast iron with a natural patina or raw iron finish.

2.2 DRAIN BASIN

A. POLYVINYL CHLORIDE (PVC) DRAIN BASIN

1. Description:

   a. Drain basins shall be installed only at the locations indicated on the Contract Drawings.

   b. Drain basins shall be 24” diameter with a minimum 4’-0” sump as indicated on the Contract Drawings.

   c. Drain basins shall be manufactured for the pipe connections indicated on the Contract Drawings. For drain basins with only one pipe connection, any and all other openings in the structure body shall be plugged in accordance with manufacturer recommendations.

   d. Drain basin hoods shall be installed inside the structure body at the outlet pipe connections indicated on the Contract Drawings. Drain basin hood sizes shall be compatible with outlet pipe sizes.

2. Technical Requirements:

   a. Drain basins shall be capable of supporting loads up to and including AASHTO H-10.

   b. Drain basins shall be manufactured with pipe stubs formed to provide watertight connections with the specified pipe system.

      1. Drain basins and pipe stubs shall conform to the mechanical property requirements of ASTM D3034 and ASTM F1336.
      2. Joints shall be tightened to conform to ASTM D3212 using flexible elastomeric seals.

3. Materials:

   a. Drain basins shall be manufactured from polyvinyl chloride (PVC).

4. Approved Products/Manufacturers:

   a. ADS Nyloplast Drain Basin

      Advanced Drainage Systems, Inc.
      Phone: 1.800.821.6710
      www.adspipe.com

   b. Or approved equal.

B. DUCTILE IRON (DI) FRAME AND DOME GRATE

1. Description:

a. Drain basin frames and grates shall be manufactured to provide a round bottom flange that closely matches the diameter of the drain basin.

b. Drain basin frames and grates shall be manufactured with a locking mechanism to prevent tampering.

c. Drain basin grates shall be dome shaped and painted black.

2. Technical Requirements:

a. Drain basin frames and grates shall be capable of supporting loads up to and including AASHTO H-10.

3. Materials:

a. Drain basin frames and grates shall be manufactured from ductile iron (DI) conforming to ASTM A536 Grade 70-50-05.

4. Approved Products/Manufacturers:

a. ADS Nyloplast Dome Grate Assembly

Advanced Drainage Systems, Inc.
Phone: 1.800.821.6710
www.adspipe.com

b. Or approved equal.

C. HIGH DENSITY POLYETHYLENE (HDPE) HOOD

1. Description:

a. Drain basin hoods shall be installed inside the structure body at the outlet pipe connections indicated on the Contract Drawings.

b. Drain basin hood sizes shall be compatible with outlet pipe sizes.

2. Materials:

a. Hoods: Shall be manufactured from high density polyethylene

(HDPE).

3. Approved Products/Manufacturers:

a. ADS Nyloplast Envirohood

Advanced Drainage Systems, Inc.
Phone: 1.800.821.6710
www.adspipe.com

b. Or approved equal.

2.3 NON-WOVEN GEOTEXTILE

A. Description:

1. Provide non-woven geotextile fabric for separation of existing soil from crushed stone.

B. Technical Requirements:

1. Non-woven geotextile fabric shall be composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position.

2. Non-woven geotextile fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

C. Materials:

1. Non-woven geotextile fabric shall meet the following mechanical and physical properties, unless otherwise approved by the Engineer:

Mechanical Property	ASTM Method	Value
Grab Tensile Strength	D4632	120 lbs. (min. avg. roll)
Grab Tensile Elongation	D4632	50% (min. avg. roll)
Trapezoid Tear Strength	D4533	50 lbs (min. avg. roll)
CBR Puncture Strength	D6241	310 lbs (min. avg. roll)
Apparent Opening Size	D4751	70 U.S. Sieve (max.)
Permittivity	D4491	1.7 sec^{-1} (min. roll)
Flow Rate	D4491	135 $gal/min/ft^2$ (min. roll)
UV Resistance (at 500 hours)	D4355	70% Strength Retained (min. test)

Physical Property	ASTM Method	Value

	Weight	D5261	4 oz./yd^2 (min. avg. roll)

D. Approved Products/Manufacturers:

1. Mirafi 140N

   Tencate Geosynthetics (Solmax)
   Phone: 1.706.693.2226
   www.solmax.com

2. Or approved equal.

2.4 PERFORATED HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

A. Description:

1. Perforated high-density polyethylene (HDPE) pipe shall be installed only at the locations specified on the Contract Drawings.

2. Perforated HDPE pipe shall be 8” or 12” in diameter as indicated on the Contract Drawings.

B. Technical Requirements:

1. Perforated HDPE pipe shall have smooth-wall interior and annular-corrugated exterior.

   a. Perforations: Shall conform to AASHTO Class II Perforation requirements.

2. Pipe joints shall be bell-and-spigot type and shall be soil-tight. Joints, gaskets, and fittings shall conform to the following technical standards:

   a. Joints: Shall conform to ASTM F2648.
   b. Gaskets: Shall conform to ASTM F477.
   c. Fittings: Shall conform to ASTM F2306.

C. Materials:

1. Perforated HDPE Pipe: Shall be manufactured from high-density polyethylene (HDPE) conforming to ASTM D3350 Cell Classification 424420C for pipes 8” in diameter, and ASTM D3350 Cell Classification 435420C for pipes 12” in diameter.

D. Approved Products/Manufacturers:

1. ADS N-12 ST IB Pipe, Perforated

Advanced Drainage Systems, Inc.
Phone: 1.800.821.6710
www.adspipe.com

2. Or approved equal.

2.5 ENERGY DISSIPATOR (TYPES A & B)

A. Description:

1. Energy dissipators shall be installed only at the locations indicated on the Contract Drawings.

2. Energy dissipator types, dimensions, and layouts shall be as indicated on the Contract Drawings.

B. Materials

1. Energy dissipators shall be constructed of granite pavers mortared in reinforced cast-in-place concrete.

2. Granite blocks shall be 4" x 4" x 8" (nominal) as indicated on the Contract Drawings.

3. Cast-in-place cement concrete shall have a minimum compressive strength of 4,000 PSI at 28 days and shall otherwise conform to the specifications for Cement Concrete found in Section 03300 – CONCRETE.

4. Cast-in-place cement concrete shall be reinforced with 8x8 welded wire mesh as indicated on the Contract Drawings.

5. Cast-in-place cement concrete slab shall be pinned 4" into adjacent curb with 12" length rods of No. 4 rebar as indicated on the Contract Drawings.

2.6 OTHER RELATED PRODUCTS

A. Clean Washed ¾" Crushed Stone:

1. For placement within excavation as pipe bedding and stone reservoir.

2. Shall meet the following physical material property requirements:

Maximum Wash Loss of 0.5%
Minimum Durability Index of 35
Maximum Abrasion of 10% for 100 revolutions
Maximum Abrasion of 50% for 500 revolutions

3. All stone shall be free from roots, leaves, and other organic materials; ice, snow, frost and other frozen soil particles.

4. Provide in accordance with crushed stone requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Gravel Subbase:

1. For placement below energy dissipators and trench drain inlets.

2. Provide in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. 6” x 24” Granite Curb:

1. For placement along biocell perimeter as indicated on the Contract Drawings.

2. Provide in accordance with Section 02524 – CURBS, WALKS, AND DRIVEWAYS.

D. Polyvinyl Chloride Pipe:

1. Provide in accordance with Section 02622 – POLYVINYL CHLORIDE PIPE.

E. Bioretention Soil Media:

1. For placement within excavation, above stone reservoir, engineered for drainage and infiltration.

2. Provide in accordance with Section 02901 – PLANTING SOILS.

F. Backfill:

1. For placement within excavation, adjacent to biocell systems.

2. Provide in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

G. Mulch:

1. Provide in accordance with Section 02901 – PLANTING SOILS.

H. Bioretention Plantings:

1. Provide in accordance with Section 02900 – LANDSCAPING.

I. Landscape Fence:

1. For placement along biocell perimeter as indicated on the Contract Drawings.

2. Provide in accordance with Section 02900 – LANDSCAPING.

PART 3 – EXECUTION

3.1 PERFORMANCE OF TEST PITS

A. Perform pre-construction test pits at locations indicated on the Drawings and as required by Owner or Owner's Engineer in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

3.2 EXAMINATION

A. Examine conditions under which the biocell systems are to be installed.

1. Carefully check and verify dimensions, quantities, and grade elevations.

2. Carefully examine the Drawings to become familiar with the existing underground conditions before digging. Verify the location of aboveground and underground lines, infrastructure, other improvements, and existing trees, shrubs, and plants to remain, including their root systems.

3. Notify the Contractor and the Engineer in writing in the event of conflict between existing and new improvements, of discrepancies, and other conditions detrimental to proper and timely completion of the installation.

4. Obtain written approval of changes to the work prior to proceeding. Proceed with installation only after changes have been made and unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Prepare for construction in accordance with Section 02100 – SITE PREPARATION AND TREE PRUNING.

B. Take proper precautions as necessary to avoid damage to existing improvements and plantings.

C. Prior to the start of work, layout and stake the limits of excavation and horizontal and vertical control points sufficient to install the complete the biocell system.

D. Coordinate installation with other trades that may impact the completion of the work.

E. Remove large stones or other hard matter that could damage materials to be installed.

3.4 TEMPORARY PROTECTION

A. Provide temporary protection in accordance with Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS.

B. Protect open excavations and soil cell systems from access and damage both when work is in progress and following completion, with highly visible construction tape, fencing, or other means until related construction is complete.

3.5 EXCAVATION

A. Notify the Engineer at least 24 hours prior to commencement of excavation for biocell(s).

B. Excavate biocells to proposed depths in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

1. Subgrade shall be unfrozen, firm, and stable with no standing water, ponding, mud, or muck.

3.6 INSTALLATION OF NON-WOVEN GEOTEXTILE FABRIC

A. Install non-woven geotextile fabric on prepared subgrade in accordance with the manufacturer instructions and recommendations, and as indicated on the Contract Drawings.

B. Install non-woven geotextile fabric to avoid damage.

1. Place non-woven geotextile fabric in a relatively smooth condition to prevent tearing or puncturing of the fabric.

2. Place non-woven geotextile fabric loosely but without wrinkles or creases so that placement of the backfill materials will not stretch or tear the fabric.

3. Do not permit traffic or construction equipment to travel directly on geotextile fabric.

4. If torn, patch non-woven geotextile fabric by placing an additional section of fabric over the tear with a minimum 3 feet of overlap.

C. Overlap non-woven geotextile fabric in accordance with manufacturer recommendations or in accordance with the following instructions, whichever is more conservative:

1. Overlap non-woven geotextile fabric a minimum of 18 inches for an unsewn lap joint.

2. Overlap non-woven geotextile fabric a minimum of 6 inches for a sewn lap joint.

D. Around irregularities, leave sufficient slack in non-woven geotextile fabric to allow for readjustments.

3.7 INSTALLATION OF DRAIN BASIN

A. Install drain basins and related products including hoods, frames, and grates, in accordance with manufacturer instructions and recommendations, and as indicated on the Contract Drawings.

3.8 INSTALLATION OF PERFORATED HDPE PIPE

A. Install perforated high-density polyethylene (HDPE) pipe and related products in accordance with manufacturer instructions and recommendations, and as indicated on the Contract Drawings.

B. The crushed stone bedding shall otherwise conform to the compaction requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

C. Pipe Joints:

1. Before jointing perforated HDPE pipes, the previously installed pipe unit shall be checked to assure that a close joint with the adjoining unit has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber, or other unyielding object.

2. Before jointing perforated HDPE pipes, joint surfaces shall be cleaned, and the bell shall be checked to ensure the rubber ring is properly seated. Apply lubricant to the spigot end only, paying particular attention to the bevel, in accordance with manufacturer recommendations. Each pipe unit shall then be carefully pushed into place without damage to pipes or gaskets. Suitable devices shall be used to force the pipe units together so that they will fit with minimum open recess inside and outside and will have tightly sealed joints. Care

shall be taken not to use such force as to wedge apart and split the bell ends. Joints shall not be "pulled" or "cramped" unless permitted by the Engineer. The resulting joints shall be flexible.

3. Suitable bell holes shall be provided at joints so that, after placement, only the barrel of the pipe receives uniform bearing pressure from the supporting material.

4. Where any two pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units and new gaskets.

D. Pipe Deflection:

1. Pipe units shall be installed so as not to exceed a maximum deflection of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing the nominal diameter of the pipe.

2. Should the installed pipe fail to meet the pipe deflection requirements of this Section, the contractor shall do all work to correct the problem without additional compensation.

E. Couplings:

1. Couplings shall be installed in accordance with manufacturer instructions and recommendations, and as indicated on the Contract Drawings.

F. Pipe Ends:

1. Open ends of pipes shall be closed with HDPE stoppers.

2. HDPE stoppers shall be secured in place in accordance with manufacturer instructions and recommendations, and in a manner deemed acceptable by the Engineer.

G. The Contractor shall take all necessary precautions to prevent flotation of the pipes in the excavated area.

H. The Contractor shall take appropriate measures to prevent soil, debris, and other materials from entering the pipes. If soil, debris, or other materials are present in the pipes, the Contractor shall clean the pipes and take necessary precautions to prevent spoils from entering existing pipes.

I. After a perforated HDPE pipe section has been installed, the Contractor shall place enough ¾" crushed stone material between the pipe and the sides of the excavation to hold the pipe in its correct alignment.

3.9 INSTALLATION OF STONE RESERVOIR

A. After the initial layers of ¾" crushed stone have been placed with the installation of the perforated HDPE pipe and PVC drain basin(s), backfill the excavation area with ¾" crushed stone to the depth/elevation indicated on the Contract Drawings. The crushed stone reservoir shall otherwise conform to the compaction requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

3.10 INSTALLATION OF BIORETENTION SOIL MEDIA

A. Backfill over the crushed stone reservoir with approved bioretention soil media to the depth/elevation indicated on the Contract Drawings and in accordance with Section 02901 – PLANTING SOILS.

3.11 INSTALLATION OF BACKFILL

A. Backfill remaining open excavation areas in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

3.12 INSTALLATION OF LANDSCAPE EDGE

A. Install granite BMP curb in accordance with 02524 – CURBS, WALKS AND DRIVEWAYS.

B. Install landscape fence in accordance with Section 02900 – LANDSCAPING.

3.13 INSTALLATION OF ENERGY DISSIPATOR

A. Place and compact gravel subbase over sufficiently prepared and compacted subgrade in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Drill holes in adjacent curb to pin curb to dissipator slab with rebar as indicated on the Contract Drawings.

C. Embed 12" length rods of No. 4 rebar into drilled holes in adjacent curb and set with epoxy.

D. Prepare forms, place welded wire mesh reinforcement, and pour cast-in-place concrete dissipator slab in accordance with the requirements of Section 03300 – CONCRETE and as indicated on the Contract Drawings.

E. Seal joint between adjacent curb and dissipator slab with caulk.

F. Mortar granite pavers to concrete dissipator slab as indicated on the Contract Drawings.

1. Granite pavers shall be set with minimum 2” gaps as indicated on the Contract Drawings to allow water to pass through the dissipator.

2. Granite pavers shall be staggered and set to varying heights as indicated on the Contract Drawings.

3.14 INSTALLATION OF TRENCH DRAIN INLET

A. Place and compact gravel subbase over sufficiently prepared and compacted subgrade in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

B. Prepare forms, place No. 3 rebar for frame support, and pour cast-in-place inlet channel in accordance with the requirements of Section 03300 – CONCRETE and as indicated on the Contract Drawings.

C. Install expansion joints between inlet channel and adjacent sections of concrete in accordance with the requirements of Section 03300 – CONCRETE.

D. Install angle iron frame around trench drain perimeter as indicated on the Contract Drawings for frame support.

E. Align grate(s) on frame and thread ¼” bolts into frame to install trench drain inlet grate(s) as indicated on the Contract Drawings.

3.15 INSTALLATION OF MULCH AND PLANTINGS

A. Install plantings as indicated on the Contract Drawings and as specified in Section 02900 – LANDSCAPING.

B. Place mulch layer around plantings as indicated on the Contract Drawings.

3.16 PROTECTION

A. Protect finished biocells from damage.

1. Limit construction traffic around finished biocells to the maximum extent practicable and provide physical barriers as necessary.

3.17 CLEAN UP

A. Perform clean up during installation and upon completion of the Work. Maintain the site free of soil, sediment, trash, and debris. Remove excess soil materials, debris, and equipment from the site following completion of the Work of this Section.

B. Repair damage to adjacent materials and surface resulting from the installation of this Work using mechanics skilled in remedial work of the construction types

and trades affected.

3.18 ACCEPTANCE

A. The Engineer shall review and confirm the performance of the biocell components. The Acceptance Period for the biocell shall be one (1) year after substantial completion of the biocell has occurred. Any deviations from the plans and specifications resulting in a decrease or decreasing performance shall be corrected by the Contractor at no additional cost to the Owner.

3.19 POST-CONSTRUCTION MAINTENANCE

A. Responsibility for the health and condition of all plantings will be the responsibility of the Contractor for the first year after installation as provided in the Contract Documents. After this one year has expired, all vegetation maintenance responsibilities shall pass to the City of Cambridge, or their appointee.

1. Remove all trash and debris from biocell (monthly).

2. Inspect biocell inlet(s) and outlet(s) (once every two months). Remove any debris or sediment buildup that might impede flow.

3. Inspect plantings and remove all weeds and invasive species by hand (May through September, monthly). Includes the removal of all plants not associated with the original planting plan. Replace individual plantings at biocell inlet(s) that are damaged and/or dead.

4. Inspect mulch. Apply clean mulch to a depth of 2 inches in the basin being careful not to smother or damage the plants (once every four months).

5. Inspect for the development of hardpan at the bottom of the basin (once, end of first year maintenance). Hardpan occurs when the soil becomes cemented, forming an impervious layer. Where this has occurred, scarify the soil to a depth of 6 inches.

END OF SECTION 02903

SECTION 02904

PRECAST POROUS CONCRETE PAVEMENT

PART 1 – GENERAL

1.1 SUMMARY

A. Porous concrete pavements are Best Management Practices (BMPs) designed to manage and treat stormwater runoff through infiltration.

B. The work in this section includes subgrade preparation and installation of precast porous concrete panels, widths vary.

C. Furnish and install precast porous concrete panels and related items as indicated on the Drawings and as specified herein, including, but not limited to the following:

1. Precast Porous Concrete Panel
2. 3/8” Crushed Stone, 3/4” Crushed Stone, Chip Stone
3. Biaxial Geogrid
4. PVC Liner – 30 Mil

1.2 RELATED SECTIONS

A. Carefully examine all of the Contract Documents for requirements that affect the Work of this section. Other specifications that directly relate to the Work of the section include, but are not limited to the following:

1. Section 02010 – SUBSURFACE INVESTIGATION
2. Section 02080 – SOIL AND WASTE MANAGEMENT
3. Section 02095 – TRANSPORTATION AND DISPOSAL OF SOIL AND FILL
4. Section 02100 – SITE PREPARATION AND TREE PRUNING
5. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING
6. Section 02500 – PAVING AND SURFACING
7. Section 02524 – CURBS, WALKS AND DRIVEWAYS

8. Section 02903 – BIOCELL

9. Section 03300 – CONCRETE

1.3 REFERENCE STANDARDS

1. American Association of State Highway and Transportation Officials (AASHTO)

2. ASTM C33 - Standard Specification for Concrete Aggregates

3. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

4. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

5. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3)

6. ASTM C1319 - Standard Specification for Concrete Grid Paving Units

7. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft3)

8. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3)

9. ASTM C1701: Standard Test Method for Infiltration Rate of In Place Pervious Concrete.

10. ASTM D1751: Standard Specification for Performed Expansion Joint Filler for Concrete Pacing and Structural Construction.

11. ASTM D 1754/1754M-12: Standard Test Method for Density and Void Content of Hardened Pervious Concrete.

12. Americans with Disabilities Act (ADA) Accessibility Guidelines

1.4 SUBMITTALS

A. Provide in accordance with Section 01300 – SUBMITTALS.

B. Submittals for Review:

1. Product Data: Submit product literature with technical data sufficient to demonstrate that the following products meet or exceed these specifications:

a. Precast Porous Concrete Panel

b. Biaxial Geogrid

c. PVC Liner

Only materials that are approved by the Engineer after review shall be used for construction.

2. Manufacturer Installation Instructions: For each type of product, submit manufacturer's written product installation instructions.

3. Certificate of Compliance: For each aggregate type proposed, submit certificate of compliance signed by the material manufacturer and by the Contractor certifying that the material meets or exceeds these specifications. The certificate of compliance shall include gradation tests.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installation shall be by a contractor and crew with at least one year of experience in placing precast porous concrete panels on projects of similar nature.

B. The Contractor shall fully inform themselves of existing site conditions before submitting their bid and shall be responsible for carrying out all site work required to execute the work of this Contract fully and correctly, regardless of the conditions encountered during the actual Work.

C. Comply with applicable requirements of the laws, codes, and ordinances of Federal, State and Municipal authorities having jurisdiction. Obtain necessary permits/approvals from these authorities.

D. Precast porous concrete panels shall be handled, stored, and installed in accordance with manufacturer specifications unless otherwise stated herein.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

B. Protect all materials from damage during delivery, storage, and handling in accordance with this section and manufacturer recommendations.

1. Deliver packaged materials in original, unopened containers indicating weight, certified analysis, name and address of manufacturer, and indication of conformance with State and Federal laws, if applicable.

2. Do not deliver or place backfill, soils, or soil amendments in frozen, wet, or muddy conditions.

3. Provide protection including tarps, plastic, and/or matting between bulk materials and finished surfaces sufficient to protect the finish material.

4. All materials shall be examined for damage and defects prior to installation. Materials that are found to be damaged or defective from any cause and are determined to be unrepairable by the Engineer shall not be acceptable for installation and shall be replaced at no cost to the Owner.

C. Provide erosion control measures to prevent erosion or displacement of bulk materials and discharge of soil-bearing water runoff or airborne dust to adjacent properties, water conveyance systems, and walkways. Provide additional sediment control to retain excavated materials, backfill, soil amendments and planting mix within the project limits as needed.

1.7 FIELD CONDITIONS

A. Existing Conditions: Do not proceed with work when subgrades and soils are in a wet, muddy or frozen condition.

B. Protection of Existing Improvements: Do not damage or disturb existing improvements or vegetation.

1. Provide suitable protection where required before starting the Work and maintain protection throughout the course of the Work.

2. Restore existing improvements damaged by construction, including existing paving on or adjacent to the site, to their original condition or better, and to the satisfaction of the Engineer and Owner at no additional cost.

C. Protection of Precast Porous Concrete Panels:

1. Precast porous concrete panels shall be stored on a level stable surface.

2. When stacking panels, timbers should be placed parallel to one another beneath the bottom panel and located directly beneath the imbedded lifting points. Timbers shall not be placed in the middle of the panels or on the ends.

3. Precast porous concrete panels shall not be used for equipment storage during construction, and under no circumstances shall vehicles be allowed to deposit soil on surfaces.

4. The contractor shall take any other necessary steps to prevent sediment from washing onto the panels during construction.

PART 2 – PRODUCTS

2.1 PRECAST POROUS CONCRETE PANELS

A. Description:

1. Precast porous concrete panels shall be installed only at the locations indicated on the Contract Drawings.

2. Precast porous concrete panels shall be ordered in standard sizes and cut as indicated on the Contract Drawings and as required in accordance with this Section. Standard panel sizes included but are not necessarily limited to the following:

   a. 5’ x 2’ x 6” Thick
   b. 5’ x 4’ x 6” Thick
   c. 4’ x 2.5’ x 6” Thick

3. Precast porous concrete panels shall have a minimum of two embedded lifting points.

B. Technical Requirements:

1. Precast porous concrete panels shall have a minimum infiltration rate of 250 inches per hour.

2. Precast porous concrete panels shall have a concrete average unit weight of 120 pcf (±4%) and a void ratio of 15-25% when tested in conformance with ASTM D1754/1754M-12.

3. When required, cut the precast concrete panels with a diamond bladed masonry saw with a minimum 6” plunge depth. Cut units shall be no narrower than 18” and cutting shall occur so that a minimum of 8” is maintained between embedded lifting points in panels and cut edges. Cut panels shall maintain a minimum of two embedded lifting points.

4. Fluid materials (asphalt, concrete, soil, etc.) shall be separated from precast porous concrete panels by the use of 1/2’’ thick pre-molded expansion joint filler conforming to ASTM D1751.

5. Precast porous concrete panels shall be separated from one another by 1/8” tapered joints. Panel surfaces shall not deviate by more than 1/8” vertically and horizontally from one to the next.

6. Install edge restraints in accordance with the Contract Drawings and the manufacturer's recommendations at the indicated locations and elevations.

C. Materials:

1. Precast porous concrete panels shall be reinforced with ultra-thin monofilament homopolymer polypropylene fibers. Provide MasterFiber 100 manufactured by Basf Corporation (Master Builders Solutions) or approved equal.

2. Precast porous concrete panels shall have ½" galvanized coil thread lifting insert. Provide part no. CI6312134P as manufactured by A.L.P Supply or approved equal.

D. Approved Products/Manufacturers:

1. Stormcrete Precast Porous Concrete

Porous Technologies, LLC
Phone: 1.888.357.1161
www.stormcrete.com

2. Or approved equal.

2.2 3/8" CRUSHED STONE (CLEAN, DOUBLE-WASHED)

A. Description:

1. Shall be installed as a leveling course for precast porous concrete panel section as indicated on the Contract Drawings.

B. Technical Requirements:

1. 3/8" Crushed Stone: Shall conform to MassDOT material specification M2.01.6 unless otherwise approved by the Engineer.

C. Materials:

1. 3/8" Clean-Washed Crushed Stone: Shall be clean, double-washed, and meet the following physical material property requirements, unless otherwise approved by the Engineer.

a. Maximum Wash Loss of 0.5%
b. Minimum Durability Index of 35
c. Maximum Abrasion of 10% for 100 revolutions
d. Maximum Abrasion of 50% for 500 revolutions

e. Uniformly and open-graded in accordance with crushed stone requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

2. All stone shall be free from roots, leaves, and other organic materials; ice, snow, frost, and other frozen soil particles.

2.3 3/4" CRUSHED STONE (CLEAN, DOUBLE-WASHED)

A. Description:

1. Shall be installed as a reservoir course for precast porous concrete panel section as indicated on the Contract Drawings.

B. Technical Requirements:

1. 3/4" Crushed Stone: Shall conform to MassDOT material specification M2.01.4 unless otherwise approved by the Engineer.

C. Materials:

1. 3/4" Clean-Washed Crushed Stone: Shall be clean, double-washed, and meet the following physical material property requirements, unless otherwise approved by the Engineer.

a. Maximum Wash Loss of 0.5%
b. Minimum Durability Index of 35
c. Maximum Abrasion of 10% for 100 revolutions
d. Maximum Abrasion of 50% for 500 revolutions
e. Uniformly and open-graded in accordance with crushed stone requirements in Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

3. All stone shall be free from roots, leaves, and other organic materials; ice, snow, frost, and other frozen soil particles.

2.4 CHIP STONE

A. Descripton:

1. Shall be installed as a joint filler as indicated on the Contract Drawings.

B. Technical Requirements:

1. Chip Stone: Shall conform to ASTM C33 and gradation requirements of ASTM D 448 No. 8.

C. Materials:

1. All Chip Stone shall be free from roots, leaves, and other organic materials; ice, snow, frost, and other frozen soil particles.

2.5 BIAXIAL GEOGRID

A. Description:

1. Biaxial geogrid shall be provided at bottom of excavation beneath stone reservoir course as indicated on the Contract Drawings and as directed by the Engineer.

B. Approved Products/Manufacturers:

1. BaseLOK BL-6 GeoGrid

BaseLOK by Industrial Fabrics
Phone: 1.800.848.4500
www.baselok.com

2. Or approved equal.

2.6 PVC LINER

A. Description:

1. Impermeable PVC liner shall be provided on sides of excavation as indicated on the Contracted Drawings and as directed by the Engineer.

B. Technical Requirements:

1. Impermeable PVC linear shall have 30 mil thickness.

2.7 OTHER RELATED PRODUCTS

A. Expansion Joint

1. For placement within joints of precast porous concrete panels as indicated on the Contract Drawings.

2. Provide 1/2” thick pre-molded expansion joint filler conforming to ASTM D1751.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine conditions under which the porous concrete panels are to be installed.

1. Carefully check and verify dimensions, quantities, and grade elevations.

2. Carefully examine the Drawings to become familiar with the existing underground conditions before digging. Verify the location of aboveground and underground lines, infrastructure, other improvements, and existing trees, shrubs, and plants to remain, including their root systems.

3. Notify the Engineer in writing in the event of conflict between existing and new improvements, of discrepancies, and other conditions detrimental to proper and timely completion of the installation.

4. Obtain written approval of changes to the work prior to proceeding. Proceed with installation only after changes have been made and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare for construction in accordance with Section 02100 – SITE PREPARATION AND TREE PRUNING.

B. Take proper precautions as necessary to avoid damage to existing improvements and plantings.

C. Prior to the start of work, layout and stake the limits of excavation and horizontal and vertical control points sufficient to install the porous driveway aprons.

D. Remove large stones or other hard matter that could damage materials to be installed.

E. Reference manufacturer's recommendations for precast porous concrete panels and associated products.

F. Do not use porous concrete panels with chips, cracks, voids, discolorations, and other defects that might be structurally unsound or visible in finished work.

G. Cut panels as required in accordance with subsection 2.1 of this Section.

H. Coordinate installation with other trades that may impact the completion of the work.

3.3 EXCAVATION

A. Excavate porous driveway aprons to proposed depth in accordance with Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND

GRADING.

1. Subgrade shall be unfrozen, firm, and stable with no standing water, ponding, mud, or muck.

3.4 INSTALLATION OF BIAXIAL GEOGRID

A. Install biaxial geogrid on prepared subgrade in accordance with the manufacturer instructions and recommendations, and as indicated on the Contract Drawings.

B. Install biaxial geogrid to avoid damage.

1. Place biaxial geogrid in a relatively smooth condition without wrinkles or creases, but with enough slack such that backfill materials will not stretch or tear the material.

2. Do not permit traffic or construction equipment to travel directly on geogrid.

3. If torn, patch or replace material in accordance with manufacturer recommendations.

C. Overlap geogrid in accordance with manufacturer recommendations.

3.5 INSTALLATION OF IMPERMEABLE PVC LINER

A. Install impermeable PVC liner on sides of excavation in accordance with the manufacturer instructions and recommendations, and as indicated on the Contract Drawings.

B. Provide 6” minimum overlap with geogrid at bottom of excavation as indicated on the Contract Drawings or provide overlap in accordance with manufacturer recommendations, whichever is more conservative.

C. Install impermeable liner to avoid damage.

1. Place liner in a relatively smooth condition without wrinkles or creases, but with enough slack such that backfill materials will not stretch or tear the material.

2. Do not permit traffic or construction equipment to travel directly on liner.

3. If torn, patch or replace material in accordance with manufacturer recommendations.

3.6 INSTALLATION OF STONE RESERVOIR

A. After the geogrid and impermeable liners have been placed, backfill the excavation area with clean-washed 3/4-inch crushed stone in maximum 10” lifts to the depth/elevation indicated on the Contract Drawings. Compact reservoir course in accordance with manufacturer instructions and recommendations, or as follows:

1. Compact reservoir course with a minimum of two passes in perpendicular directions with a 3-5 ton smooth, single- or double-drum vibratory roller.

2. Following vibratory compaction, perform two passes in perpendicular directions with a static roller.

3. Continue static rolling until there is no visible movement, weaving or deflection in the surface of the reservoir course.

B. For small area inaccessible by large follows, follow the above-listed instruction using a walk-behind plate compactor.

C. The surface tolerance of the compacted reservoir course shall be ±3/4 inches under a 10-foot straightedge.

3.7 INSTALLATION OF LEVELING COURSE

A. After the reservoir course has been placed, spread clean-washed 3/8-inch crushed stone evenly over the reservoir course to a thickness of ±2 inches or as indicated by precast porous concrete panel manufacturer recommendations.

B. Screed the leveling course stone using a minimum 1.25-inch-diameter rigid screed rail or as indicated by precast porous concrete panel manufacturer recommendations. Take care that density is loose and constant until the precast porous concrete panels are set.

C. Do not correct deficiencies in the leveling course by shimming with additional stone.

3.8 INSTALLATION OF PRECAST POROUS CONCRETE PANELS

A. Set precast porous concrete panels on the leveling course, being careful not to disturb the base. Adjacent panels shall be separated from each other by the placement of (2) 3/8” thick tapered spacers supplied by the manufacturer.

B. Keep porous concrete panels covered until all adjacent areas are stabilized to prevent dust and debris from reducing the porosity of panels.

C. Installed porous concrete panels should not be driven on by heavy construction equipment, nor should they be used for storage of other porous concrete panels or equipment.

D. Porous concrete panels should be placed on a level sub-base. If grade breaks are present, ensure that they occur at an open joint.

E. Provide joints between panels and between panels and adjacent fluid materials in accordance with subsection 2.1 of this Section.

3.9 PROTECTION

A. Protect finished porous driveway aprons from damage.

1. Limit construction traffic around finished porous driveway aprons to the maximum extent practicable and provide physical barriers as necessary.

3.10 CLEAN UP

A. Perform clean up during installation and upon completion of the Work. Maintain the site free of soil, sediment, trash, and debris. Remove excess soil materials, debris, and equipment from the site following completion of the Work of this Section.

B. Repair damage to adjacent materials and surface resulting from the installation of this Work using mechanics skilled in remedial work of the construction types and trades affected.

3.11 ACCEPTANCE

A. The Engineer shall review and confirm the performance of the porous driveway apron components. The Acceptance Period for the Precast Porous Concrete Panels shall be one (1) year after substantial completion of the apron has occurred. Any deviations from the plans and specifications resulting in a decrease or decreasing performance shall be corrected by the Contractor at no additional cost to the Owner.

END OF SECTION 02904

SECTION 02910

TREE PLANTING

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Work shall consist of furnishing all labor, materials, equipment and transportation required to complete all the planting work in strict accordance with these specifications and applicable drawings. Work shall include, but not be limited to:

a. Submitting samples of materials and analyses for approval.
b. Securing necessary permits and approvals.
c. Verifying each location is ready for new tree(s).
d. Backfilling with suitable material within tree planting area.
e. Installing trees.
f. Furnishing specified plant materials for installation and all necessary planting operations including mulching, watering, staking, guying, spraying, weeding, pruning, drip bag installation, etc.
g. Biochar amendment at the time of planting.
h. Establishing finished grades.
i. Cleaning site at end of planting operations.
j. Maintaining, protecting, weeding, pruning damaged or broken limbs, and replacing dead trees during the guarantee period.

B. The species of proposed trees on shared streets (Worcester Street, Suffolk Street, Pine Street, Ashburton Place) are shown on the LP sheets of the Contract Drawings and shall be confirmed by the City Arborist prior to tagging and planting. The species of trees on non-shared streets will also be confirmed by the City Arborist prior to tagging and planting, and will include species and sizes from the list provided below.

CODE	BOTANICAL NAME	COMMON NAME	SIZE	TYPE
AR	*Acer rubrum*	Red Maple	2-2.5" Cal.	Shade
AC	*Amelanchier canadensis*	Canadian Serviceberry	2-2.5" Cal.	Ornamental
CP	*Carpinus caroliniana*	American Hornbeam	2-2.5" Cal.	Ornamental
CO	*Celtis occidentalis*	Common Hackberry	2-2.5" Cal.	Shade
CC	*Cercis canadensis*	Eastern Redbud	2-2.5" Cal.	Ornamental
CK	*Cladrastis kentukea*	American Yellowwood	2-2.5" Cal.	Ornamental
GD	*Gymnocladus dioicus 'Espresso'*	Kentucky Coffeetree	2-2.5" Cal.	Shade
LT	*Liriodendron tulipifera*	Tulip Poplar	2-2.5" Cal.	Shade
NS	*Nyssa sylvatica*	Tupelo	2-2.5" Cal.	Shade
OV	*Ostrya virginiana*	American Hophornbeam	2-2.5" Cal.	Ornamental
PV	*Prunus virginiana*	Chokecherry	2-2.5" Cal.	Ornamental
QB	*Quercus bicolor*	Swamp White Oak	2-2.5" Cal.	Shade
QI	*Quercus imbricaria*	Shingle Oak	2-2.5" Cal.	Shade
QP	*Quercus palustris*	Pin Oak	2-2.5" Cal.	Shade
RT	*Rhus typhina*	Staghorn Sumac	10' HT	Ornamental
UP	*Ulmus americana 'Princeton'*	Princeton American Elm	2-2.5" Cal.	Shade

C. The tree planting will be by the requirements of the City Arborist. The Arborist will make any changes or instruct the Contractor if any omission, contractual or otherwise, noticed during the planting operation.

D. The City of Cambridge reserves the right to work with its own work force or other Contractor(s) as necessary.

E. Upon receipt of planting list, Contractor shall be responsible for inspecting each location to verify each location is ready for tree installation.

F. The City does not guarantee the locations of existing pipes or underground conduits. The locations of these structures shown on City engineering plans are approximate. In private and public lands where sprinkler systems, driveways, walks, steps, walls and heating cables and or heating pipes are encountered, the Contractor shall use due caution when excavating in the vicinity of these structures and will be required to repair any damages caused at the Contractor's expense.

G. The tree planting will be performed by the requirements of the Contract Documents and will be directed by the City Arborist. The Arborist will instruct the Contractor if changes need to be made due to any omission, contractual or otherwise, being noticed during the planting operation.

H. All work shall be done in a safe, professional, and skillful manner, in compliance with the rules and regulations of the Division of Industrial Safety and all other City and State agencies and authorities having jurisdiction of the types of work included in this Contract.

I. A Massachusetts Certified Arborist, ISA Certified Arborist, or equivalent, will carry out the planting of City of Cambridge Public Shade Trees. These persons will be at the work site for all planting operations. Names of Massachusetts

Certified Arborist, ISA Certified Arborist, or equivalent, will be submitted and approved by the City Arborist before any planting occurs.

J. Powers and Duties of the City Arborist

1. For the purposes of the Contract, the City of Cambridge is acting through its City Arborist who, by delegation and local ordinance, has control over and is responsible for the care and removal of all trees on City streets, playgrounds, schools, recreation lands and conservation land. The City Arborist also performs the function of Tree Warden, in accordance with the Massachusetts General Laws, Chapter 87 entitled "Shade Trees", has authority over, control and supervision of all trees which now or which may hereafter exist upon any public street or highway in this City, and over all trees which exist upon any private property in this City, when such trees are in such hazardous condition as to affect adversely the public health, safety, and welfare. The term City Arborist shall mean City Arborist or their designee.

2. In the exercise of all or any of the powers herein granted, the City Arborist shall have the authority to delegate all or any part of their powers and duties with respect to the supervision and control of this Contract to their subordinates and assistants in the employ of the City of Cambridge as he/she may determine.

1.2 RELATED WORK UNDER OTHER SECTIONS

A. The following items of related work are specified and included in other Sections of the Specifications:

1. Section 02100 - SITE PREPARATION AND TREE PRUNING

2. Section 02900 - LANDSCAPING

3. Section 02901 - PLANTING SOILS

4. Section 02902 - STRUCTURAL PLANTING MEDIUM

1.3 DESCRIPTION OF WORK

A. Contractor is to furnish all labor, materials, equipment and transportation required to complete all the tree planting work in strict accordance with these specifications and applicable drawings. Work shall include but not be limited to:

1. Submitting samples of materials and/or analyses for approval.

2. Securing necessary permits and approvals.

3. Excavating, removing unsuitable material and back-filling of tree planting area.

4. Furnishing specified tree plant materials for installation and all necessary tree planting operations including fertilizing, mulching, watering, staking and guying.

5. Cleaning up of sites at the end of planting operations.

6. Maintaining, protecting, weeding, pruning damaged or broken limbs, and replacing dead trees during the guarantee period.

B. The locations of existing underground utilities, duct banks and conduits shall be confirmed by the Contractor, whether shown on the plans or not. The Contractor shall use due caution when excavating in the vicinity of both public and private utilities and will be required to repair any damages caused at the Contractor's expense.

1.4 APPLICABLE STANDARDS

A. American National Standards Institute (ANSI): Standard A300-2008 Standard Practices for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance

B. American National Standards Institute (ANSI): Standard Z-133.1.-2006 Safety Requirements for Tree Care Operations – Pruning, Trimming, Repairing, Maintaining, and Removing Trees, and Cutting Brush.

C. All other applicable Occupational Safety and Health Administration (OSHA) standards, and state and local regulations.

D. American National Standards Institute (ANSI): Standard Z60.1-2004 or current edition.

E. American Standard for Nursery Stock, published by the American Association of Nurserymen

F. American National Standards Institute- (ANSI) is the private, non-profit organization that administers the safety and maintenance regulations for the Tree Care Industry.

1.5 DEFINITIONS

A. Whenever used in any of the Contract Documents, the following meanings shall be given to the terms herein defined:

1. The words "required", "permitted", "ordered", "designated", "prescribed", or words of like import shall mean the direction,

requirement, permission, order, designation, prescription, etc. of the Owner or the Owner's representatives, and similarly, the words "approved", "acceptable", "satisfactory", or words of like import, shall mean approved by, or acceptable or satisfactory to the Owner's authorized representative, subject in each case to the final determination of the Owner unless otherwise expressly stated.

2. Bare Root – a tree or shrub with minimal or no soil surrounding the roots of a plant.

3. Balled and Burlap (B&B) – a tree or shrub with soil containing the roots of a plant. Soil is covered by a natural or synthetic burlap material and may have a wire mesh cage around the root ball.

4. Certified Arborist – an individual who has passed and currently maintains an arborist certification with the International Society of Arboriculture, Massachusetts Arborist Association or equivalent. Arborist certification shall require continuing education units (CEU's) in order to maintain certification.

5. Container grown – a tree or shrub with a synthetic material or pot containing its roots.

6. Contract Supervisor- the individual or designated representative responsible for insuring the requirements of this contract are adhered to.

7. Caliper - The measure of a plant's trunk. - Caliper measurement of the trunk shall be taken six inches above the ground up to and including four-inch caliper size. If the caliper at six inches above the ground exceeds four inches, the caliper should be measured at 12 inches above the ground. Caliper will be measured to the nearest full inch.

1.6 SAMPLES AND SUBMITTALS

A. Upon award of the Contract and at least thirty (30) days prior to intended use, the Contractor shall provide the following samples and submittals for approval. Do not order materials until Contract Supervisor's approval of submittal has been obtained. Delivered materials shall closely match the approved samples. Should the source of supply be changed within the course of the contract, the Contractor shall submit new samples or submittals for approval per the original submission.

B. Shop Drawings:

1. Names of Massachusetts Certified Arborist or ISA Certified Arborist.

2. Submit list of sources for plant material and tagging trip schedule within 60 days of awarded Contract.

3. Mycorrhizal Fungal Transplant Inoculant with hydrogel: Submit one (1) sample packet showing composition and analysis for fertilizer, also submit invoices of total purchased material for this Contract.

4. Fertilizer: Submit one (1) sample packet of fertilizer showing composition and analysis for fertilizer, also submit invoices of total purchased material for this Contract.

5. Biochar: Submit one (1) sample showing composition and analysis, also submit invoices of total purchases material for this contract.

6. Drip irrigation bag product including product literature.

7. Stakes and ties including product literature and sample.

8. Edging including product literature and sample.

9. Certify, invoice, and order plants for each shipment grown, free of disease and insect pests. Submit certificates to Engineer.

1.7 QUALITY ASSURANCE

A. General Personnel Requirements:

1. It is required that the planting supervisor be a Massachusetts Certified Arborist, I.S.A. Certified Arborist, or equivalent pending the City Arborist's approval and as defined in Section 1.04.A.13. Supervisor shall be on site and oversee horticulturally skilled workers, trained and experienced in accepted current nursery and arboriculture practices. The work shall be done in a professional and skillful manner.

2. The Contractor shall supply sufficient personnel to perform the work in accordance with the applicable specifications and conditions listed herein. The Contractor shall employ only qualified, competent personnel to do the work; and whenever the City shall notify the Contractor in writing, that a person in charge of, or on the work site, is not working in a professional and skillful manner or is incompetent, unfaithful, disorderly, unsafe, under the influence of liquor and/or drugs, using insolent or improper language or is otherwise unsatisfactory in any manner, or not employed in accordance with the provisions of this contract, such persons shall no longer be assigned by the Contractor to perform work called for under the terms of this contract. The Contractor is responsible for administering any drug/alcohol testing of their employees as required by State and Federal agencies. The Contractor must inform the City with proper

documentation that such random testing was performed.

3. All Contractor personnel shall be dressed and be provided by the Contractor suitable work and safety clothing at all times. Clothing must contain the Contractor's name and logo making them identifiable to the public.

4. The Contractor shall provide their employees with all helmets, eye and hearing protection and any other equipment defined as safety items by OSHA and ANSI.

5. Each worker shall be experienced and highly qualified with necessary planting work skills to successfully complete this contract. Said skills shall also include worker safety and ability to be in compliance with current OSHA and ANSI standards.

6. In the event that the Contractor and/or their employees are found to be in violation of applicable safety requirements, the Contractor will be so notified by the City Arborist or persons designated by him, and said person(s) may order that work be stopped until any and all such violations are corrected.

7. The Contractor and their employees shall at all times conduct themselves in an appropriate manner. The City expects that all employees of the Contractor will interact with the public in a polite and professional manor. If the Contractor or their employees are not able to answer a question or satisfy a citizen request, then the Contractor shall promptly refer the citizen to the City Arborist as well as contact the City Arborist right away to report the nature of the citizen's inquiry.

B. Equipment Requirements

1. The equipment used for tree planting shall be of sufficient type, capacity and quantity to safely and efficiently perform the tree planting work as specified.

2. All equipment (including support equipment) to be used by the Contractor shall be listed on the Contractor's Information Report at the time of the bid opening. All such equipment can be subject to the inspection and final approval of the City Arborist. Such approval may require on-site demonstration of the capability of any proposed equipment to provide satisfactory performance.

3. All vehicles used by the Contractor shall comply with safety standards established by the Department of Transportation in the State they are registered pertaining to the operation and transportation of equipment on public and private ways. All vehicles shall be equipped with required equipment and safety equipment.

4. All crews must be equipped with cellular phones to facilitate direct communication between the City Arborist and the work crews. The cell phone shall also be equipped with a text and voice mail function.

5. Each of the Contractor's vehicles used in the performance of the work required of this contract shall be lettered and numbered with removable signs, one on each side, colored white with black lettering to be sized approximately three feet by two feet. It shall contain the following text: City of Cambridge Urban Forestry (617) 349-4885 cambridgetree@cambridgema.gov". It will also contain the logo of the Urban Forestry Division. The format and method of providing the logo will be worked out at the time of contract award. Upon completion of the contract these signs are to be turned over to the City.

6. While working for the City these signs must be on the trucks at all times. Failure to do so may result in nonpayment for those hours worked by the Contractor without the proper signage.

7. The Contractor shall remove all these signs from vehicles when the vehicles are not in service to the City of Cambridge under the terms of this contract.

8. In addition to all required safety cones and road safety devices each job site must have two "A frame" style signs approximately 3 feet tall and two feet wide. Each side of the signs shall be lettered and numbered with removable signs, one on each side, colored white with black lettering to be sized approximately three feet by two feet. It shall contain the following text: City of Cambridge Urban Forestry (617) 349-4885 cambridgetree@cambridgema.gov". It will also contain the logo of the Urban Forestry Division. The format and method of providing the logo will be worked out at the time of contract award. These signs shall be placed on the sidewalk or other similar location on either side of the job site warning pedestrians of the work and displaying the nature of the work to the public. Upon completion of the contract these signs are to be turned in to the City.

9. The Contractor's vehicles and equipment shall at all times be clean and in good repair and kept in a sanitary condition.

10. The Contractor shall be aware that the City does not have parking available for any equipment. Should the Contractor require parking for its vehicles or personnel it will be up to the Contractor to find and pay for this parking.

11. The Contractor shall hold harmless and indemnify the City for all claims, including, but not limited to, claims for property damage and liability in connection with the parking of vehicles.

12. The Contractor shall notify the City immediately if any equipment is out of service and promptly notify the City once the equipment is back in service. The Contractor shall use all due diligence to promptly effect repairs to out of service equipment and/or to secure alternate equipment if necessary to effectively perform the work of this contract.

13. At the discretion of the City Arborist, if equipment failures, breakdowns or other related problems occur that are jeopardizing the execution of this contract the City will require the failed equipment be replaced. Failure to replace the equipment may result in the contract being terminated.

14. The Contractor shall not allow any operator to leave any vehicles/equipment unattended with the motor running.

15. All employees or agents of the Contractor who are assigned to drive in or operate vehicles shall at all times possess and carry valid vehicle/operator's licenses, as applicable which are required for the operation of such vehicles.

C. Requirements Regarding Private Property

1. The normal access to a job site shall be along public roadways. Should work require the Contractor to place equipment and/or personnel on private property, the Contractor shall obtain the property owner's permission in writing and shall notify the City Arborist prior to the work. The City Arborist shall provide a permission/indemnification form to be used for this purpose.

2. The Contractor shall be required to deal directly with private citizens with respect to repairing and/or replacing damaged bushes, shrubs, and other damage to private property that may be caused by the Contractor in connection with work performed pursuant to this contract. A written report containing photos of such damage and action taken to correct the damages shall be given to the City Arborist within 24 hours of the damage incident.

3. The Contractor shall respond to the City Arborist within 24 hours in regards to all complaints of damage to private property alleged to have been caused by work performed by the Contractor. In case of such damage, the Contractor shall be required to make arrangements with the homeowner to remedy the damage. The Contractor shall make or effectuate any such repairs with in thirty (30) days of the date of the damage, or within such additional times as agreed in writing between the Contractor and homeowner.

4. In order to assist the City in the processing of claims for property damage, the Contractor shall be, at the City's discretion, required to

prepare a written report, on a form to be provided by the City Arborist, as to the condition of the tree in each instance when the Contractor removes a tree and/or limb which has damaged private property including automobiles and damage to residential and commercial property.

5. The Contractor shall provide written reports and respond to requests by the City Arborist and/or the City Solicitor's Office related to investigations of claims against the City for property damage and personal injuries claimed to be caused by incidents of falling trees or limbs including, wherever possible, reports of damage caused by trees that fall during storm conditions.

D. Work Scheduling and Hours

1. The City intends on having scheduled tree planting work twice a year, during the Fall planting season and the Spring planting season. However there may be other times during the year that the City will request that trees be planted. The City will make a list of planting location(s) in advance of the work for the Contractor.

2. Prior to the commencement of work the Contractor shall meet with the City Arborist and provide a written schedule for the completion of work. City Arborist requires that this schedule be closely adhered to. Any changes to the schedule must be submitted to the City Arborist in writing for approval.

3. The Contractor shall begin work upon receipt of written and/or verbal orders to begin such work, and the work once begun shall be continuously carried forward with a force of persons adequate in the opinion of the City Arborist to complete the work in a continuous, uninterrupted, reasonable and expeditious manner, inclement and unseasonable weather conditions excepted. In the event the City Arborist determines that the Contractor has not begun work on orders to do so, or that the work once begun has been abandoned without authority, then the City Arborist shall give the Contractor seventy-two (72) hours notice (Sunday excepted) to begin work, or resume work in case of abandonment. Failure of the Contractor to act within this specified time shall be deemed a breach of this contract and the Contractor shall be held liable for any damage or expense arising from such breach of contract.

4. Standard work hours shall be Monday through Friday from 7:00 AM to 3:30 PM. Any work outside of these hours must be approved by the City Arborist.

5. The work crew(s) are to report daily to the City Arborist when they start and when they finish work for the day. Planned work locations

shall be emailed to the City Arborist daily by 7am. Completed work locations are to be emailed on a daily basis to the City Arborist by 5pm.

E. General Standards

1. The Contractor's work shall be done in a professional and skillful manner and performance thereof and all materials and facilities furnished by them shall be to the satisfaction of the City Arborist.

2. Approved plant locations shall be identified by the City. The Contractor will physically visit each location mark and to have planting locations checked by Dig-Safe for utility conflicts before any excavation or pavement removal is started.

3. Any unexpected obstructions at the site that interfere with the tree planting operation will be communicated to the City Arborist to determine a solution before planting occurs. The Contractor will not be compensated for any planting adjustments not approved by the City Arborist.

4. All work areas shall be kept in such a manner so as to cause as little inconvenience as possible to the general public and adjacent property owners. When it is necessary to close pedestrian walks, vehicular traffic lanes or private access roads and drives, the Contractor shall provide personnel, barricades, warning signs, cones, flags or other means required by governing rules and ordinances, along with notifying the affected property owner or resident. Driveways are not to be blocked at any time.

5. The Contractor shall obtain a permit from the Department of Public Works (permit desk telephone 617-349-4800) prior to any sidewalk or roadway obstruction. A copy of this permit must be available at the work site at all times. The Contractor is required to obtain street excavation and street obstruction permits to complete the work under this contract. Fees for permits to excavate or obstruct the public way shall be waived; all permits must be obtained prior to beginning work on the City streets and sidewalks. Permits will be required for each of the project components.

6. NO PARKING SIGNS- The Contractor shall post "TEMPORARY NO PARKING—TREE PLANTING" signs a minimum of forty-eight (48) hours in advance. The Contractor shall fill in the date, time and reason where indicated on the sign with a permanent, waterproof, black marker. The signs shall be placed in each location designated for tree service on any and all roadways prior to servicing the area. Signs shall be wired to trees, utility poles or city owned street signage. Both wire and sign shall be removed and disposed of by the Contractor when planting has been completed. Nails, tacks or staples are not allowed

for attaching signs to trees. Only signs provided by the City shall be posted. A posting report shall be filed with the Cambridge Department of Transportation a week in advance and updated in case of changes. Failure to submit a posting report with a copy to the Department of Public Works will result in an illegal posting. Any reimbursement to citizens for towing resulting from illegal posting shall be at the expense of the Contractor.

7. PERMITTING- It shall be the responsibility of the Contractor to apply for and receive the appropriate permits from Public Works and the Department of Transportation before the start of work.

8. All wood, brush and debris must be disposed of properly and in compliance with the requirements as pursuant to the provisions contained herein. Any debris left must not block vehicular or pedestrian traffic, and/or access to homes, or other private or public property (except as otherwise directed by the City Arborist).

9. Contractor shall carefully protect against damage to all existing trees and plants. The Contractor shall be liable for any and all damage to such trees, plants, real property and vehicles, and shall replace, repair, restore or provide for returning the same to their original condition, to the satisfaction of the City Arborist.

10. Contractor shall clean up the entire project before the work will be accepted. All debris, rubbish, boulders from any excavation material and etc., unless specifically ordered by the City Arborist to do otherwise, or any other debris shall be disposed of by the Contractor. The entire area within easements and all other areas disturbed by the Contractor shall be graded and left in a condition comparable to that as found originally and satisfactory to the City Arborist.

11. Contractor shall exercise the greatest care to ensure that no material being hauled by the Contractor either to or from the site is spilled onto any way, public or private way, within the City limits. In the event that such spillage does occur, it shall be the Contractor's responsibility to remove the spilled material and clean the area promptly but in no event any later than the end of the workday. If in the judgment of the City Arborist, the Contractor has not satisfactorily cleaned the area of any spill, the City Arborist may then order the area to be cleaned by the City at the Contractor's expense.

12. Contractor shall furnish all the labor, materials, tools and equipment necessary to do all the work required for the completion of each item as specified.

F. Special Provisions

1. All work areas near and around the tree planting areas resurfaced by the Contractor shall be guaranteed against settlement, upheaval or failure of any kind for a period of two (2) years after the City accepts the work and Contractor shall replace such resurfacing at their own expense. The City Arborist and or the City's Engineering Department, shall be the sole judge as to what constituents a failure and which portion of the resurfacing is to be replaced, and their decision will be final.

2. Before starting the work and from time to time during the project's progress, as the City Arborist or the City's Engineering Department may request, the Contractor shall submit to them a written description of the methods they plan to use in doing the work and the various steps intended to be taken.

3. Contractor shall cooperate with any other Contractors, utility companies and or City of Cambridge that may be working at or near this project's work site covered by this contract. The City Arborist and or the City's Engineering Department, will decide as to the respective rights of the parties involved and their decisions shall be final.

4. Contractor shall review all Contract Documents and verify all existing field conditions and report any discrepancies immediately to the Owner’s Representative prior to starting work. The starting of work indicates the Contractor has reviewed and accepted the Contract Documents and existing conditions.

5. Contractor shall rebuild, repair, restore and make good any and all damages to any portion of the work occurring prior to completion and final acceptance of the work, and shall bear the expense thereof.

PART 2 – PRODUCTS

2.1 PLANTING SOILS

A. Planting soils shall be in accordance with Section 02901 - PLANTING SOILS.

2.2 BIOCHAR

A. Contractor shall be responsible for obtaining Biochar, per approval by the City Arborist.

2.3 FERTILIZER

A. Fertilizer shall be a complete, slow-release, root contact packet, 16-8-16, or equal, and a standard product complying with State and Federal Fertilizer Laws. Name of supplier and sample to be approved by the City Arborist.

2.4 WATER

A. The Contractor shall be responsible to furnish its own supply of water to the site. Water furnished by the Contractor will be free of ingredients harmful to humans and plant life. The Contractor will supply hoses and other watering equipment required for the work.

B. Contractor may use a City of Cambridge fire hydrant only with the written approval of the City's Water Department. The Contractor will be responsible for following all the procedures and requirements set by the Water Department, including guidelines for which color hydrants may be used for watering operations. The Water Department will provide the Contractor with a meter and/or backflow device and will charge the Contractor a fee for the meter and/or backflow device. It is the responsibility of the Contractor to obtain this information. The Cambridge Water Department can be reached at 617-349-4025.

Filling of water trucks at DPW facility will only be allowed upon approval of City Arborist .

C. Watering for trees shall be provided through use of a drip irrigation type bag which shall be approved by the City Arborist.

1. To be constructed of a flexible watertight material.
2. Holding capacity of a minimum of 15 gallons.
3. Must have opening in top for filling.
4. Must have small holes in bottom that slowly releases water
5. Rate of complete water release must be no quicker than 4 hours following complete fill.

D. Name of drip irrigation bag product, supplier and sample to be approved by the City Arborist.

2.4 MULCH

A. Mulch shall be in accordance with Section 02900 - LANDSCAPING.

2.5 STAKING

A. Stakes will be wood, 10' x 2" x 3" in size, pointed at one end.

B. Tree ties shall be black polyester straps. Both must be approved by the City Arborist.

C. Samples of stakes and tree ties shall be submitted to the City Arborist for approval.

2.6 EDGING

A. For all new or expanded tree wells in brick sidewalks, the Contractor shall install edging around the entire perimeter of the tree well to keep the bricks from displacing.

B. Aluminum edging shall be shop fabricated from aluminum alloy 6063-T6, 3/16 inch thick x 1-5/8 inch or 2-1/4 inch deep, with standard black baked-on acrylic paint finish. Edging shall be furnished in 16-foot lengths.

1. Adjacent sections shall be adjoined using a 4-inch sliding, locking connector of aluminum alloy 6063-T6.

2. Stakes shall be spiral steel spikes with insulating plastic washers 10 inches x 3/8 inch.

C. Name of edging product, supplier and sample to be approved by the City Arborist.

2.7 TREE PLANTING MATERIALS

A. Plant Identification and Standards: The nomenclature used in the plant list generally conforms to that of the current edition of Standardized Plant Names, as adopted by the American Joint Committee on Horticultural Nomenclature. All tree plantings shall conform to the varieties and sizes specified in the Plant List, and to the code of standards set forth in the current edition of American Standard for Nursery Stock. Substitutions will not be permitted without the consent of the City Arborist.

B. Plant List: The Contractor shall supply the plants necessary to complete the work as intended. Where the size of a plant on the Plant List is a variation between a minimum and maximum dimension, the sizes of the plants furnished will be equal to the average of the two dimensions. Where a single dimension is given, this dimension represents the minimum size of the plants to be furnished.

C. General Trees:

1. All plants shall be nursery grown whether balled and burlapped or container grown, under climatic conditions similar to those in Cambridge, Massachusetts. The tree plantings shall be typical of their species and variety. Trees shall be straight, symmetrical with a crown having a persistent main leader, be growing from a single, healthy root system with no girdling roots. All tree plantings shall be sound and healthy free from defects, disfiguring knots, sun scald, and injuries or abrasions of the bark. They shall be free of plant diseases, pests, scale and all forms of infestations, and possess a normal balance between height and spread. Plants shall be matched as closely as possible where uniformity is required.

2. Trees shall be inspected at place of growth by the City Arborist and a representative of the Contractor for conformity in shape, proportion, symmetry, branching habit and character. Unless a tree clump is designated, the trunk of each tree shall be single and straight. Each tree shall be grown from a single un-mutilated crown of roots and shall have main leaders intact. Old abrasions and pruning wounds over ¾ inch in diameter shall be completely callused over.

3. Tree Limb Structure: All limbs on large trees maturing over 30 feet must originate on the trunk at 7 feet above the top of root ball. Small trees maturing less than 30 feet must have limbs that start no lower than 5 feet. All trees will be selected by the City Arborist.

D. Substitutions: Substitutions will not be permitted. If, however, proof is submitted that a tree(s) is not obtainable or does not meet requirements of Specification, use of nearest equivalent size or variety will be considered. Trees larger than specified may be used at no increase in cost to the City. Proposed substitutions must receive the written approval of the City Arborist. When sources for trees are located by the City Arborist, there will be no substitutions and those sources will be used. The City does not guarantee it will accept substitutions. The City will require that the Contractor try every means possible to obtain the specified trees.

E. Inspections: Trees shall be inspected, selected and tagged at place of growth by the City Arborist with the Contractor. Inspection and approval at the source(s) shall not waive the right of rejection for failure to meet other requirements during progress of work.

2.8 PLANT ROOT BALLS

A. All root balls shall conform to the size requirements specified for the proposed tree species and size at planting identified in the Plant List, and to the code of standards set forth in the current edition of American Standard for Nursery Stock.

B. All tree plantings either balled and burlapped, bare root, or container grown shall retain root systems as solid units. The diameter and depth of the balls of soil must be sufficient to encompass the fibrous and feeding root system necessary for the healthy development of each tree planting.

C. The tree plantings and root balls shall remain intact as a unit during all operations. No tree planting shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken, either before or during the process of planting.

2.9 TREE SPECIES LABELS

A. Tree species labels shall be provided by the Contractor for each tree and shall

be durable, legible labels, stating the correct tree name and size, in weather resistant ink or embossed process lettering, and can be removed at end of Contract.

PART 3- EXECUTION

3.1 SAW CUTTING AND PAVEMENT REMOVAL

A. All areas where pavement will be removed will be marked in the field by white marking paint. All edges are to be cut with clean cuts using a saw and are to be straight as marked on the pavement.

B. Certain locations will require the removal of pavement to allow for the expansion and excavation of the planting holes. Pavement types may include cement, bituminous concrete and other similar substances.

C. Tree wells shall be at least 20 square feet, 5’x4’, 10’x2’, or as directed by the City Arborist.

D. The Contractor shall be responsible for marking and cutting each tree well as needed to obtain the minimum tree well opening. If a tree well cannot meet the minimum 20 square feet, the Contractor shall consult with the City Arborist prior to saw cutting.

E. All edges are to be cut with clean cuts using a saw and are to be straight as marked on the pavement.

F. All dust, debris, and deposits (including any residue from wet-saw cutting) left behind from the cutting and excavating operation shall be swept up immediately following the installation of the tree.

G. No materials will be washed off or deposited into storm drains, catch basins, or tree wells.

H. Saw cutting and excavation operations shall not be performed when cars are parked adjacent to planting site. No Parking signs shall be posted in order to prevent cars from parking during construction and planting activities.

3.2 TREE GRATE AND GUARD REMOVAL

A. From time to time prior to the planting of trees and/or at locations with existing trees the City may require that metal tree grates and tree guards be removed. Removal shall be done in such a manner that does not damage an existing tree to remain with whatever tools and equipment the Contractor deems necessary and is approved by the City Arborist.

B. The legal disposal of the grate and/or guard shall be the sole responsibility of the Contractor. The City reserves the right to keep the grate and/or guard as it deems necessary.

C. After removing the grate and/or guard each planting tree well is to be weeded and cleaned of all debris. Bark mulch is to be replaced in the tree well to a level that meets the surrounding grade/ sidewalk surface.

3.3 EDGING

A. Edging shall be installed at perimeter of new and expanded tree pits that abut brick paving. Install edging with the base resting on the base and facing toward the brick paving and sidewalk. Set edging to the required alignment, straight and true and to the required elevation to ensure full paver restraint. Thread spike through insulating washer. Drive spikes into base until spike head firmly wedges washer against flange of aluminum edging.

1. Edging shall be securely staked in required position. Stakes shall be driven every 12 inches in straight runs and into every support section in curved sections.

2. Adjacent lengths shall be attached using manufacturer's standard connections according to manufacturer's published instructions.

3. Edging shall be set plumb and vertical at required line and grade. Straight sections shall not be wavy; curved sections shall be smooth and shall have no kinks or sharp bends.

3.4 TREE PLANTING SEASON

A. Tree planting can occur under normal, favorable weather conditions. Tree planting will not be permitted as determined by the City Arborist under adverse weather conditions such as when the ground is frozen or during extreme heat.

B. Tree planting shall take place during the Spring and Fall planting seasons. On occasion, and with approval of the City Arborist, tree plantings may take place outside of these times.

1. Spring: April 1st – June 15th
2. Fall: September 15th – November 15th

C. For Bare Root trees, the Contractor shall be ready to mobilize and install trees upon delivery of bare root trees. Contractor will be given as much notice as possible prior to bare root tree delivery.

D. The Contractor shall not install trees when the forecasted daily temperature is below 32 degrees F or exceeds 90 degrees F.

3.5 TREE PLANT SELECTION

A. The City Arborist will select and tag all specified tree planting material at the nursery locations. The Contractor may be required to attend the tree plant selection.

3.6 PLANT MATERIAL HANDLING

A. Trees shall be handled and transported so as to prevent damage of any sort including but not limited to breakage of branches, scraped or bruised trunk, or broken root ball and roots.

B. For balled and burlapped trees, the root ball shall be fully supported while moving trees. Trees shall not be thrown or bounced off a truck or loader to the ground. Trees shall not be dragged, lifted, pulled by the trunk or foliage in a manner that will loosen or damage roots. Once placed they are to be covered in such a manner that sun light does not shine on the roots of the plant and the branches are protected from wind damage.

C. Bare root trees shall be handled with additional care. Precaution must by taken to avoid drying out the root system. Before loading bare root trees for transportation, the root system must be dipped into a tank containing a water and hydrogel mix. The root dip assists in keeping the roots moist. After loading for transportation, the root systems of bare root trees must be covered with a layer of wet straw or burlap, and then covered by a tarp. **Tree roots must remain moist and not be allowed to dry out.**

D. Plants shall be protected during storage, and transportation by watering and covering, as necessary to ensure their continued health and viability.

E. Special care shall be taken to ensure that the roots of bare root and balled and burlap trees are not damaged and not allowed to dry out during the course of a workday.

F. Bare root and balled and burlap trees are to be placed on a trailer, truck or other equipment gently and in a manner that does not damage any portion of the tree.

G. If it is determined that poor handling and neglect by the Contractor has caused a plant to die or fail to establish, the Contractor shall be responsible for the cost of replacing the plant. Costs shall include the cost of purchase, cost to remove dead plant and cost to install new plant. Neglect may result in potential contract termination.

3.7 TREE PLANT DELIVERY

A. The City Arborist has the right to inspect and reject unsuitable trees delivered to the Contractor's storage site or planting site.

B. When plants cannot be transported and planted immediately upon being dug

they shall be stored and protected from desiccation and extremes in temperature by being heeled-in, watered, and covered.

3.8 TREE PLANT STORAGE

A. Trees shall be delivered to the Contractor's storage site and to the tree planting site in a well-watered and vigorous condition. All unplanted trees shall be protected at all times from sun and drying winds. Care must be taken so as not to damage bark, break branches, or cause injury to the tree.

B. All trees shall be stored in an upright position and grouped according to Genus, Species and 'cultivar' or 'variety'. Stored trees shall be mulched (enough to cover 2/3 of the root-ball and heavily watered twice a day to prevent wilt and undue stress to the trees).

E. Bare root and balled and burlap trees are held in a woodchip mulch while waiting to be planted and are watered regularly by the Contractor to maintain root health. The Contractor will be expected to remove the trees from this mulch prior to bringing the plants to the planting location. Care shall be taken to not damage any of the roots during the removal process. Damaged roots/trees will be the responsibility of the Contractor.

F. It is the Contractor's responsibility to determine the best method to ensure that the roots of bare root and balled and burlap trees are not damaged and do not dry out during the course of the planting process.

G. Bare root trees shall be handled with additional care. Precaution must by taken to avoid drying out the root system. Before loading bare root trees for transportation, the root system must be dipped into a tank containing a water and hydrogel mix. The root dip assists in keeping the roots moist. After loading for transportation, the root systems of bare root trees must be covered with a layer of wet straw or burlap, and then covered by a tarp. Tree roots must remain moist and not be allowed to dry out.

H. At no time shall the roots of bare root and balled and burlap trees be exposed to direct sunlight, wind and drying out. Trees are to be covered immediately after removal from the woodchip mulch and not uncovered until immediately prior to installation. While sitting waiting to be installed trees and associated roots must be covered and protected from light and drying out.

I. Periodically throughout the day the roots of bare root trees are to be misted with water to prevent them from drying out.

3.9 GENERAL TREE PLANTING

A. Prior to tree planting, the City Arborist will supply in writing to the Contractor specified tree planting locations showing the tree species selected and approved.

B. Immediately after planting, if required by the City Arborist, Contractor shall provide one informational door hanger to residence directly adjacent to new tree planting. Door hangers to be provided by the City of Cambridge.

C. Tree planting areas may need pavement removal as required by the City Arborist. All materials excavated from the tree planting areas and considered detrimental to the growth of the trees, such as an existing tree or stump, sidewalk paving, rocks, sub-soil and debris, shall not be reused for fill or in the planting operation, and must be removed from the site.

D. Any unexpected obstructions at the site that interfere with the tree planting operation will be communicated to the City Arborist to determine a solution 72 hours before planting occurs.

E. Soil of very poor quality or heavy clay encountered by the Contractor must be reported to the City Arborist for removal and amended as required.

3.10 PLANTING HOLE PREPARATION AND TREE INSTALLATION

A. Trees shall be plumb, faced to give best appearance, and planted at the center of the planting areas. If the Contractor is unable to install tree at proper grade and/or in center of tree well or designated planting location, the Contractor shall not install tree and contact City Arborist immediately.

B. Trunk flare must be visible and free of adventitious roots. (see Appendix)

C. Place the tree in the planting hole so that the top of the roots where the trunk flare is visible is 2”-3” inches above the established sidewalk level. If root flare is covered or set significantly lower than 2” above sidewalk grade than the Contractor will not be paid for that tree until it is properly adjusted.

D. Any non-degradable materials used in wrapping the root ball must be entirely and carefully removed so as not to disturb the roots. **Cut and remove all the twine, burlap and wire basket from root ball.** Carefully cut containers and remove keeping the root ball intact. All materials cut away from the root balls must be removed from the site.

E. Remove all soil, where present, from above the root flare to expose the top-most roots where they emerge from the trunk and measure the distance between the top-most roots and the bottom of the root ball or root mass.

F. Hole shall be dug about 10% shallower than this depth and the planting area at least three times the width of the ball or in the case of bare root at least one foot further than the longest roots. Any soil beyond the planting area shall be loosened and amended to the edge of the tree well area.

G. In lawn areas, the planting area must be dug to the depth of the root-ball and 3

times the width.

H. When planting holes are dug using mechanical means, i.e. backhoe, excavator, auger, etc., and the side walls of the pits become plastered or glazed, the plastered or glazed surface shall be properly scarified.

I. Surplus excavation and unsuitable material from the planting holes shall be removed from the site and disposed of per SOIL AND WASTE MANAGEMENT of this Specification.

J. Upon approval of plant locations and pavement removal (where applicable), excavate existing soils and remove all trees and stumps, and any other deleterious materials, as shown on the drawings and as specified herein. The Contractor must haul and legally dispose of excavated material off-site.

K. Acceptable existing soil material may be put back into tree well and amended as needed with approved planting soil. If excavated material cannot be reused refer to SOIL AND WASTE MANAGEMENT for instruction.

L. Tree wells will require a minimum of 4' of ADA compliant space for sidewalk pedestrian traffic.

M. Tree wells and areas shall be approved by the City Arborist before backfilling.

3.7 FERTILIZING

A. Insert approved slow-release plant packets, number according to the caliper of the tree with the approval of the City Arborist before back-filling.

3.8 BACK-FILLING

A. Carefully backfill by hand the approved existing soil from tree well and/or topsoil as needed in layers and water each layer thoroughly to fill all voids and allow to settle. Finish back-filling to a depth that finished grade level at settlement will be at established sidewalk level.

a. Fill hole about 1/3 full and gently slice a shovel down into the backfill 15 to 25 times all around the tree. Do NOT step firmly in the backfill soil because this could compact it and restrict root growth. Be careful not to damage the trunk or roots in the process.

b. Water the first third of soil to settle and eliminate air pockets. Backfill the remainder of the tree well in layers not to exceed six 6 inches. Water soil to settle. Fill in any holes or depressions with additional backfill soil. When the hole is filled with soil the root ball should remain approximately 2 inches above the backfill soil. The top of the root ball is not to be covered by the backfill soil.

B. All soils within the tree well shall be loosened to the edge of the tree well and to a depth of not less than 12 inches.

C. Soils for all trees shall be amended with biochar at a rate of 1-quart biochar per 2 cubic feet of soil at the time of installation.

D. For trees installed in grass or planting beds, surround each tree with a shoulder of topsoil to form a temporary saucer, 3 inches deep and equal to the diameter of the planting hole.

3.9 WATERING (AT INSTALLATION)

A. After bringing soil in the tree well to grade and forming the planting saucer, thoroughly soak the tree well by repeatedly filling the tree well with water to the full depth of the saucer, allowing the water to completely percolate into the soil between fillings.

B. At the time of planting, judiciously flood (mud in) trees with not less than fifteen (15) gallons of water and fill both irrigation bags.

3.11 WATERING (THROUGH FINAL ACCEPTANCE)

A. The Contractor will also include in their base bid costs for watering trees twice a week exclusive of Saturdays, Sundays and holidays for a period of 30 days from the date of planting.

B. Watering shall be provided through use of drip irrigation bags which shall be furnished by the Contractor and installed immediately on each tree following planting per the manufacturer's instructions.

1. Immediately following the planting of the tree, 2 drip irrigation bags are to be installed per the manufacture's instructions.

2. Drip irrigation bags are to be placed around each tree planting stake.

3. If required by City Arborist, drip irrigation bags are to be secured with a zip tie or similar locking device to avoid unwarranted removal.

4. Each tree shall be watered by filling both irrigation bags at every watering.

5. At the end of the watering period the Contractor shall remove all irrigation bags. Any irrigation bags remaining on trees at the end of the watering period may result in non-payment for work. Storage of drip irrigation bags is the responsibility of the Contractor during the guarantee period.

6. At the end of the guarantee period, the Contractor shall deliver all drip irrigation bags to the Public Works Department.

3.12 WATERING (2-YEAR GUARANTEE PERIOD)

A. Watering during the 2-year Guarantee Period shall be performed as specified in Section 3.11 and shall occur a minimum of once per week (approx. 4x per month) or as acceptable to the City Arborist.

B. The Contractor shall provide the City with a schedule of watering which will be performed showing which trees will be watered during the Guarantee Period.

C. Watering shall be provided from May 15 through November 15 at the discretion of the City Arborist.

D. If required by the City Arborist, the watering crew shall report to the City Arborist, by phone or in person as to the locations they will be watering that day.

E. All installed trees that are injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct.

F. The Contractor is to provide a watering truck(s) and water sufficient to complete as described in section 3.11 and as outlined in the Equipment section and Materials section of this Specification.

G. Prior to each watering, the Contractor shall inspect each drip irrigation bag for defects or damage. Damaged drip irrigation bags shall be replaced immediately. Each watering truck shall be equipped with replacement drip irrigation bags.

H. Watering and maintenance during the Guarantee Period will be recorded and tracked utilizing the City's Asset Management System.

1. Prior to watering under the guarantee period, the contractor shall be issued a tablet computer by the City. The tablet will be GPS equipped as specified herein for all watering crews during the guarantee period so that the Agency may contact individual crews to confirm their exact location.

2. In order to quantify trees watered the watering crews will be required to update the work order established with the City's asset management system, at the time each tree is watered. The contractor will record a "Watering Task" using the City's asset management system.

3. If a tree is dead the Contractor shall remove the tree from the watering list and notify the City Arborist immediately.

4. Prior to the guarantee watering season, all crew members who will be using the watering tracking system must attend a training hosted by the City.

5. Prior to the watering season, the Contractor and City Arborist will review all data uploaded during planting to ensure all trees have been inputted into the tree inventory and asset management system. Any trees that were not inputted into the tree inventory and asset management system must be inputted within five (5) days of written notification of the Contractor.

6. The Contractor will not get credit for the required weekly watering if the watering crew fails to update the work order in the City's asset management system.

3.13 MULCHING

A. After the initial watering, once soils have settled, a three-inch layer of mulch is to be applied around trees. Mulch shall cover the entire tree well in sidewalk plantings. In park or lawn plantings this area shall be at least six feet in diameter around the trunk of the tree unless otherwise specified by the City Arborist .

B. Mulch shall not contact the trunk of the tree or the root flare. Mulch should be two to three inches from the trunk.

C. Place mulch immediately after planting. No planting areas shall be left for longer than thirty minutes without mulch. No mulch material shall be applied until soils have settled after the initial watering of the tree.

3.14 STAKING

A. Stake immediately after planting of each tree. Equally space stakes and set parallel to structures, contours, paving or curbs. Set trees plumb and hold in position until the tree has been mudded in. Place stakes to depth indicated and fasten to tree with approved strapping, with appropriate knot.

B. Any stake or strap that becomes displaced or broken shall be reset or replaced promptly by the Contractor.

C. Staking shall be of uniform height after being driven at an angle one foot below bottom of tree well and drawn vertical. Place stakes to avoid root damage and at reasonable and proper distance from trunk to prevent movement of tree and root system; tension on stakes and guy wires to be equal and at a slight angle away from tree.

No. of Stakes	Size	Length Tree Size
2	2” x 3" x 8’	From 1” caliper up to and including 3-1/2” caliper

D. Some trees may require 3 or more stakes if necessary

E. Stakes for supporting trees shall be of uniform size, 2” x 3” x 8’, capable of standing in the ground at least two years.

3.15 PRUNING

A. Prune only badly bruised, broken, crossing or dead limbs.

3.16 CLEAN UP

A. Removal and Disposal of Tree and Woody Vegetation Debris

1. The Contractor shall be responsible for the immediate removal of all debris resulting from the work at each job site. Each job site is to be left in a condition equal or better than that which existed prior to the execution of work order. The Contractor shall be solely responsible for disposal of all tree debris.

2. The City reserves the right to retain all debris, chips and wood from work completed on City of Cambridge trees at no cost to the City. The City reserves the right to use this material in any way it sees fit.

B. Restoration of work areas and cleanup

1. All areas damaged during the process of the work shall be the responsibility of the Contractor and who shall restore the disturbed and damaged areas to a condition satisfactory to the City Arborist. This may include, but not be limited to tilling, grading, paving, fertilizing, mulching, etc.

2. The Contractor shall also be responsible for any other damage caused by their process of work operations and shall dispose of all rubbish, excess soil, etc., as directed by the City Arborist, all of which shall be done at no expense to the City of Cambridge.

3.17 BACKFLOW PREVENTION DEVICES

A. When hydrants are being used, the Cambridge Water System must be protected with backflow prevention devices as per Massachusetts Department of Environmental Protection (DEP) Regulations 310 CMR 22.22 and as per the Cambridge Water Department Cross Connection Control Program. Backflow prevention devices must also be used during sweet sweeping, sewer flushing, paving operations and hookups for any other purpose. The Cambridge Water

Department can be reached at 617-349-4025.

3.15 EDUCATIONAL MATERIALS

A. If required by the City Arborist, the Contractor will post educational materials supplied by the City Arborist.

3.16 MAINTENANCE

A. Maintenance shall begin immediately after tree planting and shall continue until final inspection and acceptance. Maintenance will include: watering, re-mulching, weeding, repositioning stakes, removal of dead or broken limbs, maintaining the planting saucer, etc. Watering by the Contractor for the remainder of the guarantee period should be at least once a week or as acceptable to the City Arborist.

B. Complete removal of Stakes: At the end of 2 years after planting (end of Guarantee Period), if required by the City Arborist, the Contractor shall remove from the site all ties, stakes, and gator bags from all trees, at no additional charge to the City.

3.17 GUARANTEE

A. Trees will be guaranteed for a minimum period of time of two (2) years after the initial acceptance. Trees planted in spring shall be alive and in satisfactory growth on June 1 of the second year after planting. If planted in the fall, trees shall be alive and in satisfactory growth on October 1 of the second year after planting.

B. Tree care shall begin immediately after each plant is planted to ensure the viability of the tree throughout the Guarantee Period and shall include, but is not limited to, the following throughout the Guarantee Period.

1. straightening
2. watering
3. mulch replacement
4. weeding
5. pruning
6. treating for insect pests and diseases

C. The City Arborist, at their discretion, may require the Contractor to address tree planting related issues as they develop.

D. Plants shall be straightened, watered, mulched, weeded, pruned, sprayed and treated for insect pests and diseases, cultivated and otherwise cared for, and shall be protected until final acceptance of the project.

E. If required by the City Arborist, the Contractor shall meet with the City semi-

annually during the Guarantee Period to inspect the plantings and shall take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional specialists such as arborists and horticulturists to inspect plant materials, identify problems, recommend and carry out remedial procedures.

F. Defective work shall be corrected immediately after becoming apparent, weather and season permitting. Trees that die during the Guarantee Period shall be removed at once regardless of the cause of death at no additional charge to the City. Replacement of dead trees will be done immediately if during the specified installation season. If dead tree has been removed out of planting season, the Contractor shall wait until the beginning of the subsequent planting season, at which time the replacement tree will be planted. If tree to be replaced is a fall hazard species the Contractor shall wait until the beginning of the spring planting season, at which time the replacement tree will be planted.

G. The Contractor will be responsible for all labor, equipment and materials cost associated with the planting of the replacement plants. When this determination has been made the Contractor shall not be entitled to any further payment for the planting of the replacement plant outside of the payment for the original plant installation.

H. If required by the City Arborist, at the end of the Guarantee Period, the Contractor and the City will meet to inspect the plants to determine if they are acceptable. To be accepted, the work must be in like-new condition. Each tree must exhibit the form typical to its species with at least 75% of its original canopy viable. Any tree that has lost its leader will be rejected.

I. At the end of the Guarantee Period Each tree must be free of badly bruised, broken, crossing, or dead limbs.

J. Based on the inspection, the City will prepare a list of deficiencies in the work. When the deficiencies are corrected to the City's satisfaction, the City will issue a written notice that the Guarantee Period has ended.

3.18 REPLACEMENTS

A. During the guarantee period, dead, unsightly, or unhealthy trees shall be removed and replaced according to section 3.19F by the Contractor as required by the City Arborist.

B. Vandalized or otherwise damaged trees should be brought to the attention of the City Arborist and replaced by the Contractor.

C. Replacements shall conform to requirements in the Specifications and shall be replaced as many times as necessary to ensure the establishment of healthy plants. Replacements shall be maintained and guaranteed for two years from the time of replacement, per the terms of the Guarantee Period.

3.18 TREE CONTRACT MANAGEMENT SYSTEM

A. At the time of tree planting or shortly thereafter, all newly installed trees will be added to the City's tree inventory system by the City Arborist or designee.

B. The City issued asset management program, supplied by the Cambridge DPW, will be the sole source of accountability to be used for confirmation of work performed and may be used in the calculation of payment required.

C. The Contractor will be provided with a web accessible tablet computer to be used to record all tree watering within the City's asset management system.

1. The Contractor will be given limited/ restricted web access to view the tree data in order to assist in scheduling and routing of tree planting and watering processes.
2. Contractor is responsible for any physical damage to the tablet. In the event that the tablet is damaged, it will be replaced by the City at the contractor's expense.
3. Inappropriate use of the tablet may result in the cancellation of the Contract.
4. Any technical issues with the equipment must be reported immediately. If the Contractor repeatedly is unable to complete required tasks due to technical issues that the City cannot verify, the Contract may be terminated at the City's discretion.
5. Reports of all trees watered and maintained by the Contractor will be generated by the City and supplied to the Contractor on a regular basis as needed.

D. The Contractor shall not be compensated for any tree that is watered and has not been updated in the asset management system. All payment and quantification of work performed will be based on the Contractor's use of the City's asset management system.

E. Contractor will be required to update the watering work order, as specified below, at the time each tree is watered or maintained utilizing the City's asset management mobile application with the City issued tablet computer. Recording of trees watered in the City's asset management system is considered incidental to the work of the Contract and not eligible for payment elsewhere. If the watering work order cannot be updated at the time of watering, the Contractor will be responsible for updating work order by end of day the tree was watered. In the event the Contractor is unable to update watering work order with issued tablet computer or desktop computer, Contractor shall email locations to City Arborist at end of day.

3.19 INSPECTION AND ACCEPTANCE

A. Written notices requesting all inspections must be received by City Arborist at least five days prior to anticipated inspection dates. All work in the Contract shall be found in neat, clean and safe condition.

3.19 SEMI-FINAL INSPECTION

A. The Contractor may offer for acceptance the entire project or a completed readily defined area, if approved by the City Arborist. Semi-Final inspection will be made by the City Arborist upon completion of all work included herein.

3.20 SEMI-FINAL ACCEPTANCE

A. The City Arborist will notify Contractor in writing of acceptance in whole or in part of work, exclusive of maintenance and possible replacement of trees subject to guarantee, or of requirements for completion if deficiencies exist. Work will not be submitted for payment without the City Arborist's written acceptance. Semi-Final Acceptance can only occur after the 30 day post-installation watering (2x per week) has been completed and confirmed.

3.21 FINAL INSPECTION AND ACCEPTANCE

A. At end of maintenance and Guarantee Period, and upon written application from the Contractor, the City Arborist shall determine acceptability of completed work, including watering and maintenance.

B. Dead, missing or unhealthy trees shall be replaced during next planting season. If a substantial number of plants are unsatisfactory, missing or dead, acceptance will not be granted until replacements are made and the Contractor's responsibility for the maintenance and guarantee (which will require extension) is completed.

END OF SECTION 02910

APPENDIX

REQUIRED TREE PLANTING SETBACKS

Requirement	Cambridge, MA
Minimum Tree Pit Size	2' x 10'
Minimum Distance from Street Intersections	20'
Minimum Distance from Street Lights	10' min. varies with species
Minimum Distance from Underground Utility Lines	3' from edge of tree well
Minimum Distance from Driveways	3' from edge of tree well
Minimum Distance from Fire Hydrants	3' from edge of tree well
Minimum Distance from Adjacent Trees	varies with species
Minimum Distance from Utility Poles	3' from edge of tree well
Minimum Distance from Stop Sign	20' from edge of tree well
Minimum Distance from Traffic Signs	Coordinate with Cambridge DOT, depends on sightline requirements
Suggested Distance from Parking Meters	outside tree well
Minimum Distance from Gas or Water Valve	3' from edge of tree well
Minimum Distance from Oil Fill Pipe	2' from edge of tree well
Minimum Distance from Coal Chute	2' to edge of tree well
Minimum Distance from edge of pit to any opposite obstructions	36" for existing tree, 48" for new tree
Minimum passage for ADA considerations	36" for existing tree, 48" for new tree



THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 02950

BACK OF SIDEWALK RESTORATION

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered under this Section includes the furnishing of all labor, equipment, appliances and materials, and in performing all operations in connection with restoration and reconstruction of back of sidewalk site features to their original condition and location including matching the original patterns of walkway and driveways such as herringbone, basket weave, running bond, etc. Back of Sidewalk material may consist of, but not limited to brick, flagstone, concrete, gravel, cobble stone, wood, limestone, and asphalt walkways and driveways, and all other necessary appurtenant work to reconstruct back of sidewalk areas to their original condition, as directed by the engineer, complete and accepted in accordance with the Drawings and Specifications and as required.

1.2 RELATED WORK

A. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

B. Section 02500 – PAVING AND SURFACING

C. Section 02524 – CURBS WALKS, AND DRIVEWAYS

1.3 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with Section 01300 – SUBMITTALS.

PART 2 - MATERIALS

2.1 GENERAL

A. Materials for all Non-Standard Back of Sidewalk Restoration shall be of the type, size, grade, and class to match the existing material and pattern as directed by the Engineer.

PART 3 - EXECUTION

3.1 Prior to performing any work on private property the Contractor shall confirm that a

"Right-of-Entry" has been executed to authorize the work and entry onto the private property by the property owner. The Contractor is responsible for coordinating the Right-of-Entry with the property owner.

3.2 All workmanship shall conform to the best standard practice, and all work shall be conducted by skilled laborers.

3.3 Landscape restoration shall be completed between April and October.

END OF SECTION 02950

SECTION 02980

SITE IMPROVEMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work of this Section consists of furnishing and installing all site improvements and related items as indicated on the Drawings and/or as specified herein and includes, but is not limited to, the following:

1. Warning Regulatory and Route Marker – Aluminum Panel (Type A)

2. Street Name Sign

3. Steel Sign Post

4. Parking Meter Post and Head

5. Bicycle Ring and Post

6. Solar Trash/Recycling Combination

7. Bollard

1.2 RELATED WORK

A. Section 02210, EARTH EXCAVATION, BACKFILL, FILL, AND GRADING

B. Section 02500, PAVING AND SURFACING

C. Section 02524, CURBS WALKS, AND DRIVEWAYS

D. Section 03300, CONCRETE

1.3 REFERENCES

A. Unless otherwise specified or indicated, materials and workmanship shall conform with the latest edition of the following standards, codes, specifications, requirements and regulations:

B. Standard Specifications: The Commonwealth of Massachusetts, Department of Transportation, Standard Specifications for Highways and Bridges, latest edition.

C. American Society for Testing and Materials (ASTM):
A36 Structural Steel

A53	Pipe, Steel, Black and Hot-dipped, Zinc-coated
A120	Standard Galvanized Steel Pipe
A153	Zinc Coating (Hot-dip) on Iron and Steel Hardware
A386	Zinc Coating (Hot-dip) on Assembled Steel Products
A325	High Strength Bolts
B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
F626	Fence Fittings
F668	Polyvinyl Chloride Coated Steel Chain Link Fence Fabric
F900	Industrial and Commercial Swing Gates
F934	Standard Colors for Polymer Coated Chain Link Fence Materials
F1043	Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework

D. American Steel and Iron Institute (ASI)

E. American Welding Society (AWS):
D1.1 Structural Welding Code

F. Steel Structures Painting Council (SSPC)

G. American Welding Society (AWS):
D1.1 Structural Welding Code

H. Steel Structures Painting Council (SSPC)

1.4 SUBMITTALS

A. At least thirty (30) days prior to intended use, the Contractor shall provide the following submittals for approval:

B. Shop Drawings, Manufacturer's Literature, and installation instructions for each item included within this specification section. Refer to Specification Section 01300- SUBMITTALS for submittal requirements.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver and store work under this Section in a manner to prevent wracking or stress of components, and to prevent mechanical damage or damage by the elements.

B. Items which become rusted or damaged because of non-compliance with these conditions will be rejected and shall be replaced without additional cost to the Owner.

C. Deliver bolts and other small items required for erection of work under this Section bundled with their respective items.

1.6 GUARANTEE

A. Furnish and deliver standard written manufacturer's guarantee in Owner's name covering all materials and workmanship under this Section, in addition to, and not in lieu of, guarantee requirements set forth under GENERAL CONDITIONS and SPECIAL PROVISIONS, and other liabilities which the Contractor may have by law or other provisions of the Contract Documents.

B. Supplier shall guarantee, in writing, the satisfactory condition of the metal finish of their work in all parts for a period of twenty (20) years after date of final acceptance, and shall agree to promptly repair or replace any finish work which is found to be defective during this period.

C. Supplier shall pay for repairs of any damage to any part of the project caused by defects in their work and for any repair to the materials or equipment caused by replacement. All repairs are to be done to the satisfaction of the Engineer.

D. Any part of the work installed under this contract requiring excessive maintenance shall be considered as being defective, and shall be replaced by the Supplier during the one year period at no cost to the Owner.

PART 2 - PRODUCTS

2.1 REGULATORY SIGNAGE

A. Signs shall be fabricated per Contract Document requirements and conform to MUTCD, latest edition, standards.

B. The legend, border, and background of sign panels (except as modified below) shall be Type “C”, permanently applied legend, or Type "D”, silk screen processed, according to the requirements of Section M9.30.0 of the MassDOT Standard Specifications, Type III or Type IV.

2.2 STREET NAME SIGN

A. Street name signs shall conform to City of Cambridge specifications, and shall be 9” high. Signs shall be 24” to 36” long, depending on the length of legend required. Lettering shall be 5”-6” height FHWA series B lettering, all capitals. Suffix lettering shall be 4” high. Signs shall have white high intensity lettering on green EC film.

2.3 SIGN POST

A. New traffic sign posts shall be galvanized steel “U-channel” posts conforming to Section M8.18.6 of the MassDOT Standard Specifications except minimum post weight shall be 2.5 lbs/foot.

2.4 PARKING METER POST

A. Parking meter posts shall be Schedule 40 galvanized steel pipe; 2” inside diameter; 2-3/8” outside diameter. Length shall be 50” to 51” with exposed height of 38” after installation.

2.5 BICYCLE RING AND POST

A. Shall be “Bike Hitch” model as manufactured by DERO Bike Racks or approved equivalent product. Centerbeam shall be 2” schedule 40 pipe (2.375” OD) and the ring shall be 1.5” OD, 11-gauge tube with an outside diameter of 16.5”. Finish shall be hot dip galvanized. All attachment hardware shall be hot dip galvanized. City of Cambridge Standard.

2.6 SOLAR TRASH/RECYLING COMBINATION

A. Solar trash/recycling type shall be Big Belly Solar Trash Compactor, and Big Belly Single Stream Recycling Compactor as manufactured by BigBelly Solar, 150 A Street, Needham MA, phone 888/820-0300, or approved equivalent product. Color shall be black, as approved by the Engineer. Volume of each unit (trash and recycling) shall be 32 gallons. Units shall include foot pedal feature.\

2.6 BOLLARD

A. Bollards shall be 6” galvanized steel pipe painted yellow. Length shall be 6’ with exposed height of 3’-3” after installation. Cap shall be galvanized steel welded and ground smooth.

PART 3 - EXECUTION

3.1 PERMANENT SIGNAGE AND PARKING METER POSTS

A. The location, number and legend of new signs which are required shall be as shown on the Drawings or as directed by the Engineer.

B. The Contractor shall lay out the proposed locations of permanent signage and parking meter posts for review and approval by the Engineer and Owner prior to installation.

3.2 ANCHORING AND FOUNDATIONS

A. Coordinate and furnish anchorages and setting drawings, diagrams, templates, instructions and directions for installing items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the site.

B. Provide concrete foundations and install at proper elevation to allow paving to

be installed over foundations. Install in accordance with manufacturer's recommendations and shown on Drawings. Grout anchorages and seal joint at pavement surface. Install plumb.

C. Items shall be located as indicated on the Drawings.

D. Items shall be positioned in the required location and firmly secured to the pavement in accordance with manufacturer's recommendations.

END OF SECTION 02980

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 03300

CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of cast-in-place concrete including formwork, reinforcement concrete, materials, mix design, placement procedures, and finishes.

2. Cellular concrete as an engineered fill for pipe abandonment.

B. Concrete for sidewalks is described in Section 02524 – CURBS, WALKS AND DRIVEWAYS.

1.2 RELATED TECHNICAL SECTIONS

A. Section 03315 – GROUT

B. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Product Data: For each type of manufactured material and product indicated.

2. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

a. Indicate amounts of mix water to be withheld at plant for later addition at Project site. However, addition of water at project site shall be limited to maximum amount printed on the concrete delivery ticket. Absent this information, no water shall be permitted to be added at project site.

b. Cellular concrete mix designs shall be prepared by the foam concentrate manufacturer.

c. MassDOT mix designs shall be in accordance with section M4.06.2: High Performance Concrete of the Massachusetts Department of Transportation Standard Specifications for Highways and Bridges.

3. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

4. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

   a. Cementitious materials and aggregates,

   b. Form materials and form-release agents,

   c. Steel reinforcement and reinforcement accessories,

   d. Admixtures,

   e. Waterstops,

   f. Curing materials,

   g. Bonding agents,

   h. Adhesives,

   i. Ready-mix concrete producer,

   j. Repair materials,

5. Detailed cold-weather protection methods.

6. Qualifications of concrete installer, manufacturer, and testing agency as specified in this Section.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

1. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

D. Testing Agency Qualifications: Contractor shall employ a testing agency, acceptable to the Engineer and qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

F. ACI Publications: Comply with the following, unless more stringent provisions are indicated:

1. ACI 301, "Specification for Structural Concrete."

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

PART 2 – PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, Light Pole Piers, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, ¾ inch by ¾ inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 2 inch to the plane of the exposed concrete surface.

2. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.

3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing and for walls which are part of water containing tanks or structures.

2.2 STEEL REINFORCEMENT

A. Reinforcing Materials shall have a recycled content of 30% or greater and shall conform to the following standards:

1. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

3. Plain-Steel Wire: ASTM A 1064, as drawn.

4. Plain-Steel Welded Wire Reinforcing: ASTM A 1064, fabricated from as-drawn steel wire into flat sheets.

5. Reinforcing shall be uncoated unless indicated otherwise on the Contract Drawings.

2.3 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.

B. Joint Dowel Bars: Plain-steel bars, ASTM A 615, Grade 60. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type II.

B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:

1. Class: Severe weathering region, but not less than 3S.

2. Nominal Maximum Aggregate Size: 3/4 inch..

C. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

B. Air-Entraining Admixture: ASTM C 260.

C. Water-Reducing Admixture: ASTM C 494, Type A.

D. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

E. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

F. High Range Water Reducing Admixture: ASTM C494, Type F.

G. Crystalline Waterproofing Admixture: Xypex C-Series or approved equal.

H. Foam Concentrate for Cellular Concrete: ASTM C869

2.6 WATERSTOPS

A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed.

2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Greenstreak.

b. Meadows: W. R. Meadows, Inc.

c. Vinylex Corporation.

B. Hydrophilic Waterstops: Manufactured as self-adhesive strips or caulk, for adhesive bonding to concrete.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Earth Shield Type 23 by J.P. Specialties, Inc..

b. Hydrotite by Greenstreak.

c. Ultra Seal by Adeka Corporation.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. This product shall not be used as a substitution for curing compounds.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Volatile Organic Compounds (VOC) shall meet maximum emission limits of authorities having jurisdiction at project site.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Evaporation Retarder:

i. Eucobar; Euclid Chemical Co.

ii. E-Con; L&M Construction Chemicals, Inc.

iii. Confilm; BASF Construction Chemicals, LLC.

b. Clear, Waterborne, Membrane-Forming Curing Compound, 18 to 22 percent Solids:

i. Klear-Kote WBII 20 percent; Burke Chemicals.

ii. Dress & Seal WB; L&M Construction Chemicals, Inc.

iii. Vocomp-20; W. R. Meadows, Inc.

c. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:

i. Res-Cure; Atlas Tech Products.

ii. Lumiseal WB Plus; L&M Construction Chemicals, Inc.

iii. Vocomp-30; W. R. Meadows, Inc.

2.8 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 CONCRETE MIXES

A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

2. Fly ash and blast furnace slag shall not be used.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Concrete mixes shall be designed for the classes indicated below and in accordance with the requirements indicated.

Design Mix Schedule								
				Admixture				
Class	Specified Compressive Strength (psi)	Minimum Cement Content (lb/cy)	*Maximum Water/ Cementitious Ratio	% Air Entrainment	Corrosion Inhibitor (gal./cy)	Fiber Reinforcement (lb/cy)	Silica Fume (% wt. Cement)	Density and Aggregate Size
A	4,500	565	0.42	5+/-1	N/A	N/A	N/A	NW-3/4"
B	4,000	565	0.44	5+/-1	N/A	N/A	N/A	NW-3/4"
C	50 to 200	-	0.35 to 0.80	-	-	-	-	50 +/- pcf

* Total water in mix at time of mixing, including free water in aggregates.

1. Mix Classifications: The design mix classes indicated above shall be used as indicated on the Drawings and as follows:

   Class A: Class A shall be used for reinforced concrete structures, including manhole bases, special structures, pipe collars, reinforced concrete fills, and similar items as applicable. Class A shall NOT be used where MassDOT mix designs are indicated.

   Class B: Class B shall be used for non reinforced concrete including cradles, encasements, thrust blocks, plugs, and base for pavements and similar concrete whether reinforced or not.

   Class C: Class C shall be used for cellular concrete, with properties customized for pipe abandonment.

2. Class A &B Slump at point of placement shall be limited to 4"+/- 1". With addition of high-range water reducer, slump at point of placement shall be limited to 7"+/- 2".

2. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by the Engineer before using in work.

D. Admixtures: Subject to Engineer’s approval, use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

3. Use crystalline waterproofing admixture where indicated in the drawing details and specifications. Bituminous damp-proofing shall not be used as an alternate unless approved by the ENGINEER on a case-by-case basis.

4. Use foam concentrate admixture for cellular concrete.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

PART 3 – EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch, for concrete surfaces exposed to view.

2. Class B, 1/4 inch, for other concrete surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete where indicated on Drawings.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use

Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50°F for 72 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained. When cold weather concrete requirements apply, formwork shall be left-in-place for a minimum of 7 days.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 70% of 28-day design compressive strength.

2. Determine compressive strength of in-place concrete by testing representative field cured test specimens according to ACI 301.

3. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain required concrete cover. Do not tack weld crossing reinforcing bars, unless indicated on the Drawings.

1. Shop- or field-weld reinforcement according to AWS D1.4, only where indicated on the Drawings.

2. Do not install reinforcement into previously placed concrete.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.

2. Form using bulkhead forms with keys, unless otherwise indicated. Leave-in-place bulkhead forms are prohibited.

3. Use a bonding agent at locations where indicated on Drawings, and where fresh concrete is placed against hardened concrete surfaces.

3.7 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and

protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

B. Hydrophilic Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable and in accordance with manufacturer's typical installation details. Provide minimum depth of concrete cover per manufacturer written instructions.

3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. The area of placement shall be free of standing and running water.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved in writing by Engineer.

C. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Limit drop height of concrete off of chute to 48-inches.

2. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.

4. Concrete shall be carefully consolidated on each side of waterstop.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Maintain reinforcement in position on chairs during concrete placement.

3. Screed slab surfaces with a straightedge and strike off to correct elevations.

4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

6. Pulling of welded wire fabric through wet concrete from subgrade is prohibited.

F. Cellular Concrete for Pipe Abandonment:

1. Use job site batching, mixing, and placing equipment that is automated with bulk handling equipment certified by the foam concentrate manufacturer.

2. Bulk cement shall be weighed on a scale that operates within a tolerance of 1-1/2% per batch. Transit mixers and volumetric batching mixers are not acceptable for these low density applications.

3. Mix the materials and convey promptly to the point of placement. Cast in lift thicknesses as recommended by the manufacturer.

G. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F and not more than 80°F at point of placement.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

H. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.9 FINISHING FORMED SURFACES

A. The finish of formed surfaces shall proceed concurrently with, or immediately after the repair of surface defects. The selection of finishes shall be as indicated in the table below.

Concrete Finishes (Formed Surfaces) Location	**Finish**
Footings, exterior walls, pile caps, portions of grade beams below grade and all other concrete not exposed to view	Rough-Formed Finish
Walls, portions of grade beams above grade, and all other concrete surfaces exposed to view. Surfaces to be coated or covered with waterproofing, dampproofing, plaster or paint	Smooth-Formed Finish

B. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

C. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

D. Smooth Rubbed Finish to Permanently Exposed Surfaces: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

3.11 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.

   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.

   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment

and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.13 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall employ qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Section.

B. Class A &B Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete, plus one set for each additional 50 cu. yd. or fraction thereof.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.

6. Cast and field cure one additional set of four standard cylinder specimens for each composite sample, when outside air temperature is below or expected to fall below 40°F that night. Also provide field cured cyclinders to determine strength for form removal.

7. Compressive-Strength Tests: ASTM C 39; test one laboratory-cured specimen at 7 days, two at 28 days, and one at 56 days.

C. Class C Testing Services:

1. During placement of the initial batches, check the density and adjust the mix as required to obtain the specified cast density at the point of placement. Take four (4) test specimens for each 300 cubic yards of material placed or every four (4) hours of placing.

2. Test in accordance with ASTM C495 except do not oven dry load test specimens. The specimens shall be 3" diameter x 6" high cylinders covered after casting to prevent damage and loss of moisture. Moist cure the specimens at least up to 3 days prior to a 28-day compressive strength test. Specimens may be tested at any age to monitor the compressive strength.

D. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

E. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and, for Class A&B concrete, no compressive-strength test value falls below specified compressive strength by more than 500 psi.

F. Test results shall be reported in writing to Engineer, Owner, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.

G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency shall conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer. Petrographical analysis to determine water/cement ratio cement content, hydrated cement content, etc. shall be performed by the testing and inspection agency as directed by the Engineer when test results indicate requirements have not been met.

-END OF SECTION 03300-

SECTION 03315

GROUT

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing all materials for grout including formwork, materials, mix design, placement procedures, and finishes

2. The following types of grout shall be covered in this Section:

a. Cement Grout

b. Non-Shrink Grout: This type of grout is to be used wherever grout is shown in the Contract Documents, unless another type is specifically referenced.

c. Epoxy Grout

d. Topping Grout

1.2 RELATED TECHNICAL SECTIONS

A. Section 03300 – CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Submit certified test results verifying the compressive strength, shrinkage, and expansion requirements specified herein; and manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of non-shrink and epoxy grout used in the work.

2. Certified testing lab reports for tests indicated herein.

3. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.

4. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.

5. Manufacturer’s literature containing instructions and recommendations on the mixing, handling, placement, curing, and

appropriate uses for each type of grout used in the WORK, and location of use. The current ICC-ES or IAPMO-UES report shall be submitted for all epoxy anchor grouts for adhesive anchors.

6. Manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.

7. Submit manufacturer's written warranty as indicated herein.

8. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified

B. Field Tests:

1. Cement Grout and Topping Grout

a. Compressive strength of cement grout and topping grout shall be tested in accordance with the requirements of ASTM C 1107. The frequency of tests shall conform to the requirements of Section 03300 – CONCRETE.

2. Prepackaged Grout

a. Compression test specimens shall be taken during construction from the first placement of each type of grout, and for each different batch number of each type of grout thereafter. The specimens will be made by the Owner or its representative.

b. Compression tests and fabrication of specimens for non-shrink grout shall be performed as specified in ASTM C 109. A set of three specimens shall be made for testing at 24 hour, 28 days, and each additional time period as appropriate.

c. Compression tests and fabrication of specimens for epoxy grout shall be performed as specified in ASTM C 579, Method B. A set of three specimens shall be made for testing at 24 hours, and each earlier time period as appropriate.

3. All grout, already placed, which fails to meet the requirements of these specifications, is subject to removal and replacement at no cost to the Owner.

4. The cost of all laboratory and field tests on grout shall be borne by the Contractor, and the Contractor shall assist the Owner in obtaining specimens for testing. The Contractor shall supply all materials necessary for fabricating the test specimens.

C. Construction Tolerances: Construction tolerances shall be as specified in the Section 03300 – CONCRETE, except as modified herein and elsewhere in the Contract Documents.

PART 2 – PRODUCTS

2.1 CEMENT GROUT

A. Cement Grout: Cement grout shall be composed of one part cement, three parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 days shall be 4500 psi.

B. Cement grout materials shall be as specified in Section 03300 – CONCRETE.

2.2 PREPACKAGED GROUTS

A. Non-Shrink Grout:

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring only the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout specified herein shall be that recommended by the manufacturer for the particular application.

2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0%) and a maximum 4.0% expansion in the plastic state when tested in accordance with ASTM C-827; and shall have no shrinkage (0.0%) and a maximum of 0.2% expansion in the hardened state when tested in accordance with ASTM C 1090.

3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of ASTM C 1090.

4. Application:

a. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting

under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout specified herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.

b. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

B. Epoxy Grout:

1. Epoxy grout shall be a pourable, non-shrink, 100% solids system. The epoxy grout system shall have three components: resin, hardener, and specially blended aggregate, all pre-measured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.

2. Available Products: Subject to compliance with regulations, products that maybe incorporated into the work include, but not limited to, the following:

a. Five Star DP Epoxy Grout; Five Star Products,

b. Sikadur 42 Grout-Pak; Sika Corporation

c. Materflow 648 CP Plus; BASF

d. or equal.

3. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application.

4. The mixed epoxy grout system shall have a minimum working life of 45 minutes at 75° F.

5. The epoxy grout shall develop a compressive strength of 5000 psi in 24 hours and 10,000 psi in seven days when tested in accordance with ASTM C 579, Method B. There shall be no shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C 827.

6. The epoxy grout shall exhibit a minimum effective bearing area of 95%. This shall be determined by a test consisting of filling a 2-inch diameter by 4-inch high metal cylinder mold covered with a glass plate coated with a release agent. A weight shall be placed on the glass plate. At 24 hours after casting, the weight and plate shall be removed and the area in plan of all voids measured. The surface of the grout shall be probed with a sharp instrument to locate all voids.

7. The peak exotherm of a 2-inch diameter by 4-inch high cylinder shall not exceed 95°F when tested with 75°F material at laboratory temperature. The epoxy grout shall exhibit a maximum thermal coefficient of 30 x 10^{-6} inches/inch/degree F when tested according to ASTM C 531 or ASTM D 696.

8. Application: Epoxy grout shall be used for all other applications required in the Contract Documents, unless specified in drawings.

C. Epoxy Anchor Grout:

1. Epoxy anchor grout for use in concrete shall be certified for use in accordance with ICC-ES AC 308.

2. Epoxy anchor grout shall conform to ASTM C 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete, Type IV, Class B & C, Grade 3 with the exception of gel time.

3. Heat deflection temperature per ASTM D 648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position shall be a minimum 120 degrees F.

4. Manufacturer shall certify that the epoxy anchor grout will maintain 100 percent of its capacity up to a short term temperature of 110 degrees F and 50 percent of its capacity up to a short term temperature of 150 degrees F.

5. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.

6. Epoxy anchor grout shall be capable of being used in submerged applications once cured.

7. Compressive strength per ASTM D 695 – Standard Test Method for Compressive Properties of Rigid Plastics shall be 10,000 psi minimum.

8. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject

to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink grout and oversized holes.

9. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar unless otherwise noted on the Contract Documents.. Embedment shall not exceed 67 percent of the member depth.

10. Epoxy anchor grout shall be **PE1000+ by Powers Fasteners; HIT-RE 500-SD** by **Hilti**, **SET-XP** by **Simpson Strong-Tie**, or equal.

2.3 TOPPING GROUT

A. Grout for topping of slabs shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and mixed as specified herein. All materials and procedures specified for normal concrete in Section 03300 – CONCRETE shall apply except as noted otherwise herein.

B. Topping grout shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45.

C. Coarse aggregate shall be graded as follows:

US Standard Sieve Size	Percent By Weight Passing
1/2"	100
3/8"	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

D. Final mix design shall be as determined by trial mix design under supervision of the approved testing laboratory.

E. Strength: Minimum compressive strength of topping grout at the end of 28 days shall be 4000 psi.

2.4 CURING MATERIALS

A. Curing materials shall be as specified in Section 03300 – CONCRETE, for cement grout and as recommended by the manufacturer of prepackaged grouts.

2.5 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application.

B. The slump for topping grout shall be adjusted to match placement and finishing conditions but shall not exceed 4 inches.

2.6 MEASUREMENT OF INGREDIENTS

A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement shall not be allowed.

B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 – EXECUTION

3.1 GENERAL

A. All surface preparation, curing, and protection of cement grout shall be as specified in Section 03300 – CONCRETE. The finish of the grout surface shall match that of the adjacent concrete.

B. The manufacturer of non-shrink grout and epoxy grout shall provide on-site technical assistance.

C. Base concrete or masonry must have attained its design strength before grout is placed, unless authorized by the Engineer.

3.2 GROUTING PROCEDURES

A. Prepackage Grouts: All mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.

B. Base Plate Grouting:

1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a 1-inch thickness of grout or a thickness as shown on the drawings.

2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The mixture shall be of a trowelable consistency and tamped or rodded solidly into the space between the plate and the base concrete. A backing board or stop shall be provided at the back side of the space to be filled with grout. Where

this method of placement is not practical or where required by the Owner, alternate grouting methods shall be submitted for acceptance by the Engineer.

C. Topping Grout:

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping. The base slab shall be given a roughened textured surface by sandblasting or hydroblasting exposing the aggregates to ensure bonding to the base slab.

2. The minimum thickness of grout topping shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45° with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3 ½ inches wide by 1 ½ inches deep.

3. The base slab shall be thoroughly cleaned and wetted prior to placing topping. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat Type II cement grout shall be broomed into the surface of the slab just before topping of fill placement. The topping shall be compacted by rolling or tamping, brought to established grade, and floated.

4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.

5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

3.3 CONSOLIDATION

A. Grout shall be placed in such a manner, for the consistency necessary for each application, so as to assure that the space to be grouted is completely filled.

-END OF SECTION 03315-

SECTION 03410

PLANT-PRECAST STRUCTURAL CONCRETE

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Furnishing, installing, and testing of underground precast concrete structures, complete and in place, within the limits and to the lines and grades indicated.

B. Refer to Section 02252 – MANHOLES for requirements relating to the following:

1. Jointing and gaskets,

2. Coatings,

3. Castings,

4. Masonry and building inverts,

5. Flexible manhole seals,

6. Installation regarding placing structure in trench, connecting pipes, building inverts, and backfilling,

7. Inspection and testing of completed structures.

1.2 RELATED TECHNICAL SECTION

A. Section 02140 – DEWATERING

B. Section 02160 – TEMPORARY EXCAVATION SUPPORT SYSTEMS

C. Section 02210 – EARTH EXCAVATION, BACKFILL, FILL AND GRADING

D. Section 02252 – MANHOLES

E. Section 02590 – BRICK MASONRY

F Section 03300 – CONCRETE

G. Section 03315 – GROUT

H. Section 07160 – BITUMINOUS DAMPPROOFING

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Complete shop drawings which show details in accordance with ACI 315 and ACI 318 for all precast structural concrete units, cast iron frames and covers and appurtenances including:

a. Details of structures, joints and gaskets, construction details, tolerances, and other information as required by the Owner. Indicate member locations, plans, elevation, dimensions, shapes, cross sections, openings, and types of reinforcement, including special reinforcement.

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

c. Design Mixes: For each concrete mix. Prior to commencing operations, including fabrications of the precast for any mock-up, a statement shall be submitted giving the nominal maximum aggregate size and proportions of all ingredients that will be used in the manufacture of concrete. The statement shall include test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made in materials used in the concrete mix without approval and additional tests to verify that the concrete properties are satisfactory. A copy shall be submitted of concrete mix with each set of samples.

d. Indicate welded connections by AWS standard symbols. Detail loose and cast-in hardware, inserts, connections, and joints, including accessories.

e. Indicate locations and details of anchorage devices to be embedded in other construction.

2. Design drawings and calculations signed and sealed by a Professional Structural Engineer registered in the Commonwealth of Massachusetts to the Engineer.

3. Material Test Reports: From a qualified testing agency indicating and interpreting test results of the following for compliance with requirements indicated:

a. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

i. Concrete materials.

ii. Reinforcing materials.

iii. Admixtures.

4. Certificates of Compliance: Certificates of compliance shall be submitted attesting that materials and products meet or exceed specified requirements.

5. Qualification Data: List of projects/orders completed in the last 5 years demonstrating capabilities and experience as specified in the Quality Control paragraph of this Section. Include project name and addresses, and other information specified.

6. Submit manufacturer's recommended installation procedures for informational purposes.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

1. Installer Qualifications: An experienced installer who has completed precast structural concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

2. Fabricator Qualifications: A firm that complies with the following requirements and is experienced in manufacturing precast structural concrete units similar to those indicated for this Project and with a record of successful in-service performance.

a. Assumes responsibility for engineering precast structural concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified Professional Engineer.

b. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of precast structural concrete that are similar to those indicated for this Project in material, design, and extent.

c. Participates in PCI's Plant Certification program and is designated a PCI-certified plant for Group C, Category C1.

d. Has sufficient production capacity to produce required units without delaying the Work.

3. Testing Agency Qualifications: An independent testing agency, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

4. Design Standards: Comply with ACI 318 and the design recommendations of PCI MNL 120, "PCI Design Handbook--Precast and Prestressed Concrete."

5. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and camber and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products."

6. Product Options: Drawings indicate size, profiles, and dimensional requirements of precast concrete units and are based on the specific types of units indicated. Other fabricators' precast concrete units complying with requirements may be considered.

7. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."

B. Owner reserves right to inspect and test by independent services at manufacturer’s plant or elsewhere at his own expense.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT.

1.6 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Dead Loads: 130 pcf soil load on roof.

2. Live Loads: AASHTO HS-20.

3. Lateral Earth Pressure; 90 psf/ft below ground level.

4. Internal Fluid Pressure: Based on unit weight of 63 pcf filled from invert to finished grade with no external soil pressure.

5. Traffic Surcharge:

   a. Vertical Load: 240 psf at the ground surface level.

   b. Lateral Load: 120 psf at the side of the wall applied over the full height of the wall.

6. Seismically induced earth pressure is not required by Geotechnical Design recommendations from Brierley Associates, LLC.

7. Maximum allowable bearing pressure at the bottom of foundation support shall be 2000 psf. Provide 12 inches of compacted crushed stone over the compacted bearing surface.

PART 2 – PRODUCTS

2.1 GENERAL

A. Each structure section shall be constructed with a bell-and-spigot or tongue-in-groove joint.

B. Structure flat tops shall be reinforced and not less than 8 inches thick. Manhole openings shall have a minimum inside diameter of 24 inches.

C. All exterior concrete surfaces shall be coated with bituminous dampproofing as per Section 07160 – BITUMINOUS DAMPPROOFING.

D. Jointing shall be O-ring gaskets or butyl rubber molding sealants. All joints shall be provided so as to be watertight under all conditions of service. The ends of base, riser, and top sections to be jointed using neoprene “O-ring” type joints shall be designed to enclose the gasket on four surfaces when the joint is in its final position.

E. Mortar for Brickwork shall be provided per Section 02590 – BRICK MASONRY.

F. Bricks shall be provided per Section 02560 – BRICK MASONRY.

G. Structure castings shall be provided per Section 02252 – MANHOLES.

2.2 MOLD MATERIALS

A. Molds: Provide molds and, where required, form-facing materials of metal, plastic, wood, or another material that is nonreactive with concrete and dimensionally stable to produce continuous and true precast concrete surfaces within fabrication tolerances and suitable for required finishes.

2.3 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

C. Steel Bar Mats: ASTM A 184, assembled with clips, as follows:

1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.

D. Plain-Steel Wire: ASTM A 82, as drawn.

E. Plain-Steel Welded Wire Fabric: ASTM A 85, fabricated from as-drawn steel wire into flat sheets.

F. Supports: Manufacturer's bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place according to CRSI's " PCI MNL 116, and as follows:

1. For uncoated reinforcement, use all-plastic CRSI Class 1 plastic-protected bar supports.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, of same type, brand, and source.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 4S.

C. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

D. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

E. Water-Reducing Admixture: ASTM C 494, Type A.

F. Retarding Admixture: ASTM C 494, Type B.

G. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

H. Ground Granulated Blast Furnace Slag: ASTM C 989, Grade 100 or better.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36.

B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished; AWS D1.1, Type A or B, with arc shields.

C. Malleable Steel Castings: ASTM A 47.

D. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706.

E. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.

F. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

G. Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123, after fabrication.

1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94% zinc dust by weight, and complying with DOD-P-21035A or SSPC-Paint 20.

H. Welding Electrodes: Comply with AWS standards.

I. Accessories: Provide clips, hangers, plastic shims, and other accessories required to install precast structural concrete units.

2.6 STAINLESS-STEEL CONNECTION MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 316L, of grade suitable for application.

B. Stainless-Steel Bolts and Studs: ASTM F 593, alloy 316, hex-head bolts and studs; stainless-steel nuts; and flat, stainless-steel washers.

C. Stainless-Steel Headed Studs: ASTM A 276.

2.7 CONCRETE MIXES

A. Prepare design mixes for each type of concrete required.

B. Design mixes may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to the maximum percentage by weight of cement permitted by ACI 318.

D. Normal-Weight Concrete: Proportion mixes by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Specified Compressive Strength (28 Days): f'c 5,000 psi.

2. Maximum Water-Cementitious Materials Ratio: 0.440.

3. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows, with a tolerance of plus or minus 1-1/2 percent:

a. Air Content: 6% for 1-inch nominal maximum aggregate size.

b. Air Content: 6% for 3/4-inch nominal maximum aggregate size.

c. Air Content: 7% for 1/2-inch nominal maximum aggregate size.

E. Other Admixtures: Use water-reducing, high-range water-reducing, water-reducing and accelerating, or water-reducing and retarding admixtures according to manufacturer's written instructions.

F. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.8 FABRICATION

A. Formwork: Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances.

1. Coat surfaces of forms with bond-breaking compound before reinforcement is placed. Provide commercial-formula, form-coating compounds that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's written instructions.

B. Built-in Anchorages: Accurately position built-in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or concrete placement. Do not relocate bearing plates in units unless approved by Engineer.

C. Cast-in openings larger than 10 inches in diameter or 10 inches square according to Shop Drawings. Smaller holes may be field cut by trades requiring them, as approved by Engineer.

D. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete.

2. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.

3. Place reinforcement to obtain at least the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Mix concrete according to PCI MNL 116 and requirements in this Section. After concrete batching, no additional water may be added.

F. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units. Comply with requirements in PCI MNL 116 for measuring, mixing, transporting, and placing concrete.

G. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL 116.

H. Comply with ACI 306.1 procedures for cold-weather concrete placement.

I. Comply with ACI 305R recommendations for hot-weather concrete placement.

J. Identify pickup points of precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint casting date on each precast concrete unit on a surface that will not show in finished structure.

K. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.

L. Product Tolerances: Fabricate precast structural concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product tolerances.

M. Finish formed surfaces of precast structural concrete as indicated for each type of unit, and as follows:

1. Standard Finish: Normal plant-run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls will be tolerated. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.

N. Screed finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections.

1. Apply scratch finish to precast concrete units that will receive concrete fill after installation. After initial strikeoff, transversely scarify surface to provide ridges approximately 1/4 inch deep.

O. Repair of damaged epoxy coating, when required, shall be made with patching material conforming to ASTM A 775. Repair shall be in accordance with the material Manufacturer's recommendations.

2.9 GASKETS

A. Gaskets for sealing joints using the "O-ring" type gaskets shall conform to ASTM C443, latest revision, and shall be of rubber of a special composition having a texture to assure a watertight and permanent seal and shall be the product of a manufacturer having at least five years experience in the manufacture of neoprene gaskets for pipe joints, or shall be vulcanized butyl rubber sealants meeting or exceeding Federal Specifications SS-S-210.

B. Each gasket shall be a continuous ring of round solid cross-section having smooth surfaces free from blisters, porosity and other imperfections. The joint sealing gasket shall be of a composition and texture which shall be resistant to sewage, industrial wastes including gasoline, oils and groundwater, and which will endure permanently under the conditions likely to be imposed by this use. The tensile strength shall be at least 1,200 psi. The elongation shall be such that 2-inch gauge marks shall stretch to not less than 9 inches. The compression set (constant deflection) shall not exceed 25 percent of the original gauge length. The tensile strength after accelerated aging shall be not less than 80 percent of the original strength.

C. The butyl rubber sealant shall have a self adhesive nature and shall have a diameter of 1 inch and shall be furnished in coils. The sealant shall meet the following properties:

DESCRIPTION	SEALANT PROPERTY
Base	Vulcanized Butyl Rubber
Percent of Solids	100%
Shore "A" Durameter:	
- Initial	10
- Aged	20
Adhesion to Clean Surfaces	Excellent
Temperature Range:	
- Application	-20° F to 120° F
- Service	-65° F to 200° F
Water Absorption after 14 days immersion:	Less than 5%
Chemical Resistance after 7 days immersion in 5% Potassium Hydroxide and 5% Hydrochloride Acid	Excellent
Resistance to Water and Organic Solvents	Excellent
Resistance to Shock, Heat, and Cold	Excellent
Color	Black
Shelf Life	Excellent
Elongation	
- Initial	30%
- 2 weeks at 190° F, drying	250%
- 2 weeks in water	300%
Weather Resistance	Excellent
Moisture Diffusion Resistance	Excellent
Specific Gravity	1:18
Flash Point	None
Fire Point	Over 620° F

2.10 FLEXIBLE MANHOLE SEALS

A. Flexible manhole seals shall be:

1. New Lok Joint Flexible Sleeve by Interpace,

2. A-Lok Manhole Sleeve by L & L Concrete Products,

3. Press Wedge II by Pre-Seal Basket Corporation,

4. or approved equal.

B. Field applied seals shall be similar to a style typified by Kor-N-Seal boot or an approved equal.

C. Manhole sleeves, gaskets and sealants shall be furnished complete with lubricants, stainless steel stops, inserts, clamps, etc.

2.11 SOURCE QUALITY CONTROL

A. Contractor will employ an independent testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.

1. Allow Contractor’s testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.

B. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 116 requirements.

C. Strength of precast concrete units will be considered deficient if units fail to comply with PCI MNL 116 requirements, including the following:

1. Units fail to comply with compressive-strength test requirements.

2. Reinforcement of units do not comply with fabrication requirements.

3. Concrete curing and protection of units against extremes in temperature fail to comply with requirements.

4. Units are damaged during handling and erecting.

D. Testing: If there is evidence that the strength of precast concrete units may be deficient or may not comply with PCI MNL 16 requirements, Engineer may employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42.

1. A minimum of three representative cores will be taken from units of suspect strength, from locations directed by Engineer.

2. Cores will be tested in an air-dry condition per ACI 301 if units will be dry under service conditions.

3. Strength of concrete for each series of 3 cores will be considered satisfactory if the average compressive strength is equal to at least 85 percent of the 28-day design compressive strength and no single core is less than 75% of the 28-day design compressive strength.

4. Test results will be made in writing on the same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports will include the following:

a. Project identification name and number.

b. Date when tests were performed.

c. Name of precast concrete fabricator.

d. Name of concrete testing agency.

e. Identification letter, name, and type of precast concrete unit or units represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mix that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Dimensional Tolerances: Units with dimensions smaller or larger than required and not complying with tolerance limits may be subject to additional testing.

1. Precast concrete units with dimensions larger than required will be rejected if the appearance or function of the structure is adversely affected or if larger dimensions interfere with other construction. Repair or remove and replace rejected units, as required, to comply with construction conditions.

G. Defective Work: Precast concrete units that do not comply with requirements, including strength, manufacturing tolerances, and finishes, are unacceptable. Replace with precast concrete units that comply with requirements.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances, true and level bearing surfaces, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Welding: Perform welding in compliance with AWS D1.1 and AWS D1.4, with qualified welders.

1. Protect precast concrete units and bearing pads from damage by field welding or cutting operations and provide noncombustible shields as required.

2. Repair damaged metal surfaces by cleaning and applying a coat of galvanized repair paint to galvanized surfaces.

B. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units unless approved by Engineer.

C. Erection Tolerances: Install precast concrete units level, plumb, square, and true, without exceeding the recommended erection tolerances in PCI MNL 127, "Standards and Guidelines for the Erection of Precast Concrete Products".

D. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at keyways, connections, and joints as follows:

1. Provide forms or other approved method to retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

3.3 FIELD QUALITY CONTROL

A. Testing: Contractor will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Field welds and connections using high-strength bolts will be subject to tests and inspections.

C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

D. Remove and replace work that does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.4 CLEANING

A. Clean exposed surfaces of precast concrete units after erection to remove weld marks, other markings, dirt, and stains.

1. Wash and rinse according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes.

3.5 PROTECTION

A. Adjacent surfaces shall be protected from damage during sealing and cleaning operations and against damage, disfiguration or discoloration from subsequent operations. Noncombustible shielding shall be used during welding operations.

-END OF SECTION 03410-

[THIS PAGE INTENTIONALLY LEFT BLANK]

SECTION 05500

MISCELLANEOUS METALS

PART 1 – GENERAL

1.1 DESCRIPTION

A. This Section includes the following:

1. Furnishing, installing, and testing all miscellaneous metalwork and appurtenances complete in accordance with the Contract Documents.

1.2 RELATED TECHNICAL SECTIONS

A. Section 01600 – PRODUCTS, MATERIALS, AND EQUIPMENT

B. Section 02980 – SITE IMPROVEMENTS

B. Section 03300 – CONCRETE

C. Section 03315 – GROUT

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS:

1. Shop Drawings of all miscellaneous metalwork used in the Work showing materials, sizes, finishes, locations, attached hardware and fittings, and details for manufactured items and fabricated metalwork, including grating span charts, field erection details showing cuts, copes, connections, holds, thread fasteners and welds. Indicate welds, both shop and field, by symbols conforming to AWS standards. Indicate coatings or other protection against corrosion.

2. Manufacturer's literature describing standard items.

3. Setting diagrams, erection plans, templates and directions for installing of backing plates and anchors.

4. Statement stating that all materials, finishes and load requirements conform to the Contract Documents.

5. Anchor Submittals

a. Submit an ICC-ES or IAPMO-UES report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor.

b. Submit an ICC-ES or IAPMO-UES report listing the ultimate load capacity in tension and shear for each size and type of concrete anchor.

c. Upon review by the ENGINEER, these instructions shall be followed specifically.

d. No substitution for the indicated anchors will be considered unless accompanied with an ICC-ES or IAPMO-UES report verifying strength and material equivalency.

e. Complete structural calculations and anchorage details shall be prepared and submitted by the Contractor for all anchors and anchor groups that are shown but not completely detailed (type, size, location, spacing and embedment) on the Contract Documents. Calculations and anchorage details shall be signed and stamped by a Professional Engineer registered in the state in which the project is located.

1.4 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified

1. Welders Qualifications: All weld procedures and welder qualifications shall be available in the Contractor's field office for the Owner's review.

2. All welding shall be inspected by a Contractor-provided inspector qualified in accordance with AWS requirements and approved by the Owner.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Steel:

1. Wide Flange Shapes: ASTM A992

2. Shapes, Plates, Bars: ASTM A36

3. Pipe, Pipe Columns: ASTM A 53, Type E or S, Grade B Standard weight unless noted otherwise

4. Tubes: ASTM A 500 Grade B

5. Unless otherwise indicated, miscellaneous metalwork of fabricated steel, which will be submerged shall be hot-dip galvanized after fabrication. All other miscellaneous steel metalwork shall be coated or protected from corrosion with a specified protective coating.

B. Stainless Steel:

1. Unless otherwise indicated, stainless steel metalwork and bolts shall be of Type 316 stainless steel and shall not be galvanized.

2. Shapes and Bars: ASTM S276

3. Type (or Grade) 316L for Welding

C. Aluminum: Unless otherwise indicated, aluminum metalwork shall be of Alloy 6061-T6. Aluminum in contact with concrete, masonry, wood, porous materials, or dissimilar metals shall have coated contact surfaces.

D. Cast Iron: Unless otherwise indicated, iron castings shall conform to the requirements of ASTM A 48, Class 50B or better.

2.2 IRON CASTINGS

A. Iron castings shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage, distortion, or other defects. They shall be smooth and well cleaned by shotblasting.

B. Covers shall fit within their respective frames so that the cover fits flush with the surrounding finish surface and so that the cover does not rock or rattle when loading is applied. Covers and frames shall have machined bearing surfaces.

C. Covers with matching frames shall be designed to support the following loadings:

1. Where located within a structure, the design loading shall match that required for the adjacent floor area, or, if no loading is given, a minimum of 300 pounds per square foot, unless indicated otherwise.

2. Exterior covers and grates shall be designed for AASHTO HS20 loading unless indicated otherwise.

2.3 ACCESS HATCHES

A. Configuration

1. Hatch opening sizes, number and swing direction of door leaves, and locations shall be as indicated.

2. Indicated sizes are for the minimum clear opening. Provide hatches with increased clear opening as necessary.

3. Where the number of leaves is not indicated, openings larger than 42 inches in either direction shall be provided with double-leaf doors.

4. Unless indicated otherwise, hinges shall be located on the longer dimension side.

B. General

1. Hatch hardware shall be Type 316 stainless steel.

2. Hatches shall be provided with an automatic hold-open arm with release handle.

3. Hatch doors shall have an integral gasket.

C. Fabricated Steel Hatches

1. Hatches shall be fabricated from A36-GR50 steel, hot dip galvanized after fabrication.

2. The design live load shall be HL-93 minimum for direct low velocity traffic.

3. Door leaves shall be fabricated from a minimum of 1/4-inch thick checkered-pattern plate.

4. Channel frames shall be fabricated from a minimum 1/4-inch material with an anchor flange around the perimeter.

5. Hatches shall be designed to be water-tight and shall be equipped with a joint gutter, a moat-type edge drain, and drain piping of the length and size necessary to remove the drain water from all dry spaces accessed by the hatch.

6. A minimum 1-1/2 inch diameter drain connection shall be provided, located by the manufacturer.

7. Hatches shall be provided with a recessed hasp for a padlock covered by a hinged lid that is flush with the surface.

8. Hatches shall be provided with spring assist for hand operation.

9. Hatches shall be EJ Group, Acudor, US Fabrication or equal.

D. Fall Protection

1. Hatch nets shall be provided for all floor hatches conforming to OSHA requirements with a clear opening of 42" or less. Hatch nets shall be Hatch Net 121, as manufactured by Safe Approach, Inc, Auburn, ME, or equal.

2. For larger hatch openings, provide hinged removable safety grates integral to the hatch assembly.

2.4 BOLTS AND ANCHORS

A. Corrosive Service: All bolts, nuts, and washers shall be Type 316 stainless steel for all areas indicated below.

1. All buried locations.

2. All submerged locations.

3. All locations subject to seasonal or occasional flooding.

4. Inside hydraulic structures below the top of the structure.

5. Inside buried vaults, manholes, and structures which do not drain through a gravity sewer or to a sump with a pump.

6. All locations subject to continuous or intermittent wetting or spraying other than weather.

7. All locations indicated by the Contract Documents or designated by the Owner to be provided with stainless steel bolts.

B. Non-Corrosive Service: All bolts nuts and washers used in locations not identified in Paragraph 2.4.A, shall satisfy the following.

1. All bolts, anchor bolts, nuts, and washers shall be Type 304 stainless steel, class 2, conforming to ASTM A 193 for bolts and to ASTM A 194 for nuts.

C. Bolt Requirements:

1. The bolt and nut material shall be free-cutting steel.

2. The nuts shall be capable of developing the full strength of the bolts. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads. All bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.

3. All bolts and nuts shall be installed with washers fabricated of material matching the base material of bolts, except that hardened washers for high strength bolts shall conform to the requirements of the AISC

Specification. Lock washers shall be installed with washers where indicated and shall be fabricated of material matching the bolts.

4. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 1/2-inch beyond the nut.

5. All threads on stainless steel bolts shall be protected with an anti-seize lubricant, shall be classified as acceptable for potable water use by NSF and suitable for submerged stainless steel bolts, to meet government specification MIL-A-907E.

6. Buried bolts in poorly drained soil shall be coated the same as the buried pipe.

D. Adhesive Anchors: Unless otherwise indicated, all drilled, concrete or masonry anchors shall be adhesive anchors. Any substitutions must be accompanied by an ICC-ES or IAPMP-UES report verifying strength and material equivalency.

1. Epoxy adhesive anchors are required for drilled anchors where exposed to weather, in submerged, wet, splash, overhead, and corrosive conditions, and for anchoring pumps and other equipment. Epoxy anchor grout shall comply with Section 03315 – GROUT. Threaded rod shall be Type 316 stainless steel.

E. Expanding-Type Anchors: Expanding-type anchors, if indicated or permitted, shall be steel expansion type (lead caulking anchors will not be permitted) and the size indicated. Expansion type anchors which are to be embedded in grout may be steel. Non-embedded, buried, or submerged anchors shall be stainless steel. Expanding-type anchors shall be similar to a style typified by Kwik Bolt TZ by Hilti Corporation, Strong-Tie Strong Bolt 2 by Simpson, Power-Stud+SD1 by Powers or an approved equal.

PART 3 – EXECUTION

3.1 FABRICATION AND INSTALLATION REQUIREMENTS

A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

B. Install fabricated products in accordance with manufacturer written instructions.

3.2 WELDING

A. Method: All welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook"

as supplemented by other pertinent standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards governing same.

B. Quality: In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall be as indicated by the AWS Code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. All sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.3 GALVANIZING

A. All structural steel plates shapes, bars and fabricated assemblies required to be galvanized shall, after the steel has been thoroughly cleaned of rust and scale, be galvanized in accordance with the requirements of ASTM A 123. Any galvanized part that becomes warped during the galvanizing operation shall be straightened. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

B. Field Repairs

1. Field repairs to damaged galvanizing shall be performed by preparing the surface and applying a coating.

2. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.

3. The coating shall be applied to at least 3 mils dry film thickness, and shall be Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide, or equal.

3.4 DRILLED ANCHORS

A. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill, cleaned and dry. Drilled anchors shall not be installed until the concrete has reached the specified 28-day compressive strength. Adhesive anchors shall not be loaded until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

B. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars.

C. All abandoned drilled holes shall be filled with Epoxy Anchor Grout.

- END OF SECTION 05500-

SECTION 07160

BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Cold applied, cut-back (asbestos-free) bituminous dampproofing applied to the following surfaces:

a. Apply dampproofing to exterior below grade surfaces of new concrete walls and slabs.

b. Exterior, below-grade surfaces of all new manholes and drain structures.

c. Exterior, below-grade surfaces of other concrete items specified.

B. Bituminous dampproofing can be factory applied, providing the application meets coating manufacturer's requirements. Additional field coatings must be applied, as directed by Engineer, to repair any coating imperfections, and chipped or damaged areas.

1.2 RELATED TECHNICAL SECTIONS

A. Section 02251 – MANHOLES

B. Section 03300 – CATCH BASINS

C. Section 03410 – PLANT PRE-CAST STRUCTURAL CONCRETE

1.3 SUBMITTALS

A. Submit the following in accordance with Section 01300 – SUBMITTALS

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

2. For informational purposes only, submit recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

3. Material Certificates signed by manufacturers.

1.3 QUALITY CONTROL

A. Provide in accordance with Section 01400 – QUALITY CONTROL and as specified.

B. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.4 DELIVERY, STORAGE AND HANDLING

A. Provide in accordance with Section 01600 – PRODUCTS, MATERIALS AND EQUIPMENT.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

C. Allow a minimum of 48 hours for drying before backfilling, unless a greater drying period is recommended by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cold-Applied, Cut-Back (Solvent-Based) Bituminous Dampproofing shall be:

a. Karnak 83 AF by Karnak Corporation,

b. Sealmastic by Meadows, W. R., Inc.,

c. Waterban 50 by Lambert Corporation,

d. Or equal.

2.2 BITUMINOUS DAMPPROOFING (ASBESTOS-FREE)

A. Cold-Applied, Cut-Back (Solvent-Based) Bituminous Dampproofing:

1. Brush and Spray Coats: ASTM D 4479, Type I.

2. Trowel Coats: ASTM D 4586, Type I.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturers' written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated and shall be applied to subsequent coat(s).

2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coat(s).

B. Apply dampproofing to all exterior below grade concrete surfaces.

1. For application on structures extending above grade, apply from finished-grade line down.

3.4 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. On all dampproofing applications: Apply two brush or spray coats at not less than 1.25 gallons/100 feet² for first coat and 1 gallons/100 feet² for second coat, or one trowel coat at not less than 4 gallons/100 feet².

3.5 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 07160

SECTION 15252

FLAP GATES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install flap gates in the locations shown, complete and operable, including frames, transition pieces, bracing, mountings, gaskets or sealant, coatings, as indicated and specified.

1.2 RELATED WORK

A. Division 1 - General Requirements

B. Section 05500 – Miscellaneous Metalwork

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Section 01300 – Submittals.

1. Shop and erection drawings stamped and signed by a Massachusetts Registered Professional Engineer.

2. Data regarding valve characteristics and performance.

3. Shop drawing data for accessory items.

4. Manufacturer's literature as needed to supplement data.

5. Operating and maintenance manuals.

6. Recommendations for short- and long-term storage.

1.4 SPECIAL REQUIREMENTS:

A. Refer to applicable specification Sections with regard to providing the following:

1. Lubricants.

2. Special Tools.

3. Bolts, Anchor Bolts, and Nuts as specified in Section 05500 – Miscellaneous Metalwork.

1.5 QUALITY ASSURANCE

A. Equipment Field Testing

1. The CONTRACTOR shall coordinate and conduct a hydrostatic test for each flap gate in the presence of a manufacturer's factory service representative. Attendance by the manufacturer's factory service representative shall be furnished by the CONTRACTOR.

2. The hydrostatic test shall maintain a downstream head pressure equal to the maximum possible condition of service (i.e. flooded manhole) and an upstream head pressure of zero for a minimum of 60 minutes. Leaks exceeding 0.1 GPM per foot of wetted seal shall be corrected by adjusting and servicing the gate. The gate shall be retested until found to be satisfactory.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Provide in accordance with the General Conditions and Manufacturer's recommendations.

B. Shipping:

1. Ship equipment and material fully assembled except where partial disassembly is required by transportation regulations or for protection of components.

PART 2 - PRODUCTS

2.1 FLAP GATES

A. Type:

1. Hinged, single flap type design to close tight whenever downstream pressure exceeds upstream pressure with fully-adjustable double pivot points.

2. Gate frames shall have flat backs for attachment to wall thimbles, unless otherwise shown.

3. Resilient Seals, the material shall be suitable for contact with wastewater.

4. Unless otherwise shown, flap gates shall be mounted against wall thimbles with Type 316 stainless steel bolts and sealant or gaskets.

B. Materials:

1. Body and Flap: 316L Stainless Steel construction,

2. Seat: Resilient seal; material selected to be compatible with wastewater.

3. Hinge Arms: 316L Stainless Steel

4. Hinge Pins: Designed in double shear, Type 316 stainless steel.

C. Fabrication:

1. Flap: Spherical dished design, size to withstand maximum operating loads.

2. Hinge Arm: Provide two pivot points. Provide an adjustable lower pivot with limited rotation and a threaded upper hinge post to adjust flap valve sensitivity.

3. Provide a lubrication fitting for each pivot.

4. Ends: 125lb. ANSI standard drilling.

D. Transition Piece

1. Material: 316L Stainless Steel

2. The thimbles shall be of the cast iron F-pattern type, to match the thickness of the walls in which they are installed, and they shall be supplied by the manufacturer of the flap gate, to match the bolt dimensions of the valves.

3. One-piece construction, of section to withstand all operational and installation stresses.

4. Provide a water stop cast around the periphery of the transition piece.

5. Provide a machined front flange and provide tapped holes for the flap valve attaching studs.

6. Provide a permanent gasket of uniform thickness or mastic between the flap valve and the wall thimble.

7. Transition pieces shall be fabricated to fit the curved inside of the existing manholes as shown on the drawings.

E. Protective Coatings:

1. Provide all ferrous metals except stainless steel with a high solids epoxy

coating for submerged service. Prep surfaces in accordance with SSPC-SP-10 and apply one primer coat and one top coat. Total dry film thickness shall be a minimum of 8 mils.

F. Manufacturers:

1. Whipps series 452 (316 SST)

2. Rodney Hunt series A-611

3. Waterman series SSF-41

PART 3 - EXECUTION

3.1 INSTALLATION

A. Flap gates shall be installed in strict accordance with the manufacturer's printed recommendations and the requirements herein.

B. Contractor to verify dimensions required for fabrication and installation of transition piece flush mounted to inside of structure.

C. Mounting of Gates

1. Apply grout as necessary to manhole to create a flat surface for mounting the flap gate.

2. Shortly before setting each gate, apply a 1/8-inch-thick layer of mastic grade polysulfide elastomeric sealant to the back of the gate frame.

3. After setting the gate, the nuts shall be turned down on the anchor bolts far enough only to make them snug and to cause the rubber sealant to begin to ooze out, but not far enough to produce any significant stress to the frame.

4. Excess sealant at the edges shall be removed.

5. The sealant shall be allowed to cure for at least 7 Days, after which the anchor bolt nuts shall be tightened to their final positions.

6. If gaskets are being used, they shall be installed over the studs in one piece, or dovetailed and cemented with a liquid-type gasket material.

D. Damage to surface coatings incurred during shipment or installation shall be repaired.

- END OF SECTION 15252 -

SECTION 16050

ELECTRICAL WORK, GENERAL

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall provide electrical Work, complete and operable, in accordance with the Contract Documents.

B. The provisions of this Section apply to all sections in Division 16, except as indicated otherwise.

C. The Work of this Section is required for operation of electrically-driven equipment provided under specifications in other Divisions. The Contractor's attention is directed to the requirement for proper coordination of the Work of this Section with the Work of equipment specifications.

D. Concrete, excavation, backfill, and steel reinforcement required for encasement, installation, or construction of the WORK of the various sections of Division 16 is included as a part of the WORK under the respective sections, including duct banks, manholes, handholes and equipment housekeeping pads.

E. All electrical work, including installation of raceways, shall be completed by a licensed electrician.

1.2 REFERENCE STANDARDS

NEC (NFPA 70)	National Electrical Code – 2023 edition
NETA	International Electrical Testing Association
NEMA 250	Enclosure for Electrical Equipment (1000 Volts Maximum)

Massachusetts Electrical Code

A. Electrical equipment shall be listed by and shall bear the label of Underwriters' Laboratories, Inc. (UL) or an independent testing laboratory acceptable to the local code enforcement agency having jurisdiction.

B. Installation of electrical equipment and materials shall comply with OSHA Safety and Health Standards (29 CFR 1910 and 29 CFR 1926, as applicable), state building standards, and applicable local codes and regulations.

C. Where the requirements of the specifications conflict with UL, NEMA, NFPA, or other applicable standards, the more stringent requirements shall govern.

1.3 SIGNAGE AND MARKINGS

A. Identification: Provide danger, caution, and warning signs and equipment identification markings in accordance with applicable federal and state OSHA and NEC requirements.

B. Warning Signs

1. Six hundred volts nominal, or less: Entrances to guarded locations that contain live parts shall be marked with conspicuous signs prohibiting unqualified persons from entering.

1.4 PUBLIC UTILITIES REQUIREMENTS

A. The Contractor shall contact serving utility company and verify compliance with requirements of adding a new service to the existing utility transformer before performing work on this contract.

B. Electrical service shall be as indicated and be as required by the serving utility – Eversource Energy. All Work shall be performed in strict accordance with Eversource Energy requirements.

C. The Contractor shall verify with the utility the location of each new service point and type of service and shall pay any charges levied by the serving utilities as part of the Work.

D. Cellular service for this facility is by Verizon. The Contractor shall contact Verizon prior to performing Work on this Contract.

1.5 PERMITS AND INSPECTION

A. Permits shall be obtained, and inspection fees shall be paid according to the General Conditions.

1.6 CONTRACTOR SUBMITTALS

A. Shop Drawings: Include the following for all enclosures, panels and equipments as applicable:

1. Complete lists stating manufacturer and brand name of each item or class of material.

2. Low voltage conductors (600V or less), terminations and lugs.

3. Grounding and Bonding including not specifically indicated.

4. EV chargers and associated components

5. Handholes

6. Underground ducts, detectable tape and all other underground structures

7. Conduits, Location of conduit entrances and access plates.

8. Hangers, fittings, and supports.

9. Overcurrent protection devices, shunt trips, pushbuttons and surge protective devices.

10. Wiring device and light fixtures.

11. Electrical cabinets, panels, enclosures, associated components and mounting hardware.

12. Paint finish.

13. Catalog cuts or photocopies of applicable pages of bulletins or brochures for mass produced non-custom manufactured material. Catalog data sheets shall be stamped to indicate the project name, applicable Section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the Engineer stamp.

B. Shop Drawings shall be custom prepared. Drawings or data indicating "optional" or "as required" equipment are not acceptable. Options not proposed shall be crossed out or deleted from Shop Drawings.

C. Materials and Equipment Schedules: The Contractor shall deliver to the Engineer within 30 Days of the commencement date in the Notice to Proceed, a complete list of materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

D. Technical Manuals: Complete information in accordance with Section 01300.

E. Record Drawings: The Contractor shall show invert and top elevations and routing of duct banks and concealed below-grade electrical installations. Record drawings shall be prepared, be available to the Engineer, and be submitted according this to Section.

1.7 ENCLOSURE DESIGNATIONS

A. General

1. Raceway system enclosures shall comply with Section 16110 - Electrical Raceway Systems.

2. Electric Work specifically indicated in sections within any of the specifications shall comply with the requirements of those sections unless indicated otherwise.

B. Material Requirements

1. NEMA 3R enclosures shall be 304 Stainless Steel.

2. NEMA 3R, NEMA 1 and NEMA 12 enclosures shall be custom painted per owners preferred color (dark green). Painting shall be in conformance with Section 16050 – Electrical Work General.

1.8 TESTS

A. The Contractor shall be responsible for factory and field tests required by specifications in Division 16 and by the Engineer or other authorities having jurisdiction. The Contractor shall furnish necessary testing equipment and pay costs of tests, including replacement parts and labor, due to damage resulting from damaged equipment or from testing and correction of faulty installation.

B. Where test reports are indicated, proof of design test reports for mass-produced equipment shall be submitted with the Shop Drawings, and factory performance test reports for custom-manufactured equipment shall be submitted and be approved prior to shipment. Field test reports shall be submitted for review prior to Substantial Completion.

C. Equipment or material that fails a test shall be removed and replaced or if the Engineer approves, may be repaired and retested for compliance. Corrections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be done in a manner that does not void the warranty.

1.9 CONSTRUCTION SEQUENCING

A. Work shall be scheduled, subject to Owner’s approval. The Contractor shall submit a written request, including sequence and duration of activities to be performed during plant shutdown.

B. Extreme caution shall be exercised in digging trenches to not damage existing underground utilities. Costs of repairs of damages caused during construction shall be the Contractor's responsibility as a part of the Work.

C. The Contractor shall visit the Site before submitting a Bid to better acquaint itself with the Work of this Contract. Lack of knowledge will not be accepted as justification for extra compensation to perform the Work.

PART 2 – PRODUCTS

2.1 GENERAL

A. Equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. Equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the Work shall be products of the same manufacturer. Equipment and materials shall be of industrial grade standard of construction.

B. NEMA enclosure types shall be provided as indicated.

2.2 MOUNTING HARDWARE

A. Miscellaneous Hardware

1. Nuts, bolts, and washers shall be type 304 Stainless Steel.

2. Threaded rods for trapeze supports shall be continuous threaded, stainless steel, 3/8" diameter minimum.

3. Strut for mounting of conduits and equipment shall be type 304 Stainless Steel. Where contact with concrete or dissimilar metals may cause galvanic corrosion, suitable non-metallic insulators shall be utilized to prevent such corrosion. Strut shall be as manufactured by Unistrut, B-Line, or approved equal.

4. Anchors for attaching equipment to concrete walls, floors, and ceilings shall be 304 stainless steel expansion anchors, such as "Rawl-Bolt," "Rawl-Stud" or "Lok-Bolt" as manufactured by Rawl, similar by Star, or approved equal. Wood plugs shall not be permitted.

2.3 INDIVIDUALLY ENCLOSED CIRCUIT BREAKERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Square D

2. ABB General Electric

3. Eaton Cutler Hammer

4. Siemens

5. Or approved equal

B. Breakers shall be quick-make, quick-break, thermal-magnetic molded case breakers.

C. Enclosures

1. Provide enclosure at installed locations with the following environmental rating:

a. Indoor, dry and clean locations: NEMA 250, Type 1

2. Breaker enclosures shall be designed to permit breaker to be padlocked in the "open" position.

D. Number of poles and trip ratings of breakers shall be as indicated on the drawings. Unless otherwise indicated, breakers shall have a minimum RMS interrupting capacity matching or exceeding that of the upstream distribution equipment.

E. Provide shunt trip where noted.

2.4 ELECTRICAL CABINET

A. Manufacturers: Mass Electrical Apparatus or approved equal.

B. Material: 0.125 5052-H32 Aluminum.

C. NEMA Type: 3R Rating.

D. Ventilation on roof and door.

E. Open Bottom.

F. Stainless steel full length piano hinge.

G. Single door design with captive door restraint and Corbin lock.

H. Stainless steel padlockable handle, 3-point latching mechanism with nylon rollers at top and bottom.

I. Door frame double flanged on all four sides.

J. 12GA steel black powder coated white.

K. Cabinet finish: natural aluminum mill finish.

L. U.L. Listed.

2.5 PANELBOARDS

A. General

1. Provide panelboards constructed in accordance with NEMA Standard PB1 and which bear the UL service entrance label.

2. Provide panelboard enclosures as follows:

   a. General interior – NEMA 1 enclosure.

   b. Exterior work - NEMA 3R enclosure.

3. Panelboard enclosures shall contain front hinged to box.

4. Indicate circuit number on or adjacent to circuit breakers and provide a typed circuit directory on the inside of panelboard doors which clearly describes the loads served by breakers. Also provide the following information on the directory:

   a. Panel designation

   b. Voltage, Phase and Amps

   c. AIC rating

   d. Feeder and conduit size

   e. Feeder source and overcurrent protection size.

5. Provide panelboards with copper bus.

B. Subject to compliance with requirements, provide products by one of the following:

1. Square D

2. ABB General Electric

3. Eaton

4. Siemens

5. Or approved equal.

C. Provide bolt-on thermal-magnetic circuit breakers.

D. Provide common trip type two or three-pole breakers. Single pole units with a handle tie are not acceptable. Provide multi-pole breakers for all multiwire branch circuits.

2.6 WIRING DEVICES

A. Toggle switches, pushbuttons and receptacles shall be by Hubbell, Pass & Seymour, Leviton, or approved equal.

1. Switches:

   a. Toggle type.

   b. Back and side wired.

   c. Industrial Grade.

   d. 20 amperes.

   e. 120-277 volts.

   f. Illuminated and non-illuminated.

   g. Clear color for illuminated type. White color for non-illuminated type.

2. Receptacles:

   a. NEMA 5-20.

   b. Back and side wired.

   c. Industrial Grade.

   d. 20 amperes.

   e. 120 volts.

3. Pushbuttons:

   a. Flushed actuator with red round button

   b. Back and side wired.

   c. Industrial Grade and Weather-Proof.

   d. Normally Open (NO).

   e. 24 volts.

   f. Surface mounting.

g. Clear color for illuminated type. White color for non-illuminated type.

B. Wiring Device Cover Plates:

a. Galvanized steel rated for use in outdoor environment.

2.7 CABINET LIGHTING FIXTURES

A. Manufacturers: Lithonia Lighting, Cooper Lighting, or approved equal.

B. Type: Light Emitting Diode (LED).

C. Lumens: 500-800 lumens.

D. Color Temperature: 4000K.

E. CRI (Color Rendering Index): CRI 90.

F. Mounting type: surface-mounted fixtures.

G. Lifespan: Fixtures shall be 35,000 hours or more.

2.8 SURGE PROTECTIVE DEVICES (SPD)

A. Subject to compliance with requirements, provide products by one of the following:

1. Square D

2. ABB General Electric

3. Eaton Cutler Hammer

4. Siemens

5. Or Approved Equal

B. SPD units shall be designed for use in parallel connection applications. Series systems that are limited to system current will not be acceptable.

C. SPD units shall conform to the following environmental and operating conditions:

1. Frequency: 60 Hz

2. Voltage: 480V

3. Surge protection current rating: 300kA

D. SPD units for downstream locations (distribution or branch level) shall be rated as Type 2.

E. SPD units shall be equipped with a 3-pole breaker to serve as a maintenance disconnect.

F. SPD units not integrally mounted in the electrical equipment shall be housed in a NEMA 1 enclosure (indoor), or NEMA 3R enclosure (outdoor).

G. Where external units are provided, they shall be mounted as close as possible to the bus being protected. In no case shall lead lengths exceed 36".

2.9 ELECTRICAL IDENTIFICATION

A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica Type ES-1 or approved equal. Each shall be fastened securely, using fasteners of brass, cadmium-plated steel, or stainless steel, screwed into inserts or tapped holes as required. Engraved characters shall be block style with no characters smaller than 1/8-inch top to bottom.

B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or approved equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or approved equal.

PART 3 – EXECUTION

3.1 GENERAL

A. Incidentals: The Contractor shall provide materials and incidentals required for a complete and operable system, even if not required explicitly by the Contract Documents. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

B. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of conduit runs, equipment, and other items. Exact locations shall be determined by the Contractor in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations on the Drawings, however, shall be followed as closely as possible.

1. Where conduit development drawings or "home runs" are indicated, the Contractor shall route the conduits in accordance with those

requirements. Routings shall be exposed or encased as indicated, except that conduit in finished areas shall be concealed unless specifically indicated otherwise. Conduits encased in a slab shall be sized for conduit OD to not exceed one-third of the slab thickness and be laid out and spaced to not impede concrete flow.

2. Conduit and equipment shall be installed in such a manner as to avoid obstructions. Where the Drawings do not indicate exact locations, such locations will be determined by the Engineer. If equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner.

C. Workmanship: Materials and equipment shall be installed in strict accordance with printed recommendations of the manufacturer. Installation shall be accomplished by workers skilled in the WORK. Installation shall be coordinated in the field with other trades to avoid interferences.

D. Protection of Equipment and Materials: The Contractor shall fully protect materials and equipment against damage from any cause. Materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. Moving parts shall be kept clean and dry. The Contractor shall replace or refinish damaged materials or equipment, including faceplates of panels and switchboard sections as part of the Work.

3.2 PANELBOARDS

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Install filler plates in unused spaces.

3.3 WIRING DEVICES

A. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for device boxes with routers that are guided by riding against outside of boxes.

B. Clean boxes prior to installation of devices.

C. When conductors larger than what is recommended for termination by the manufacturer are installed, splice #12AWG pigtails for device connection. Do not exceed box fill requirements.

D. Install ground pin of vertically mounted receptacles (up)(down), and on horizontally mounted receptacles to the (right)(left).

3.4 ENCLOSED CIRCUIT BREAKERS

A. Coordinate layout of breakers to maintain required workspace clearances and clearances/access for equipment access door and panels.

3.5 CORE DRILLING

A. The Contractor shall perform core drilling required for installation of raceways through concrete walls, floors and pads. Locations of penetrations, as may be required, shall be based on field conditions. Verify exact core drilling locations based on equipment actually furnished as well as exact field placement. To the extent possible, identify the existence and locations of encased raceways and other piping with the Owner prior to any core drilling activities. Damage to any encased conduits, wiring, and piping shall be repaired as part of the Work. Seal all openings after new Work is installed.

3.6 EQUIPMENT ANCHORING

A. Floor-supported, wall, or ceiling-hung equipment and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the project is located. Wall-mounted panels that weigh more than 500 pounds or that are within 18-inches of the floor shall be provided with fabricated steel support pedestals. If the supported equipment is a panel or cabinet enclosed within removable side plates, it shall match supported equipment in physical appearance and dimensions.

B. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as Shop Drawings under Section 16050.

3.7 EQUIPMENT IDENTIFICATION

A. General: Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for terminal block groupings, circuit breakers, control and instrumentation panels, starters, switches, and pushbutton stations. In addition to nameplates, control devices shall be equipped with standard collar-type legend plates.
2. Control devices within enclosures shall be identified as indicated. Identification shall be similar to the subparagraph above.
3. Toggle switches that control loads out of sight of switches and multi-switch locations of more than 2 switches shall have suitable inscribed finish plates.

4. Equipment names and tag numbers, where indicated on the Drawings, shall be utilized on nameplates.

5. The Contractor shall furnish typewritten circuit directories for circuit breakers; circuit directory shall accurately reflect the outlets or equipment connected to each circuit.

6. Termination points on terminal blocks shall be labeled by identifiers on the blocks. Identifiers shall be preprinted by the terminal manufacturer or custom-printed. Hand lettered markers will not be acceptable.

3.8 PAINTING

A. Remove rust, scale, grease, and dirt from structure & allied equipment and leave ready for painting.

B. Apply primer to each surface, unless specifically not required by coating manufacturer.

C. Apply coatings of primer to specified thicknesses per manufacturer's instructions.

D. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish.

E. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

F. Equipment specified with factory baked enamel finish shall be touched up as required to provide a surface visually free of scratches, nicks, and blemishes.

G. Paint the equipment to provide maximum protection against corrosion. Match the finish as indicated.

3.9 CLEANING

A. Before final acceptance, the electrical WORK shall be thoroughly cleaned. All cement, plaster, and other materials shall be completely removed from exposed surfaces. Temporary tags, markers, stickers, etc. shall be removed. Adhesive residue, oil and grease spots shall be removed with a non-flammable solvent that dries completely after use. Such surfaces should be carefully wiped and cracks and corners cleaned out. Touch-up paint shall be neatly applied to scratches on panels and cabinets. Electrical cabinets and enclosures shall be thoroughly vacuum cleaned.

B. Debris and refuse from cleaning shall be appropriately disposed of off-site.

C. Determined by the Engineer.

END OF SECTION 16050

SECTION 16110

ELECTRICAL RACEWAY SYSTEMS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Provide electrical raceway systems, complete and in place, in accordance with the Contract Documents.

B. All raceways shall be installed by a licensed electrician.

1.2 RELATED WORK

A. Division 1 - General Requirements

B. Section 16050 – Electrical Work, General

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Section 01300 – Submittals.

1. Shop Drawings: Submit Shop Drawings as specified below and in accordance with Section 16050 – Electrical Work, General

a. Complete catalog cuts of all raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.

PART 2 -- PRODUCTS

2.1 GENERAL

A. Pull and junction boxes, fittings, and other indicated enclosures which are dedicated to the raceway system, shall comply with the requirements of this Section.

2.2 CONDUIT

A. Rigid PVC Coated Galvanized Steel (RPGS) Conduit

1. The conduit, prior to PVC coating, shall meet the requirements for RGS conduit above.

2. A PVC coating shall be bonded to the outer surface of the galvanized conduit. The bond between the coating and the conduit surface shall be greater than the tensile strength of the coating.

3. PVC coating thickness shall be not less than 40 mils.

4. PVC coated RGS shall be manufactured in accordance with the following standards:

   a. UL-6

   b. ANSI C80.1

   c. NEMA RN1 - PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

5. Manufacturers

   a. Robroy

   b. Ocal

   c. Or approved equal

B. Electrical Metallic Tubing (EMT) or Intermediate (IMC) conduit will not be accepted.

C. Rigid Non-Metallic Conduit

1. Rigid non-metallic conduit shall be Schedule 40 PVC, sunlight resistant.

2. Rigid PVC conduit shall be manufactured in accordance with NEMA TC-2 - Electrical Plastic Tubing and Conduit, and UL-651 - Standard for Rigid Non-metallic Conduit standards.

3. Manufacturers

   a. Carlon

   b. Condux

   c. Or approved equal

2.3 FITTINGS AND BOXES

A. General

1. Cast fittings for use with metallic conduit shall be the threaded type with five full threads.

2. Fittings and boxes shall have neoprene gaskets and non-magnetic stainless steel screws. All covers shall be attached by means of holes tapped into the body of the fitting. Covers for fittings attached by means of clips or clamps will not be acceptable.

3. Boxes larger than standard cast types shall be 304 stainless steel, NEMA 3R.

4. In outdoor areas, conduit shall be terminated in raintight hubs as manufactured by Myers, O.Z. Gedney, or equal. In other than outdoor areas, sealed locknuts and bushings shall be used.

5. Conduit, fittings, and boxes in hazardous locations shall be suitable for the Class and Division indicated.

6. Below grade conduit fittings shall be provided with precision machined tapered threads and a molded Santoprene (or equal) seal designed to create watertight union.

B. PVC Fittings and Boxes

1. Fittings for use with rigid non-metallic conduit shall be PVC, solvent welded type.

2. Boxes shall be PVC or fiberglass reinforced polyester (FRP).

3. Manufacturers

   a. Carlon

   b. Crouse-Hinds

   c. Hoffman

   d. Or approved equal

4. Provide all welding solvent as required for installation of non-metallic conduit and fittings.

C. PVC Coated Fittings

1. Fittings for use with PVC coated RGS shall be PVC coated and shall be products of the same manufacturer as the conduit.

D. Stainless Steel Boxes

1. Stainless steel boxes shall be used with PVC coated RGS conduit and where indicated.

2. Stainless steel boxes shall be NEMA 3R, Type 304.

3. Stainless steel shall be minimum 14-gauge thickness, with a brushed finish.

4. Doors shall have full length stainless steel piano hinges. Non-hinged boxes are not acceptable.

5. Manufacturers

a. Hoffman

b. Rohn

c. Hammond

d. Or approved equal

2.4 HANDHOLES AND BOXES UNDERGROUND WIRING

A. Description: Comply with SCTE 77 for load rating of enclosure and cover.

1. Composite Handhole and Cover: Eversource handhole and cover shall be H20 rated and city handhole shall be tier 22 rated.

2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.

3. Handhole shall meet the requirements of The City of Cambridge and MassDOT Standard Specifications Section M4.02.14. Covers shall be clearly marked “ELECTRIC”.

4. Cover: Nonskid, weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

5. Cover Legend: Molded lettering, suited to type of service.

6. Size: Where not indicated on Drawings, provide handholes sized per National Electrical Code to accommodate conduit entry and cable bending space required.

7. All Handholes will have a ground rod installed in the handhole. Ground Rods will be 5/8" diameter by 10'-0" long, minimum.

PART 3 - EXECUTION

3.1 GENERAL

A. Raceways shall be installed between equipment as indicated. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, and shall be accomplished with tools designed for this purpose. Factory elbows shall be utilized wherever possible.

B. Where raceway routings are indicated on plan views, the Contractor shall follow those routings to the extent possible.

C. Where raceways are indicated but routing is not shown, such as home runs or on conduit developments and schedules, raceway routings shall be the Contractor's choice and in strict accordance with the NEC, customary installation practice. Raceway shall be encased, exposed, concealed, or under floor as indicated.

D. Routings shall be adjusted to avoid obstructions. Coordinate with all other trades prior to installation of raceways. Lack of such coordination shall not be justification for extra compensation, and removal and re-installation to resolve conflicts shall be at no extra cost to the Owner.

E. All exposed raceways shall be installed at least 1/2-inch from walls or ceilings except that at locations above finished grade where damp conditions do not prevail, exposed raceways shall be installed 1/4-inch minimum from the face of walls or ceilings by the use of clamp backs or struts.

F. Wherever contact with concrete or dissimilar metals can produce galvanic corrosion of equipment, suitable insulating means shall be provided to prevent such corrosion.

3.2 CONDUIT

A. All exposed conduit shall be RPGS.

B. All conduit concealed, buried, or encased in concrete shall be Schedule 40 PVC except as noted otherwise. Where conduit emerges from concrete encasement, a RPGS elbow shall be utilized for transition from the concrete. Conduit shall emerge from the concrete perpendicular to the surface whenever possible. Conduit that transitions from the concrete pad to the electrical hand hole shall be RPGS.

C. Exposed conduit shall be 3/4-inch minimum trade size. Encased conduit shall one-inch minimum trade size. Supports shall be installed at distances required by the NEC.

D. Encased conduit shall have outer diameters not exceeding 1/3 of the concrete slab thickness. Encased conduit shall be routed between reinforcing bars.

E. All threads shall be coated with a conductive lubricant before assembly.

F. Joints shall be tight, thoroughly grounded, secure, and free of obstructions in the pipe. All conduit shall be adequately reamed to prevent damage to the wires and cables inside. Strap wrenches and vises shall be used to install conduit to prevent wrench marks on conduit. Conduit with wrench marks shall be replaced at no additional cost to the Owner.

G. Wherever possible, conduit runs shall slope to drain at one or both ends of run. Wherever conduit enters substructures below grade, the conduit shall be sloped to drain water away from the structure. Extreme care shall be taken to avoid pockets or depressions in conduit.

H. All conduit, fittings, and boxes required in hazardous classified areas shall be suitably rated for the area and shall be provided in strict accordance with NEC requirements.

END OF SECTION 16110

SECTION 16120

WIRES AND CABLES

PART 1 -- GENERAL

1.1 DESCRIPTION

A. Provide wires and cable, complete and operable, in accordance with the Contract Documents.

B. Installation of wires and cables shall be completed by a licensed electrician.

1.2 RELATED WORK

A. Division 1 – General Requirements

B. Section 16050 – Electrical Work, General

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Section 01300 – Submittals.

1. Shop Drawings: Submit Shop Drawings in accordance with Section 16050 – Electrical Work, General

PART 2 -- PRODUCTS

2.1 GENERAL

A. All conductors, include grounding conductors, shall be copper. Aluminum conductor wire and cable will not be permitted. Insulation shall bear UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. All conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. All wiring shall have wire markers at each end and in all intermediate pull and junction boxes.

2.2 LOW VOLTAGE WIRE AND CABLE

A. Power and Lighting Wire

1. All wire rated for 600 volts in duct or conduit for all power circuits shall be Class B Type THHW OR THWN cross-linked polyethylene conforming to UL-44-UL Standard for Safety Rubber Insulated Wires and Cables.

2. Wiring for 600 volt class power shall be as manufactured by Southwire, General Cable, Okonite, or approved equal.

B. Control Wire

1. Control wire in duct or conduit shall be the same type as power wire indicated above.

2. Control wiring shall be No.14 AWG.

3. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations, and be as manufactured by American, Carol Cable, or equal.

C. Instrumentation/Signal Cable

1. Instrumentation cable shall be rated at 600 volts.

2. Individual conductors shall be No. 16 AWG stranded, tinned copper. Insulation shall be color coded polyethylene: black-clear for two-conductor cable.

3. Instrumentation cables shall be composed of the individual conductors, an aluminum polyester 100% coverage foil shield, a No. 18 AWG stranded tinned copper drain wire, and a PVC outer jacket.

4. Two conductor shielded cable shall be UL 2106 Type as manufactured by Belden, Alpha, or equal.

2.3 CABLE TERMINATIONS

A. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Statek", or equal. Threaded connectors, and pressure type, twist-on connectors will not be acceptable.

B. Pre-insulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.

C. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip-knot", or equal. High temperature tape shall be polyvinyl as manufactured by Plymouth, 3M, or equal.

D. Labels for coding all 600 volt wiring shall be computer printable or pre-printed, self laminating, self sticking as manufactured by W.H. Brady, 3M, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

A. The Contractor shall provide and terminate all power, control, and instrumentation conductors except where indicated.

3.2 INSTALLATION

A. Conductors shall not be pulled into raceway until raceway has been cleared of moisture and debris.

B. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

C. Instrumentation wire shall not be run in the same raceway with power and control wiring except where specifically indicated.

D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.

3.3 SPLICES AND TERMINATIONS

A. General

1. All wire taps and splices shall be properly taped and insulated according to their respective classes.

2. In general, there shall be no cable splices in underground handholes. Splices in underground handholes may be made only with the approval of the Engineer.

3. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.

4. Excess control and instrumentation wire shall be properly taped and terminated as spares.

5. Below grade vault cable and wire splices shall be made using 3M Scotchcast Inline Resin Splice Kits or approved equal.

B. Control Wire and Cable

1. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment.

2. In junction boxes, and control panels, all control wire and spare wire shall be terminated to terminal strips.

C. Instrumentation Wire and Cable

1. Shielded instrumentation cables shall be grounded at one end only, preferably the receiving end on a 4-20 mA system.

2. Two-conductor shielded cables installed in conduit runs which exceed 2,000 feet may be spliced in pullboxes. Such cable runs shall have only one splice per conductor.

D. Power Wire and Cable

1. All 120/240/480 volt branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor in accordance with NEC requirements.

3.4 CABLE IDENTIFICATION

A. General: Wires and cables shall be identified for proper control of circuits and equipment and to reduce maintenance effort.

B. Identification Numbers: The Contractor shall assign to each control and instrumentation wire and cable a unique identification number as directed by the Engineer. Numbers shall be assigned to all conductors having common terminals and shall be shown on all "as built" drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes.

1. Multi-conductor cable shall be assigned a number which shall be attached to the cable at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above.

2. The 120/240/480-volt system conductors shall be color coded as follows: Line 1-Black, Line 2-Red, and Neutral-White. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green,

and neutral shall be gray. Color coding and phasing shall be consistent throughout the Site, bus bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.

3. General purpose AC control cables shall be red. General purpose DC control cables shall be blue.

4. All spare cable shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.

5. Terminal strips shall be identified by computer printable, cloth, self-sticking strips attached under the terminal strip.

3.5 TESTING

A. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements of ICEA Publication No. S-68-516 - Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. Factory test results shall be submitted in accordance with the requirements of the Special Conditions prior to shipment of cable. The following field tests shall be the minimum requirements:

1. All cables rated at 600 volts shall be tested for insulation resistance between phases and from each phase to a ground using a megohmeter.

2. All field testing shall be done after cables are installed in the raceways.

3. Field tests shall be performed by a certified test organization acceptable to the cable manufacturer. Test results shall be submitted to the Engineer for review and acceptance.

4. Cables failing the tests shall be replaced with a new cable or be repaired. Repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.

B. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed after installation and prior to placing cables in service.

END OF SECTION 16120

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16130

EV CHARGING STATIONS

PART 1 -- GENERAL

1.1 DESCRIPTION

A. Furnishing, installing and start-up of EV Charging Stations, complete and operable, in accordance with the Contract Documents.

1.2 RELATED WORK

A. Section 16050 – Electrical Work, General

1.3 SUBMITTALS

A. General: Submit the following in accordance with Section 01300 – Submittals.

1. Complete shop drawings for EV Charging Station.

2. Submit manufacturer's recommended installation procedures for informational purposes.

1.4 DELIVERY, STORAGE AND HANDLING

A. Contractor shall take care in protecting the EV Charging Stations prior to, and following, installation.

PART 2 -- PRODUCTS

2.1 SINGLE HEAD EV CHARGING STATION PRODUCT REQUIREMENTS

A. Electrical Input

1. The input current shall be 30A for each charger.

2. The input power connection shall be an independent 40A branch circuit for each charger.

3. The required service panel breaker shall be 40A 2-pole (non-GFCI shunt trip type) for each charging port.

B. Electrical Output

1. The electrical output shall be 7.2kW (240V AC@30A) for each charge port.

C. Functional Interfaces

1. The type of connectors installed shall be SAE J1772.

2. The cable lengths shall be minimum 23 feet.

3. Overhead Cable Management System, Card Reader, and Locking Holsters shall be implemented.

D. The station enclosure shall be NEMA 3R with operating temperature range between -40 F to 122 F.

E. The station shall be bollard mounted configuration.

F. EV Charging Station shall be CT4000 Level 2 Commercial Charging Station manufactured by ChargePoint, or approved equal.

2.2 DUAL HEAD EV CHARGING STATION PRODUCT REQUIREMENTS

B. Electrical Input

4. The input current shall be 30A for each individual branch circuit. Provide two branch circuits for dual port system.

5. The input power connection shall be an independent 40A branch circuit for each charging port.

6. The required service panel breaker shall be 40A 2-pole (non-GFCI type) for each charging port.

B. Electrical Output

2. The electrical output shall be 7.2kW (240V AC@30A) for each charge port.

C. Functional Interfaces

4. The type of connectors installed shall be SAE J1772

5. The cable lengths shall be minimum 23 feet.

6. Overhead Cable Management System, Card Reader, and Locking Holsters shall be implemented.

G. The station enclosure shall be NEMA 3R with operating temperature range between -40 F to 122 F.

H. The station shall be bollard mounted configuration.

I. EV Charging Station shall be CT4000 Level 2 Commercial Charging Station manufactured by ChargePoint, or approved equal.

PART 3 -- EXECUTION

3.1 INSTALLATION

A. Installation shall comply with manufacturer's installation guide and as shown on the Plans.

END OF SECTION 16130

THIS PAGE INTENTIONALLY LEFT BLANK

SECTION 16135

ROADWAY LIGHTING INFRASTRUCTURE

PART 1 - GENERAL

1.1 Summary

A. Work includes the furnishing and installation of street lighting fixtures and poles, removal and relocation of existing street lights, light pole foundations, conduit, handholes, and wiring at locations indicated in the Contract Documents. Conduits in sidewalks and roadways shall be concrete encased. This work shall be performed in accordance with the Massachusetts Electrical Code and as required in the Contract Documents

B. Work required to furnish and install handholes and light pole foundations for lighting shall be in accordance with Section 801 of the Mass DOT Standard Specifications and as required in the Contract Documents.

C. Work required to furnish and install ground rods and wiring shall conform to the requirements of Section 813 of the Mass DOT Standard Specifications and as required in the Contract Documents.

D. Conduits between lighting control enclosures or utility manhole to electric hand holes or lighting control enclosures shall be 4 inches.

E. Conduits between hand holes and light bases or receptacles shall be 2 inches, or as indicated on the drawings.

PART 2 - PRODUCTS

2.1 Electric Conduit

A. Rigid non-metallic conduit and fittings shall be high-quality polyvinyl chloride conduit (PVC). PVC conduit shall be heavy-wall Type 40, shall conform to industry standards and Commercial Standard CS207-60, shall be listed by Underwriters' Laboratories for direct burial underground use, and shall conform to or exceed all property requirements of UL651 and NEMA TC-2, 1970. All conduit shall be furnished with plain ends.

B. Concrete for encasement shall be 3,000 psi / 3/8 inch / 565 per MassDOT Standards.

2.2 Handholes

A. Precast handhole units for lighting shall be 12”W x 24”L x 20” D and shall otherwise meet the requirements of The City of Cambridge and Mass DOT Standard Specifications Section M4.02.14. Covers shall be clearly marked “LIGHTING”. EV Precast handhole shall be marked “ELECTRICAL”,

2.3 Light Foundations (Standard Precast)

A. Precast units shall meet the requirements of Mass DOT Standard Specifications Section M4.02.14.

B. Steel reinforcing bars shall be deformed bars rolled from new billet steel conforming to the requirements of ASTM A615, Grade 60.

C. The Contractor shall provide 2" rigid galvanized steel conduit to stub out of base.

D. Anchor bolts for installation of light pole per manufacturer's recommendations.

2.4 Lamp Posts and Luminaires

A. Light poles, arms and luminaires shall match the City of Cambridge standards and specifications.

B. Contractor shall furnish and install all lamp posts and luminaires as indicated and as specified on the drawings.

2.5 Ground Rod

A. A 10-foot long, 3/4 inch copper-clad ground rod shall be provided for all light control enclosures, light fixture foundations and handholes. The minimum size grounding conductor shall be No. 4 AWG with an approved type connection at each ground rod and light fixture foundation. All steel conduit where used shall be bonded. The grounding conductor shall be continuous and where connections are made, pressure connectors suitable for the purpose shall be used. The conductor shall provide connection between the associated handhole cover frame and the ground rod and between the handhole ground rod and the lighting pole foundation. This connection will be made with an exothermic weld.

2.6 Wiring

A. The minimum size wire from the circuit breaker to all hand holes shall be Three (3) No.4 A.W.G. type THHN copper. 1 Black, 1 White and 1 No.4 A.W.G. THHN copper. Green for grounding conductor

B. The minimum size wire from the handholes to each light fixture luminaire, shall be two No. 10 A.W.G. type THHN copper for each service and one No. 10 A.W.G. type THHN copper for grounding. 1 Black, 1 White and 1 Green for grounding conductor

C. The minimum size wire from the handholes to each receptacle mounted at top of light pole, shall be two No. 10 A.W.G. type THHN copper for each service and one No. 10 A.W.G. type THHN copper for grounding. 1 Black, 1 White and 1 Green for grounding conductor

D. The minimum size grounding conductor from handhole or light fixture to ground rod shall be No. 4 AWG THHN copper with an approved type connection at each ground rod and light fixture.

E. Wires shall be continuous where practicable and where splices are made pressure connectors suitable for the purpose shall be used.

2.7 Lighting Control Equipment

A. The astronomic timer switch shall be rated 125 VAC, 1- pole, 20 Amp and be manufactured by Tork, Paragon or equal.

B. The photocell shall be rated 125 VAC, 20 Amp and be manufactured by TORK or equal.

PART 3 - EXECUTION

3.1 Electrical Conduit

A. The Perimeter of the paved area to be removed for conduit installation shall be sawcut.

B. The depth of excavation shall be sufficient to allow passing the conduit beneath curb as necessary and encasing the conduits as specified herein and as shown on the plans. Conduits shall have a minimum of thirty inches (30") of cover in the public way. Any deviation from this requirement must be approved by the City of Cambridge Electrical Department and Engineer prior to installation.

C. A 6-inch wide magnetic marker tape shall be placed approximately one-foot above underground conduit. This tape shall be colored and serve as a warning device to personnel who may be involved in future excavations that electrical cable is located below and should be avoided if possible. It will serve as a general warning that hand digging is required beyond this point in order that the rigid non-metallic conduit below the tape is not damaged or otherwise penetrated.

D. PVC conduit shall be jointed by means of solvent cement joints. Conduit shall be cut square and deburred. All surfaces shall be wiped clean and dry. Using a natural bristle brush of width about equal to conduit size, the Contractor shall apply a coat of cement to the outside of the conduit end. (Note: Cement should be flowed on and not brushed out). Conduit and coupling shall then be firmly pressed together and the fitting turned a quarter turn to distribute the cement evenly. The time elapsed between applying the cement and completing the joint should not exceed 60 seconds. All conduit and fittings shall be watertight.

E. All conduits shall be free of foreign materials prior to the installation of conductors

F. A polypropylene or nylon pull rope shall be installed in all empty conduits.

G. Conduits shall be sealed after installation, prior to placing concrete encasement and installing conductors.

3.2 Handhole

A. In general, the locations of lighting handholes are shown diagrammatically on the drawings. When a handhole is required, it is the intent that a lighting handhole with ground rod be located at or near each proposed light installation. Handhole determinations shall be made by the Cambridge Electrical Department.

B. Handhole must be installed prior to the streetlight control cabinet for the service connection. No conductors other than the service entrance conductors shall be permitted in this handhole.

3.3 Light Standard Foundation (Precast)

A. All foundations shall be installed at the location as shown on the plan except as approved deviations are required to meet field conditions. All locations must be approved by the Engineer prior to installation.

B. Contractor to coordinate with the City of Cambridge Electrical Department for type of anchor bolts to be used for securing the existing light poles to the precast foundations.

C. All foundations will be set plumb and true to grade.

D. The Contractor shall carefully mark the proposed location of the concrete foundation and then shall determine if any utilities or underground or overhead obstruction will prevent the installation at these locations. Similar marking shall be done for the conduit runs to the foundation. If such an obstruction is evident, the Contractor shall request permission from the Engineer to move or adjust the location of the foundation.

E. If no obstruction is apparent at the proposed foundation location, the Contractor shall make an excavation in order to install the foundation as detailed on the drawings, to be accomplished with hand digging. Mechanical excavating equipment may be used if approved by the Engineer. The Contractor must provide a compacted 6-inch cushion of gravel borrow under the foundation and shall backfill using acceptable excavated material or gravel borrow compacted in 6-inch layers around the foundation. A compaction of 95% for the backfill material of the excavation is required.

F. The backfill shall be thoroughly compacted by tamping with a pneumatic hammer equipped with a round dirt tamping pad with a minimum diameter of 6-inches driven by an air compressor with a minimum of 100 psi pressure.

G. . Use of a vibrator type compactor around pre-cast foundations or handholes is prohibited.

H. If the Contractor encounters no difficulty in the excavation and the soil conditions are suitable to support the foundation, the Contractor shall install the pre-cast concrete foundation. The top of the foundation must be level and installed as indicated on the detail plans. If difficulty is encountered in excavation due to underground obstructions, ledge, rock or when, in the opinion of the Engineer, the soil conditions require, the Contractor may install an approved precast short foundation or cast-in-place foundation with the approval of the Engineer.

I. Where foundations are placed adjacent to straight sections of roadway curb, the bolts and face of foundation shall be parallel with the face of the curb. When adjacent to curved curb, the bolts may be adjusted with the approval of the Engineer to allow proper placement of the pole when installed.

3.4 Installation of Lighting Fixtures

A. Furnish and install a complete lighting system, including conduit, wire, outlet boxes, lighting fixtures with lamps, receptacles, and switches as required.

B. Where job conditions require locations different from those shown to avoid equipment, etc., such changes shall be made without additional cost to the Owner.

C. All fixtures shall be furnished complete with sockets, wiring, trims, hangers, frames, lamps, etc.

D. Each streetlight pole shall be provided with its own separate ground rod adjacent to its foundation and bonded to the pole's grounding lug as shown on the Drawings. Install luminaires with the correct optical system orientation, socket position and inclination angle to meet the specified photometric requirements. Align luminaires vertical and perpendicular (or tangent) to the centerline of the street, install new lamps, and clean luminaire components of all construction dirt and dust and fingerprints prior to final completion.

E. Handle lighting fixtures carefully to prevent breakage, denting or scoring of fixtures' finishes. Do not install damaged lighting fixtures. Replace with undamaged units and return damaged units to equipment manufacturer. Install luminaire, fusing and wiring complete. Install a wattage identification sticker inside the pole handhole. No other identifying numbers except the manufacturer's nameplate shall be installed on the poles or arms or luminaries.

F. Splices and junctions shall be made only in pole handholes and underground handhole junction boxes. Perform no more splices than needed. Do not splice or junction any wires that continue through a pole or junction box, in other words, those conductors without a termination to the adjacent pole. Use Junction box as a pulling point only. Cable pulled through poles or junction boxes shall be marked per the following paragraph and shall have sufficient loop to extend 18" beyond handhole or junction box lid for future maintenance but shall not be spliced. All splices in junction boxes shall be made waterproof by a UL listed heat shrink splice cover. All splices and junctions shall be considered incidental to the pay item.

G. Install a tie wrap type permanent wire marker on each and every pair of conductors passing through every junction box or pole handhole (bundle circuit pairs together). Mark controller number, circuit letter and pole number on each tie wrap and designate home runs as encountered. Install markers in each pole handhole.

3.5 Ground Rod

A. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

3.6 Wiring

A. The Contractor shall be required to furnish and install all materials, equipment and labor necessary to completely wire and operate the street lighting system. All materials and wiring procedures shall conform to the specifications contained herein and to the requirements and standard practices of the Section 800 and the following:

All wire and connectors shall conform to the standards of the National Electrical Manufacturers Association or the Underwriters' Laboratories, Inc., whichever is applicable. All materials and workmanship shall conform to the requirements of the Mass Electrical Code, Standards of the American Society for Testing and Materials, and any local ordinances that may apply. Wherever any reference is made to the standards mentioned above, the reference should be construed to mean the standard that is in effect on the day the Notice to Proceed to the Contractor for the work is dated. Wire sizes shall be based on American Wire Gage (AWG), as applied to copper conductors.

B. Runs of wire and cable from the handholes to each light fixture shall be continuous with no splices except as required for branch connections. Splices, where required, shall be made in the handholes with compression type fittings suitable for the application. Shop drawings of the compression splice fittings shall be submitted for approval, by the Engineer, prior to any order being placed.

C. No wire shall be drawn in to any conduit until all work that may cause damage to the wire is complete.

D. All wire terminals, taps and splices shall be made secure with connectors, splicing materials and methods as hereinafter specified.

E. All incoming wires and outgoing wires in lighting load centers, handholes and poles shall be banded as indicated on the contract drawings.

3.7 Grounding

A. Coatings and rust on conduits and grounding rods shall be removed at the location where the ground fittings are to be installed.

B. The bare copper conductor shall be connected to the continuous insulated bonding lead, which shall be identified with green plastic marking tape as noted in the specifications. Bonding leads for lighting fixtures on poles shall be an insulated #10 AWG, marked green, which shall be extended to the nearest handhole and interconnected to the bare copper ground wire in the handhole of gauge shown on the contract drawings and the pig tail conductor shall be connected to the ground rod. The ground wire shall also connect to the ground lug on the handhole frame and be bonded to the handhole cover.

C. A conductor with the same insulation of the power leads shall be installed in all conduits as a continuous bond wire. All bonding leads from fixtures, pole, control boxes, fittings and ground rods shall be connected to the continuous insulated bonding lead which shall be identified with green plastic marking tape as noted in the specifications.

D. All grounding shall conform to the applicable provisions of the National Electrical Code.

E. Field Tests

1. Upon the completion of each wiring system, and before any connection is made to operating equipment, the Contractor shall perform, in the presence of the Engineer, the following tests of each circuit to determine whether the installations are in acceptable working order.

    a. Tests for continuity

    b. Tests for ground

    c. Tests for insulation resistance (Megger Test) from circuit wires to ground, and between circuit wires.

2. Tests for ground shall be performed in accordance with the relevant provisions of Section 813 of the Standard Specifications. The entire electrical wiring system shall be tested for

continuity, grounds, resistance to ground, insulation, shorts and opens. This shall be done by means of a megohm meter test.

3. After installation of the wiring system is complete with the required splices, the lamp ballast primary shall be disconnected and each circuit shall be tested with a 1000 volt megger. Tests on each circuit shall be between each conductor. When the measured value is less than 200 megohms between two conductors, the Contractor shall locate the point or points at fault, make proper corrections, and then demonstrate by further test the elimination of such faults.

4. These tests shall be performed in the presence of the Engineer.

5. The test results shall be submitted to the Engineer for review and approval. If any results are questionable or inconsistent, the Contractor shall repeat the tests and make any necessary corrections at the request of the Engineer. No wiring system will be accepted until these are satisfactorily performed and approved.

6. The Contractor shall furnish the Engineer with a report of the megohm-meter readings for a permanent project record.

7. All tests and any necessary repairs or replacements that are indicated by the Engineer to produce a fault-free system will be performed at the Contractor's expense.

F. Warranties

1. The Contractor shall provide a performance warranty for twelve months on the entire work performed under this contract including the performance of all equipment and components of the roadway lighting system specified. The performance warranty responsibility of the contractor shall commence after official Project acceptance by the city of Cambridge or the Engineer.

2. NOTE: The Contractor shall be completely responsible for all maintenance, repairs and replacement of damaged equipment during the functional test and throughout the performance warranty period.

3. If within 48 hours after notification by the Engineer of a malfunction, and the Contractor fails to make such repairs as necessary, the Engineer will undertake repairs of which all costs are to be borne by the Contractor. The cost of any maintenance necessary, except electrical energy, shall be at the Contractor's expense and will be considered as included in the price paid for the contract item involved and no additional compensation will be allowed therefore.

3.8 Removal and Disposal of Existing Light Fixtures

A. The Contractor shall coordinate with City of Cambridge before starting any work. The work shall include temporarily disconnecting wiring, removing and stacking of luminaires at the Town’s DPW Yard, delivery to Cambridge Electrical Department (CED) Yard any aluminum poles requested for salvage by CED, removal and disposal of unwanted poles, foundations, conduit and hand holes no longer required for proposed installations, and repairing the disturbed area to match surrounding surfaces. In special case, the existing foundation and the like can be left in place, as approved by the Engineer. The Contractor shall exercise extreme caution when working near existing trees. The Contractor shall exercise extreme caution when removing and stacking the

existing luminaires so as not to damage them.

3.9 Lighting Control Equipment

A. Furnish and install all control wiring and devices, complete with all accessories as indicated on the Drawings and as specified hereunder. All control devices shall be the product of a single manufacturer except where specifically stated otherwise.

B. Lighting control equipment such as photocells, timers, circuit breakers shall be furnished and installed in existing lighting control cabinets to control the lighting as shown on the Drawings.

END OF SECTION 16135