SECTION 01570

TRAFFIC REGULATION

PART 1 GENERAL

1.01 DESCRIPTION

A. The work under this Section shall consist of maintaining and protecting traffic in the project area to the satisfaction of the applicable Local Regulatory Agencies, and the Owner.
   1. Unless otherwise specified within the Contract Documents, the Contractor must maintain pedestrian and vehicular traffic and permit access to businesses, factories, residences, and intersecting streets.

PART 2 PRODUCTS

2.01 TRAFFIC SIGNS

A. The Contractor shall furnish light(s) and maintain traffic signs as may be directed, or may be necessary for the safe regulation, or convenience of traffic.
   1. Said signs shall be as shown or noted on the Contract Drawings or elsewhere herein, or if not specified, they shall be adequate for the regulation, safety, and convenience of traffic and in conformance with the applicable requirements of the State/Federal Manual on Uniform Traffic Control Devices.

2.02 BARRICADES

A. Suitably lighted barriers or barricades shall be furnished by the Contractor and put up and maintained at all times during the night or daytime, around all open ditches, trenches, excavation, or other work potentially dangerous to traffic.
   1. Such barricades shall be as shown on the Contract Drawings, or if not shown, shall be constructed of 2 inch by 8 inch rough lumber, securely supported, braced and at least 3 feet high above the ground.
   2. Barricades shall be placed on all sides and throughout the entire length and breadth of all open ditches, trenches, excavations, or other work which must be barred to the general public.
   3. Barricades shall be properly painted to the satisfaction of the Local Regulatory Agency in order to retain a high degree of visibility to vehicular and pedestrian traffic.

2.03 FLASHERS

A. The Contractor shall furnish and securely fasten flashing units to signs, barricades, and other objects in such numbers and for such lengths of time as are required for the maintenance and protection of traffic.
   1. The flashers shall be in operation during all hours between sunset and sunrise, and during periods of low visibility.
   2. Suitably lighted barricades shall be defined as barricades lit by flashers in accordance with this Section or other lighting methods approved by the Local Regulatory Agency in lieu thereof.
   3. Flashers shall be placed along the entire length of the barricades at an interval no greater than 8 feet, center to center. Flashers shall be power operated, lens directed,

enclosed light units which shall provide intermittent light from 70 to 120 flashers per minute, with the period of light emittance occurring not less than 25 percent of each on-off cycle, regardless of temperature.

4. The emitted light shall be yellow in color and the area of light on at least one face of the unit shall be not less than 12 square inches. The discernible light shall be bright enough to be conspicuously visible during the hours of darkness at a minimum distance of 800 feet from the unit under normal atmospheric conditions.
5. For units which beam light in one or more directions, the foregoing specifications shall apply 10 degrees or more to the side and 5 degrees or more above and below the photometric axis.

2.04 TEMPORARY BRIDGING

A. The Contractor shall include in his bid, bridging for trenches at all street and driveway crossings in such manner as the Local Regulatory Agency may direct for the accommodation and safety of the traveling public, to provide facilities for access to private driveways for vehicular use, and to prevent blocking of intersecting traffic.

1. He shall erect suitable barriers around the excavation to prevent accidents to the public and shall place and maintain, during the night, sufficient lights on or near the work.
2. A space of 20 feet must be left so that free access may be had at all times to fire hydrants and proper precautions shall be taken so that the entrances to fire hydrants and fire stations shall not be blocked or obstructed.

2.05 DETOURS

A. Temporary detours shall be constructed on the site as proposed by the Contractor and approved by the Applicable State and/or Local Authorities required by the Contract Drawings or specified elsewhere herein.

1. Detours shall not have grades in excess of 10% anywhere along their lanes unless otherwise shown on the Contract Drawings. Detours shall be smooth riding.
2. Suitable barricades shall be installed continuously along both sides of a detour where:
   a. The adjacent side slope is steeper than 1 on 6 inches.
   b. The Contractor's operations or equipment may operate within 20 feet of the detour.
   c. Other unsafe conditions requiring them for the protection of traffic along the line of detour.

2.06 MISCELLANEOUS

A. The Contractor may be required to employ traffic persons and take other such reasonable means or precautions as the Local Regulatory Agency may direct, or as may be needed to prevent damage or injury to persons, vehicles, or other property, and to minimize the inconveniences and danger to the public by his construction operations.

PART 3 EXECUTION

3.01 CONTROL OF TRAFFIC

A. It shall be the sole responsibility of the Contractor to keep the Local Regulatory Agencies (including but not limited to the Police and Fire Departments) pre-warned at least 72 hours

in advance of changes in traffic patterns due to reduction of pavement widths or closing of streets.

B. The Contractor shall supply, install, maintain, adjust, move, relocate, and store all signs, suitably lighted barricades, traffic cones, and traffic delineators, as necessary to carry out the traffic routing plan and maintain vehicular and pedestrian traffic.
   1. All of this work shall meet with the requirements of the Local Regulatory Agencies.
   2. The Contractor shall maintain, relocate and operate barricades and flashers throughout the life of this Contract.

C. Should the Contractor or his employees neglect to set out and maintain barricades or lights, as required in these Specifications, the Owner immediately, and without notice, may furnish, install and maintain barricades or lights.
   1. The cost thereof shall be borne by the Contractor and may be deducted from any amount due or to become due to the Contractor under this Contract.

3.02 ACCESS TO PROPERTY AND UTILITIES

A. The Contractor shall arrange his operations to provide access to properties along the street including temporary bridges to driveways, and provide access to fire hydrants, manholes, gate boxes, or other utilities.
   1. Whenever any trench obstructs traffic in or to any public street, private driveway, or property entrance, the Contractor shall take such steps as required to maintain necessary traffic and access including temporary bridging if required.
   2. The Contractor shall confine his occupancy of public or traveled ways to the smallest space compatible with the efficient and safe performance of the work contemplated by the Contract.
   3. If the Contractor's operations or occupancy of any public street or highway, or the uneven surfaces over any trenches being maintained by the Contractor, interfere with the removal or sanding of snow or ice by the public authorities or adjoining land owners, in an ordinary manner with regular highway equipment, the Contractor shall be required to perform such services for the public authorities or adjoining owners without charge.
   4. If the Contractor fails to do so, he shall reimburse the said authorities or adjoining owners or the Owner for any additional cost to them for doing such work occasioned by conditions arising from the Contractor's operations, occupancy, or trench surfaces, together with any damage to the equipment of said parties by those conditions or claims of any parties for damage or injury or less by reason of failure to remove snow or ice or to sand icy spots under these conditions.
   5. The Contractor shall observe and obey all local and state laws, ordinances, regulations and permits in relation to the obstruction of streets and highways, keeping passageways open and protecting traffic where there may be danger from blasting or other construction activities.

B. The Contractor shall be held responsible for any damages that the Engineer, Owner, Governmental units, or their heirs or assigns may have to pay as a consequence of the Contractor's failure to protect the public from injury, and the same may be deducted from any payments that are due or may become due to the Contractor under this Contract.

END OF SECTION

SECTION 01572

UNIFORMED POLICE OFFICERS

PART 1 GENERAL

1.01 DESCRIPTION

A. The Contractor shall make all arrangements with the Town of Mansfield Chief of Police and/or the State Police for the services of Uniformed Police Officers.

PART 2 MATERIALS

2.01 The Town of Mansfield Chief of Police will assign Uniformed Police Officers from his department in the quantity and at the location(s) as determined to be necessary by the Chief of Police and as Uniformed Police Officers are available.

2.02 The local police/constables shall be uniformed including headgear, and equipped so as to be readily distinguishable as a traffic person/traffic director.

PART 3 EXECUTION

3.01 ARRANGEMENT

A. The Contractor shall make all arrangements with the Town of Mansfield Chief of Police and/or the State Police for the services of Uniformed Police Officers. If, in the opinion of the Chief of Police, Uniformed Police Officers are required for the protection of persons and control of traffic, the Contractor shall be responsible for making all arrangements with the Chief of Police as may be required.

3.02 PAYMENT

A. The Owner shall pay for all Uniformed Police Officers in the amount invoiced by the Chief of Police and/or the State Police for Uniformed Police Officers directly to the Police Department.

END OF SECTION

SECTION 01610

PRODUCT HANDLING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Protect products scheduled for use in the Work by means including, but not necessarily limited to, those described in this Section.

1.02 QUALITY ASSURANCE

A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.03 MANUFACTURER'S RECOMMENDATIONS

A. Comply with manufacturers' recommendations on product handling, storage, and protection.

1.04 PACKAGING

A. Deliver products to the job site in their manufacturer's original container(s), with labels intact and legible.
   1. Maintain packaged materials with seals unbroken and labels intact until time of use.
   2. Promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the Owner.

B. The Engineer may reject as non-complying such material and products that do not bear identification satisfactory to the Engineer as to manufacturer, grade, quality and other pertinent information.

1.05 PROTECTION

A. Mechanical equipment subject to damage by the atmosphere if stored outdoors, shall be stored in a building with a controlled environment. The building may be a temporary structure on the site or a building off the site.

B. PVC pipe shall be covered to protect it from UV degradation.

1.06 REPAIRS AND REPLACEMENTS

A. In event of damage, promptly make replacements and repairs to the approval of the Engineer at no additional cost to the Owner.

B. Additional time required to secure replacements and to make repairs will not be considered by the Engineer to justify an extension in the Contract Time of Completion.

END OF SECTION

SECTION 01650

FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

A. Reference Section 01445, Manufacturer's Services.

B. Correction Period: The Correction Period begins after the final acceptance test and the Owner accepts the Work as "Substantially Complete".

C. Facility Startup: Includes placing Project in operating order, cleaning, adjusting and balancing equipment, initial operation (startup) of equipment item, operating equipment, starting systems, operation of systems, testing of equipment and systems, and demonstration and verification of the completed facility as a unit.

D. Final Acceptance Test: Following the facility startup test and written acceptance by the Massachusetts Department of Environmental Protection (MassDEP) to pump treated water into the distribution system, the final acceptance test requires operation of the facility in the manner intended for 5 continuous days without significant interruption. This period is in addition to any training, functional, performance or facility startup test periods specified elsewhere. The Owner may operate the facility to its maximum capacity for the duration of the final acceptance test. A significant interruption will require the final acceptance test then in progress to be stopped and restarted after corrections are made.

E. Functional Test: A test or tests in the presence of Engineer to demonstrate that the installed equipment or system meets manufacturer's installation and adjustment requirements, and other requirements specified including, but not limited to, noise, vibration, alignment, speed, proper electrical and mechanical connections, thrust restraint, proper rotation, and initial servicing.

F. Performance Test: A test performed in the presence of Engineer and after any required functional test specified, to demonstrate and confirm that the equipment and/or system meets the specified performance requirements.

G. Significant Interruption: May include any of the following events:
1. Failure of Contractor to maintain qualified onsite startup personnel as scheduled.
2. Failure to meet specified performance for more than 3 consecutive hours or other duration specified.
3. Failure of any critical equipment unit, system, or subsystem that is not satisfactorily corrected within 3 hours after failure.
4. Failure of the same critical equipment unit, system, or subsystem more than two times for any duration.
5. Failure of noncritical unit, system, or subsystem that is not satisfactorily corrected within 8 hours after failure.
6. Failure of the same noncritical equipment unit, system or subsystem more than two times for any duration.
7. As may be determined by Engineer.

H. Facility Startup Test Period:
   1. Startup of the entire facility or any portion thereof includes coordinated operation of the facilities by Contractor, Subcontractors, Owner operating personnel, and manufacturer's representatives for equipment items and systems after all required functional tests have been completed and those performance tests deemed necessary for the safe operation of the entire facility have been completed.
   2. Startup of the entire facility or any portion thereof shall be considered complete when, in the opinion of Engineer, the facility or designated portion has operated in the manner intended for 7 continuous days without significant interruption. This period is in addition to any training, functional, or performance test periods specified elsewhere. A significant interruption will require the startup then in progress to be stopped and restarted after corrections are made.

I. Systems: The overall process, or a portion thereof, that performs a specific function. A system may consist of two or more subsystems as well as two or more types of equipment.

1.02 SUBMITTALS

A. Administrative Submittals:
   1. Functional and performance test schedules and plan for equipment, units, and systems at least 30 days prior to start of related testing. Include test plan, procedures, and log format.
   2. Schedule and plan of facility startup activities at least 30 days prior to commencement.

B. Quality Control Submittals:
   1. Manufacturer's Certificate of Proper Installation as required.
   2. Test Reports: Functional and performance testing, in format acceptable to Engineer and certification of functional and performance test for each piece of equipment or system specified.
   3. Certifications of Calibration: Testing equipment.

1.03 GENERAL CONTRACTOR FACILITY STARTUP RESPONSIBILITIES

A. General:
   1. Perform work for tests specified in individual Sections.
   2. Demonstrate proper installation, adjustment, function, performance and, operation of equipment, systems, control devices, and required interfaces individually and in conjunction with process instrumentation and control system.
   3. Provide sampling, labor, and materials as required and provide laboratory analyses.
   4. Provide water, power, and other items as required for testing, unless otherwise indicated.
   5. Furnish and install all equipment and provisions necessary to treat, dechlorinate and properly dispose of the water during the startup and testing period. Contractor shall discharge spent water to the site's stormwater management system provided measures are taken to prevent erosion and that the discharge does not adversely impact the function of the stormwater management system (i.e., rain events, standing water for more than 48 hours, etc.) or introduce heavily chlorinated water into the stormwater management system as detailed in Section 02675, Disinfection of Water Mains and Water Storage Facilities. Monitor the overall condition and

functionality of the stormwater management systems during this period and report any irregularities to the Engineer.

6. Provide labor to assist the Engineer and Owner with completion of a Contact Time Tracer Study for the clearwell at least 45 days prior to the anticipated startup of the WTP.

B. Contractor shall be responsible for all chemicals used during startup.

1. The Owner shall be responsible for furnishing all chemicals used in the treatment process unless otherwise stated in other Sections of these specifications.
   a. The Contractor shall notify the Owner a minimum of one month in advance of the anticipated startup date so as to allow sufficient time for ordering and delivery.
   b. The Contractor shall not hold the Owner accountable for any delays in the project due to the inability of the Owner to supply the chemicals when needed because of supplier delivery scheduling, or insufficient notification by the Contractor.
2. Upon satisfactory completion of startup, the Contractor shall reimburse the Owner for all chemical utilized based on the unit price for each chemical paid by the Owner.

C. Contractor shall also be responsible for all electricity and propane gas that is necessary during construction, start-up and testing of the project until the Owner has approved "Substantial Completion" of the facility.

D. Startup will not begin until all safety equipment has been furnished and is readily accessible for use, and all personnel safety systems have been tested and accepted (i.e.: ambient air analyzers and associated audio/visual alarms).

1.04 OWNER/ENGINEER FACILITY STARTUP RESPONSIBILITIES

A. General:

1. Review Contractor's test plan and schedule.
2. Witness each functional or performance test.
3. Coordinate other plant operations, if necessary, to facilitate Contractor's tests.
4. Coordinate and complete a Contact Time Tracer Study for the Clearwell at least 45 days prior to the anticipated startup of the WTP.

B. Facility Startup Test Period and Final Acceptance Test: Operate process units and devices, with support of Contractor.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 TESTING PREPARATION

A. General:

1. Complete work associated with the unit and related process before testing, including related manufacturer's representative services.

2. Furnish qualified manufacturer's representatives when required to assist in testing.
3. Document functional and performance procedures, results, problems, and conclusions.
4. Schedule and attend pretest (functional and performance) meetings related to test schedule, plan of test, materials, chemicals, and liquids required, facilities' operations interface, Engineer, and Owner involvement.
5. Designate and furnish one or more persons to be responsible for coordinating and expediting Contractor's facility startup duties. The person or persons shall be present during facility startup meetings and shall be available at all times during the facility startup and final acceptance test periods.
6. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required to conduct testing.
7. Furnish operator training on all specialized safety equipment (i.e.: emergency respirators, gas cylinder repair kits, etc,).
8. Verify availability and operation of all personnel safety systems and equipment.

B. Cleaning and Checking: Prior to starting functional testing:
1. Calibrate testing equipment for accurate results.
2. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
3. Lubricate equipment in accordance with manufacturer's instructions.
4. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
5. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
6. Check power supply to electric-powered equipment for correct voltage.
7. Adjust clearances and torques.
8. Test piping for leaks.
9. Balance HVAC systems, measuring airflow (cfm) static pressure, and component pressure losses. Furnish typed report documenting results of balancing.

C. Ready-to-test determination will be by Engineer based at least on the following:
1. Notification by Contractor of equipment and system readiness for testing.
2. Acceptable testing plan.
3. Acceptable Operation and Maintenance Manuals.
4. Receipt of Manufacturer's Certificate of Proper Installation, if specified.
5. Adequate completion of Work adjacent to, or interfacing with, equipment to be tested.
6. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
7. Equipment and electrical tagging complete.
8. All spare parts and special tools delivered to Owner.
9. Availability of personnel safety equipment and satisfactory operation of personnel safety systems.

3.02 FUNCTIONAL TESTING

A. General:
1. Begin testing at a time mutually agreed upon by Owner, Engineer, manufacturer's representative(s), and Contractor.

2. Notify in writing Owner, Engineer, and manufacturer's representative at least 30 days prior to scheduled date of functional tests.
3. Separate items of equipment demonstrated to function properly during subsystem testing may require no further functional test if documentation of subsystem testing is acceptable to Engineer.
4. Conduct functional test until each individual component item or system has achieved 1 continuous hour, or other specified duration, of satisfactory operation. Demonstrate all operational features and controls function during this period while in automatic modes.
5. If, in Engineer's opinion, each system meets the functional requirements specified, such system will be accepted as conforming for purposes of advancing to performance testing phase, if required. If, in Engineer's opinion, functional test results do not meet requirements specified, the systems will be considered as nonconforming.
6. Performance testing shall not commence until the equipment or system meets functional tests specified.

3.03 PERFORMANCE TESTING

A. General:
1. Begin testing at time mutually agreed upon by Owner, Engineer, manufacturer's representative(s), and Contractor, as appropriate.
a. Engineer will be present during test.
b. Notify Engineer and Owner at least 30 days prior to the scheduled date of the test.
2. Follow approved testing plan and detailed procedures specified.
3. Source and type of fluid, gas, or solid for testing shall be as specified.
4. Unless otherwise indicated, furnish all labor, materials, and supplies for conducting the test and take all samples and performance measurements.
5. Prepare performance test report summarizing test method. Include test logs, pertinent calculations, and certification of performance measurements.

3.04 FACILITY STARTUP TEST PERIOD

A. Test Reports: As applicable to the equipment furnished, certify in writing that:
1. Necessary hydraulic structures, piping systems, and valves have been successfully tested.
2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational.
3. Systems and subsystems are capable of performing their intended functions.
4. Facilities are ready for intended operation.

B. Attend planning meetings and arrange for attendants by key major equipment manufacturer representatives as required by the Contract Documents.

C. Designate and furnish one or more persons, other than the field superintendent, to be responsible for coordinating and expediting Contractor's facility startup duties.

D. When facility startup has commenced, schedule remaining Work so as not to interfere with or delay the completion of facility startup. Support the facility startup activities with adequate staff to prevent delays and process upsets. This staff shall include, but not be

limited to, major equipment and system manufacturers' representatives, subcontractors, electricians, instrumentation personnel, millwrights, pipefitters and plumbers.

E. Supply and coordinate specified manufacturer's facility startup services.

F. Make adjustments, repairs, and corrections necessary to complete facility startup.

G. After the facility is operating, complete the testing of those items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to startup test period.

H. At least 45 days prior to the anticipated startup of the WTP assist the Owner and Engineer with the completion of a Contact Time Tracer Study for the clearwell.

3.05 PARTIAL UTILIZATION

A. After successful performance testing of a particular equipment or system, Owner may elect to start up a portion of the equipment or system for continuous operation in accordance with Article 15.04 of the General Conditions. Such operation will not interfere with testing or other equipment and systems that may still be underway and shall not preclude the need to startup that portion operated in combination with the rest of the facility when testing is completed.

3.06 CONTINUOUS OPERATIONS

A. Owner shall request field review and written acceptance by the MassDEP, and the Contractor shall obtain an occupancy permit issued by the local Building Department only after successful facility startup is completed and documented, disinfection is complete, reports submitted, and manufacturer's services completed for testing and for training of Owner's personnel.

B. After receiving MassDEP approval to pump treated water into the distribution system and the occupancy permit, the final acceptance test can be conducted. MassDEP approval and the occupancy permit must be obtained before the final acceptance test can be conducted.

C. Following written approval by the MassDEP, obtaining an occupancy permit issued by the local Building Department, and completion of the final acceptance test, the Owner can accept the Work as "Substantially Complete". It is at the time of Substantial Completion that the 1-year minimum Correction Period shall begin for all portions of Work that have been accepted by Owner/Engineer.

D. Contractor shall be responsible for providing and incurring all costs associated with water, electricity, propane gas, chemicals, waste brine disposal, fuel, cable, fiber, and/or telephone service until the date of "Substantial Completion" by the Owner.
   1. All water treatment chemicals remaining in the respective tanks shall remain the property of Owner.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 DESCRIPTION

A. The work of this Section consists of procedures and requirements for contract closeout, such as cleaning, restoration of project site to original condition, inspections, and guarantees.

PART 2 MATERIALS (Not Applicable)

PART 3 EXECUTION

3.01 CLEANING UP

A. During its progress, the work and the adjacent areas affected thereby shall be kept cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

B. Where material or debris has washed or flowed into or been placed in water-courses, ditches, gutters, drains, catch basins, or elsewhere as a result of the Contractor's operations, such material or debris shall be entirely removed and legally disposed of during progress of the work, and the ditches, channels, drains, etc., kept in a neat, clean and functioning condition.

C. On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted in writing, remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operation in a neat and satisfactory condition.

D. Unless otherwise specifically directed or permitted in writing, the Contractor shall perform the following tasks:
   1. Tear down and remove all temporary buildings and structures built by him.
   2. Remove all temporary works, tools, and machinery or other construction equipment furnished by him.
   3. Remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses, and other buildings used by him.
      a. Subsequent to disinfection, remove or suitably neutralize disinfectant residuals from treated area(s).
   4. Remove all rubbish from any grounds which he has occupied.
   5. Leave roads and all parts of premises and adjacent property affected by his operations in a neat and satisfactory condition.

3.02 RESTORATION

A. The Contractor shall restore or replace, when and as directed by the Engineer, any public or private property damaged by his work, equipment, or employees, to a condition at least equal to that existing immediately prior to the beginning of operations.
   1. To this end, the Contractor shall do as required all necessary highway or driveway, walk, and landscaping work.
   2. Suitable materials, equipment, and methods shall be used for such restoration, or as required in other divisions of this Specification.

B. In restoring the disturbed areas the Contractor shall:
   1. Replace to an equivalent depth any loam that has been removed during the excavation.
   2. Remove from the property and legally dispose of in an approved fashion all trees, brush, and other items that the Contractor has cut in order to prosecute his work.
   3. Remove from the property upon completion of the work thereon, all excess materials of construction such as stone, pipe, concrete block, gravel, etc., that the Contractor may have stockpiled for use during the course of the work.
   4. Leave the land in a smooth, even condition. All ruts, holes or other undesirable grading conditions which resulted from work under this Contract shall be filled and the area so graded to eliminate ponding.
   5. All drainage course(s) shall be restored to their pre-existing condition or better.
   6. Reset all public or private monuments, iron pipes or other types of property line and geodetic markers damaged or disturbed by operations under this Contract. This work shall be done by a licensed land surveyor at no additional cost.
   7. Repair, reset or replace as directed all pipes, walls, utilities, fences, railings, stone walls, etc., and ornamental or utilitarian domestic accessories, such as, but not limited to, arbors, fireplaces, sheds and incinerators, or other surfaces, structures, or property which may have been damaged, either directly or indirectly by his operations under this Contract.
   8. Restore to a condition at least equal to that in which they were found immediately prior to the beginning of construction all sidewalks, gutters, driveways and curbs which have been damaged by the Contractor's operations.

3.03 FINAL INSPECTION

A. At completion of all work, the Owner and Engineer, along with the General Contractor and each of the subcontractors shall conduct a final inspection jointly for "punch list" purposes and to determine the exact status of the project before final acceptance.

3.04 GUARANTEES

A. The Contractor shall take notice of special guarantees required in the technical Sections of these Specifications.
   1. If, in the opinion of the Owner, any item requires excessive maintenance during guarantee periods, the item shall be considered defective and the Contractor shall correct the defects.
   2. All defects so corrected shall be at the expense of the Contractor.

END OF SECTION

SECTION 01710

CLEANING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Through the construction period, maintain the buildings and site in a standard of cleanliness as described in this Section.

B. Related Work:
1. Documents affecting work of this section include, but are not necessarily limited to, Sections in Division 1 of these Specifications.
2. In addition to standards described in this Section, comply with requirements for cleaning as described in pertinent other Sections of these Specifications.

1.02 QUALITY ASSURANCE

A. Conduct daily inspection, and more often if necessary, to verify that requirements for cleanliness are being met.

B. In addition to the standards described in this Section, comply with pertinent requirements of governmental agencies having jurisdiction.

1.03 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01610.

B. Promptly process and distribute required copies of test reports and related instructions to assure necessary re-testing and replacement of materials with the least possible delay in progress of the work.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

A. Provide required personnel, equipment, and materials needed to maintain the specified standard of cleanliness.

2.02 COMPATIBILITY

A. Use only cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by manufacturer of the material.

PART 3 EXECUTION

3.01 PROGRESS CLEANING

A. General:
   1. Retain stored items in an orderly arrangement allowing maximum access, not impending traffic or drainage, and providing required protection of materials.
   2. Do not allow accumulation of scrap, debris, waste material, and other items not required for construction of this Work.
   3. At least twice each month, and more often if necessary, completely remove all scrap, debris, and waste material from the job site.
   4. Provide adequate storage for all items awaiting removal from the job site, observing requirements for fire protection and protection of the environment.

B. Site:
   1. Daily, and more often if necessary, inspect the site and pick up all scrap, debris, and waste material. Remove such items to the place designated for their storage.
   2. Weekly, and more often if necessary, inspect all arrangements of materials stacked on the site. Restack, tidy, or otherwise service arrangements to meet the requirements of subparagraph 3.01-A-1 above.
   3. Maintain the site in a neat and orderly condition at all times.

C. Structures:
   1. Weekly, and more often if necessary, inspect the structures and pick up all scrap, debris, and waste material. Remove such items to the place designated for their storage.
   2. Weekly, and more often if necessary, sweep interior spaces clean.
      a. "Clean," for the purpose of this subparagraph, shall be interpreted as meaning free from dust and other material capable of being removed by use of reasonable effort and a hand-held broom.
   3. As required preparatory to installation of succeeding materials, clean the structures or pertinent portions thereof to the degree of cleanliness recommended by the manufacturer of the succeeding material, using equipment and materials required to achieve the necessary cleanliness.
   4. Following the installation of finish floor materials, clean the finish floor daily (and more often if necessary) at all times while work is being performed in the space in which finish materials are installed.
      a. "Clean," for the purpose of this subparagraph, shall be interpreted as meaning free from foreign material which, in the opinion of the Engineer, may be injurious to the finish floor material.

3.02 FINAL CLEANING

A. "Clean," for the purpose of this Article, and except as may be specifically provided otherwise, shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.

B. Prior to completion of the work, remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste. Conduct final progress cleaning as described in Article 3.01 above.

C. Site:
   1. Unless otherwise specifically directed by the Engineer, broom clean areas on the site and public paved areas adjacent to the site.
   2. Completely remove resultant debris.

D. Structures:
   1. Exterior:
      a. Visually inspect exterior surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.
      b. Remove all traces of splashed materials from adjacent surfaces.
      c. If necessary to achieve a uniform degree of cleanliness, hose down the exterior of the structure.
      d. In the event of stubborn stains not removable with water, the Engineer may require light sandblasting or other cleaning at no additional cost to the Owner.
   2. Interior:
      a. Visually inspect interior surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.
      b. Remove all traces of splashed material from adjacent surfaces.
      c. Remove paint droppings, spots, stains, and dirt from finished surfaces.
   3. Glass: Clean inside and outside.
   4. Polished surfaces: To surfaces requiring routine application of buffed polish, apply the polish recommended by the manufacturer of the material being polished.

E. Schedule final cleaning as approved by the Engineer to enable the Owner to accept a completely clean work.

3.03 CLEANING DURING OWNER'S OCCUPANCY

A. Should the Owner occupy the Work or any portion thereof prior to its completion by the Contractor and acceptance by the Owner, responsibilities for interim and final cleaning shall be as determined by the Engineer.

END OF SECTION

SECTION 01730

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section includes procedural requirements for compiling and submitting operation and maintenance data required to complete the project.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these Specifications.

1.03 SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. Equipment furnished under Divisions 11, 12, 13, 15 and 16 shall include the cost of a competent representative of the manufacturers of all equipment to supervise the installation, adjustment and testing of the equipment and to instruct Owner's operating personnel on operation and maintenance. This supervision may be divided into two or more time periods as required by the installation program or as directed by Engineer.

B. See the detailed specifications for additional requirements for furnishing the services of manufacturer's representatives.

C. A certificate in the form attached to this Section, from the manufacturer and signed by Owner's representative stating that the installation of equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation and that the operating personnel have been suitably instructed in the operation, lubrication and care of the unit, shall be submitted for each piece of equipment indicated above.

D. For all equipment furnished under other Divisions, furnish the services of accredited representatives of the manufacturer only when some evident malfunction or over-heating makes such services necessary in the opinion of Engineer.

1.04 OPERATING MANUALS

A. The manual for each piece of equipment furnished under Divisions 11, 12, 13, 15 and 16, and where otherwise specified, shall be a separate document with the following requirements:

Contents:

a. Table of contents and index.
b. Brief description of each system and components.
c. Starting and stopping procedures.
d. Special operating instructions.

e. Routine maintenance procedures identified in one schedule for all equipment included in the manual, with the maintenance schedule tabbed or listed in the table of contents for ease of reference.
f. Manufacturer's printed operating and maintenance instructions, parts list, illustrations and diagrams.
g. One copy of each wiring diagram.
h. One copy of each approved shop drawing and each Contractor's coordinating layout drawings.
i. List of spare parts, manufacturer's price, and recommended quantity.
j. Name, address and telephone numbers of local service representatives.

Material:
a. Originals or first generation, clear dry copy reproductions of all text.
b. Loose leaf on 60 lb., punched paper.
c. Holes reinforced with plastic cloth or metal.
d. Page size: 8-1/2" by 11"
e. Diagrams, illustrations, and attached foldouts as required, of original quality, reproduced by dry copy method.
f. Covers: oil, moisture, and wear resistant 9-inch by 12-inch size.
g. Tabs or dividers to clearly separate the different sections of the manual.

B. The manuals shall be customized in that all data that does not pertain to the equipment furnished shall be either deleted or crossed out.
1. Parts manuals shall be modified to reflect only those parts or optional equipment pertaining to the equipment furnished.
2. Copies of all required labor and material warranties/guarantees shall be bound in each manual.

C. All operations and maintenance manuals for equipment of the same type shall be bound in a single manual as follows, independent if equipment has been furnished by various suppliers:
a. All HVAC equipment.
b. All plumbing fixtures.
c. All centrifugal process pumps.
d. All vertical turbine pumps.
e. All electrical motor control centers, panel boards, etc.
f. Emergency generator and automatic transfer switch (if not furnished as part of the motor control center).
g. Recommended cleaning and maintenance procedures for architectural finishes (i.e.: wall and floor tiles, painted surfaces, acoustical ceilings, doors and windows, etc.).

D. Draft versions of each operation and maintenance manual shall be submitted to the Engineer for review in electronic format in accordance with Specification Section 01300 Submittals. Upon completion of the operation and maintenance manual submittal review, the Contractor shall submit a final version of the manual in electronic format and a minimum of two physical manuals to the Engineer.

1.05 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of project, names, addresses and telephone numbers of Engineer, subconsultants and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers; including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

E. Type Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.

F. Warranties and Bonds are to be as specified in these Specifications.

1.06 MANUAL FOR MATERIALS AND FINISHES

A. Building Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Provide information for re-ordering custom manufactured products.

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.

C. Moisture Protection and Weather Exposed Products: Include product data listing, applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

D. Additional Requirements: As specified in individual product specifications.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS

A. For each Item of Equipment and Each System provide the following:

1. Overview of system and description of unit or system and component parts. Identify function, normal operating characteristics and limiting conditions. Include performance curves, with engineering data and tests and complete nomenclature and commercial number of replaceable parts.
2. Panelboard Circuit Directories including electrical service characteristics, controls and communications and color coded wiring diagrams as installed.
3. Operating Procedures: Include start-up, break-in and routine normal operating instructions and sequences; regulations, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.
4. Maintenance Requirements:

a. Routine procedures and guide for trouble-shooting; disassembly, repair and reassemble instructions; and alignment, adjusting, balancing and checking instructions.
b. Servicing and lubrication schedule and list of lubricants required.
c. Manufacturer's printed operation and maintenance instructions.
d. Sequence of operation by controls manufacturer.
e. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

5. Control diagrams by controls manufacturer as installed.
6. Contractor's coordination drawings, with color coded piping diagrams as installed.
7. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
8. List of original manufacturer's spare parts, current prices and recommended quantities to be maintained in storage.
9. Test and balancing reports as specified.
10. Additional Requirements: As specified in individual product specification.

1.08 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment and maintenance of products, equipment and systems, at agreed upon times.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

PART 2 PRODUCTS (not applicable)

PART 3 EXECUTION (not applicable)

END OF SECTION

EQUIPMENT MANUFACTURER'S CERTIFICATE OF INSTALLATION TESTING AND INSTRUCTION

Owner:

Project:

Contract No.:

T&H No.:

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

_____
(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

installed for the subject project has been installed in a satisfactory manner, has/have been satisfactorily tested, is/are ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the units on Date: _____ Time: _____.

CERTIFIED BY: _____ Date: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGMENT OF MANUFACTURER'S INSTRUCTION

I/We the undersigned, authorized representative of the _____ and/or Plant Operating Personnel have received classroom and hands on instruction on the operation, lubrication, and maintenance of the subject equipment and am/are prepared to assume normal operational responsibility for the equipment:

_____ Date: _____

_____ Date: _____

_____ Date: _____

SECTION 01900

SEISMIC REQUIREMENTS

PART 1 GENERAL

1.01 DESCRIPTION

A. This section establishes the minimum seismic design requirements for architectural, process, mechanical, electrical and non-structural components.

B. The Contractor shall be responsible for the seismic requirements specified including the conformance of work for all subcontractors, manufacturers and suppliers with regard to the indicated and specified seismic requirements.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 through Division 16 of these Specifications.

1.03 STANDARDS

A. American Society of Civil Engineers:
   1. ASCE 7: Minimum Design Loads for Buildings and Other Structures.

B. American Society for Testing and Materials:
   1. C 635: Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
   2. C 636: Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

C. American Petroleum Institute
   1. STD 650: Welded Steel Tanks for Oil Storage

D. American Society of Mechanical Engineers
   1. A 17.1: Safety Code for Elevators and Escalators
   2. B 31: Code for Pressure Piping
   3. Boiler and Pressure Vessel Code

E. American Water Works Association
   1. D100: Welded Steel Tanks for Water Storage
   2. D 110: Wire Wound Prestressed Concrete Tanks for Water Storage

F. International Code Council (ICC)
   1. International Building Code

G. Manufacturers Standardization Society of the Valve and Fitting Industry
   1. SP-58: Pipe Hangers and Supports - Materials, Design and Manufacture

H. National Fire Protection Association:
   1. Standard for the Installation of Sprinkler Systems

I. Rack Manufacturers Institute
   1. Specification for the Design, Testing, and Utilization of Industrial Steel Storage Racks

J. Seismic design and construction details shall comply with IBC 2009, ASCE 7.05 and Massachusetts Code Amendments included in 780 CMR Section 16.

1.04 DEFINITIONS

A. Components are defined as systems, equipment, parts, or other elements, including supporting structures and attachments.

B. The reference building code is defined as the building code cited on the structural drawings or specified herein for the design of the basic structure.

C. The specified seismic criteria is defined as the seismic criteria cited on the structural drawings or specified herein for the design of the basic structure.

1.05 SEISMIC DESIGN REQUIREMENTS

A. Refer to structural drawings for seismic requirements and also conform to the requirements specified herein.

B. Seismic design shall conform to the International Building Code and ASCE/SEI 7.

C. Architectural, mechanical, electrical and non-structural components shall be designed and constructed to resist the seismic forces and displacements based upon ASCE/SEI 7, the reference building code, and the specified seismic criteria. In the case of conflict the more stringent requirements shall govern.

D. The interrelationship of components and their effect on each other shall be such that the failure of one component shall not cause the failure of any other component.

E. Components shall be anchored to the building structure to transfer seismic forces. Connections shall be bolted, welded or otherwise positively anchored to the structure. Anchorage shall not rely on friction for force transfer.

F. Exceptions: Exemption from the requirements for seismic analysis and design are permitted only to the extent permitted in the reference code.

1.06 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

1.07 SPECIFIC COMPONENTS

A. Compound Equipment: Connecting elements for equipment combinations such as pumps and motors, valves and operators, engines and generators, etc. which are not capable of transferring seismic loads or accommodating seismic displacements shall be protected by appropriate design.

B. Storage Tanks: Tanks, supporting structures and anchorages shall be designed for the weight of the tank, appurtenances and the tank contents at the maximum capacity. Tank contents shall not be considered in resistance to seismic loads.

C. Ductwork: Equipment installed within ductwork shall be independently supported and braced. Support and bracing of heating and cooling coils shall account for the weight of the contents.

D. Piping Systems: Support and bracing of piping systems shall account for the weight and hydrodynamic effects of the contents.

E. Pressure Piping: Pressure piping support and bracing shall conform to ASME B 31 in addition to the force and displacement requirements of the reference code.

F. Sprinkler Systems: Sprinkler system support and bracing shall conform to NFPA 13 in addition to the force and displacement requirements of the reference code.

G. General Supports: Pipe, duct, raceways and cable tray supports and bracing shall conform to the AISC Manual of Steel Construction and MSS SP-58 in addition to the force and displacement requirements of the reference code.

END OF SECTION

WADING RIVER WATER TREATMENT PLANT
CONTRACT NO. 10
DWSRF NO. 16764

CERTIFICATE OF UNIT RESPONSIBILITY

For Specification Section _____

_____
(Section title)

In accordance with the Contract Documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under Specification Section _____ and the requirements specified in Section 01900. We hereby certify that these components are compatible and comprise a functional unit suitable for the specified and indicated performance and design requirements.

_____ _____
Notary Public Name of Corporation

_____ _____
Commission expiration date Address

Seal: By: _____
Duly Authorized Official

_____
Legal Title of Official

Date: _____

INDEX

DIVISION 2 SITE WORK

SECTION 02015

TEST PITS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide test pits where noted/shown on the Drawings or at locations requested by the Engineer.
   1. In general the work under this Section shall consist of the excavation of test pits or other miscellaneous excavations not specified for payment elsewhere, by the Contractor where it may be necessary to locate or examine soils, groundwater, drains, pipes, rock, public utilities, subsurface structures, or any other possible obstacle or condition.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02200 Earthwork

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 COORDINATION WITH UTILITY OWNERS

A. The Contractor shall coordinate the excavation of all test pits with the respective utility owners having facilities in the vicinity of the location of test pits.
   1. All utilities shall be informed of the necessity of work under this Section and the Contractor shall give sufficient notice to the respective utility owners to afford reasonable time for coordination.
   2. If so desired by respective utility owners, all or part of the work under this Section may be accomplished by their crews and/or supervised by them.

3.02 EXCAVATION

A. Unless otherwise specified, the Contractor shall dig test pits as required by the Contract Documents, and the Contractor shall notify the Engineer of the results immediately and prior to the start of any underground installations within said test pit areas.
   1. The Owner/Utility Companies shall be notified well in advance of excavation so that they also may make the necessary measurements to locate all objects within test pits.

2. Excavation of test pits shall be accomplished by such means as are required to ensure that any underground utilities or structures that may be encountered are not damaged
3. It shall be the Contractor's responsibility for any damages incurred during the excavation operations. Any such damages shall be repaired by him (if permitted) to the satisfaction of the Responsible Agency at the Contractor's own expense. Where the repair and/or replacement must be done by the Responsible Agency, any and all costs thereof shall be borne by the Contractor.
4. The Contractor shall notify the Engineer and/or utility companies of any conflicts uncovered which may require design revisions, relocations and/or adjustment.
5. No work shall be started within these areas of conflict until so authorized by the Engineer.
6. Test pit excavation and backfill shall comply with the applicable provisions of Section 02200.
7. Hand excavation shall be performed where necessary to prevent damage to the existing utilities.

3.03 MEASUREMENT

A. The Contractor shall measure and record the size, configuration, horizontal and vertical location of all utilities, pipes or other obstacles uncovered in the various test pits dug under this Section.
   1. Size of test pits shall be as directed by the Engineer.

3.04 RESTORATION

A. Where an existing pavement has been removed for the test pit excavation, the surface shall be restored to grade. Pavement restoration shall comply with the applicable provisions of Section 02513.
   1. In all other areas, the surface of test pit areas shall be restored to a condition equal to or better than original.

END OF SECTION

SECTION 02050

SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 DESCRIPTION

A. The Work of this section includes furnishing all required labor, tools, staging, and equipment to demolish and haul off site the existing concrete water storage tank in its entirety as follows:
   1. Chlorine contract tank in its entirety including concrete foundation.
   2. Existing chemical feed building in its entirety
      a. Including diesal generator and proper disposal of all remaining diesal fuel.
   3. Selected equipment inside the existing pump station including but not limited to:
      a. High lift pumps
      b. Concrete Pads
      c. Piping
      d. High lift pump electrical panels

B. No demolition shall take place without the approval of Owner and Engineer. All demolition shall be conducted in accordance with the sequence of construction described in Section 01100 (Special Project Procedures) of these specifications.

C. Selective demolition work generally consists of, but is not limited, to the following at the existing Wading River Water Treatment Plant:
   1. No demolition shall begin until the new water treatment plant has completed startup and is fully operational.
   2. Protect tight tank used for bathroom in pump building to prevent damage during demolition.
   3. Remove and dispose of all remaining chemicals used for chemical injection.
   4. Remove and dispose of all remaining diesal fuel used for backup generator.
   5. Demolition of chlorine contract tank and chemical feed building.
   6. Removal of existing high lift pumps, piping, valves, and appurtanences.
   7. Removal of existing high light pump concrete pads.
   8. Removal of existing system controls and instrumentation components.
   9. Removal and capping of miscellaneous small piping.
   10. Removal of existing flow meters.
   11. Removal of selected components of the existing electrical system as shown on the Drawings.

D. All items which are removed shall remain the property of Owner.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 01100 Special Project Procedures
   2. Division 02 Site Work
   3. Division 11 Equipment

4. Division 15 Mechanical
5. Division 16 Electrical

1.03 QUALITY ASSURANCE

A. Standards: Comply with applicable requirements of American National Standards Institute (ANSI) Standard A10.6, Safety Requirements for demolition, current edition and OSHA Safety and Health Regulations (see 29 CFR Part 1926 and all subsequent amendments) as promulgated by the United States Department of Labor on June 24, 1974; The Prevention of Accidents and Illnesses in Construction Operations. Contractors are urged to become familiar with the requirements of these regulations.

B. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

C. The Contractor shall be responsible for being familiar with and complying with all local, state and federal safety, health and environmental rules, laws and regulations, and shall conduct his operation in compliance therewith.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 14 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Permits and notices authorizing building demolition, if required.
   2. Permit for transport and disposal of debris.
   3. Demolition procedures and operational sequence for review and acceptance before start of work.

1.05 STANDARDS

A. The Contractor shall comply with the provisions of the following agencies as they apply to this project and as referenced:
   1. Associated General Contractors of America, Inc. (AGCA) "Manual of Accident Prevention in Construction".
   2. Occupational Safety and Health Administration (OSHA), United States Department of Labor Requirements.
   3. American National Standards Institute (ANSI) "Safety Requirements for Construction and Demolition".

B. Provide and maintain all protective devices, including fences, barricades, bracing, shoring, planning, guards, warning lights and signs, as necessary or required for protection against injury to persons or damage to property. Conform to ANSI current edition.

1.06 COORDINATION

A. Owner and Engineer shall be contacted and advised of proposed work prior to the start of work by the Contractor. No demolition work shall proceed without the approval of Owner and Engineer.

1.07 PROJECT/SITE CONDITIONS

A. The Contractor acknowledges that it has satisfied itself as to the nature and location of the work, such as but not limited to:
   1. Local conditions, particularly those bearing upon:
      a. Transportation, disposal, handling and storage of materials.
      b. Availability of labor, water and electric power.
      c. Access to the site.
   2. The character of equipment and facilities needed prior to and during the execution of the work, and all other matter which can in any way effect the work or the cost thereof.
   3. The Contractor should visit the site to obtain as much information as is possible on the existing structure, as to:
      a. Access to storage tank and storage tank size.
      b. Materials of construction.
      c. Accessibility of items to be removed.
      d. Size and location of items to be removed.
   4. Any failure by the Contractor to become acquainted with all available information concerning these conditions will not relive the Contractor from the responsibility for estimating the difficulty and cost of successfully performing the work.

B. Existing Tank
   1. The existing 600,000 gallon chlorine contact tank to be dismantled, constructed circa 1993, is comprised of prestressed concrete construction supported upon a reinforced concrete foundation. The tank is 80 feet in diameter and approximately 27.5 feet in height. The interior baffle walls are approximately 18.5 feet in height.

C. Existing Chemical Feed Building
   1. The existing chemical feed building to be dismantled, constructed circa 1993, is approximately 42-feet x 60-feet (2,520 square feet) supported upon a reinforced concrete slab and foundation. The exterior includes brick faced walls with an asphalt shingled roof.

1.08 PROTECTION OF ADJACENT PROPERTY AND STRUCTURES

A. Cease operations and notify Engineer immediately if safety of adjacent structure(s) appears to be endangered. Take precautions to properly support structures(s). Do not resume operations until safety is restored.

B. Prevent movement, settlement or collapse of adjacent services and construction. Assume liability for such movement, settlement or collapse. Property repair damage at no cost to the Owner.

C. Provide, erect and maintain sheds, barricades, lighting and guard rails as required to protect general public, workers and adjoining property.

1.09 EXISTING PIPING

A. Arrange and pay for cutting and capping all internal piping flush with the tank base slab.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 SELECTIVE DEMOLITION

A. General:
1. All debris from the selective demolition shall be removed from the site and disposed of legally.
2. Contractor shall not dispose of demolition materials in wetlands or other areas prohibited by the Corps of Engineers, the State, the local Conservation Commission, or any other government agency having jurisdiction in such matters.

3.02 EXISTING STRUCTURE AND FACILITIES

A. Condition: Existing floors, walls, doors, windows and ceilings shall be protected from damage. Any damage shall be repaired by Contractor.

B. All items that are to be removed or temporarily relocated to allow removal and replacement of the specified equipment shall be protected from damage.
1. All items shall be reinstalled in their original location at the completion of the Work.
2. Damaged items shall be replaced with new items at Contractors expense.

END OF SECTION

SECTION 02110

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Clear and grub the project site to the limits required by the Contract Documents.
   1. In general the entire project site shall be cleared and grubbed.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02200 Earthwork
   3. Section 02210 Site Grading

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

1.04 COORDINATION

A. Coordinate clearing and grubbing with Owner and Engineer. Clearing and Grubbing shall not occur outside of the noted 'Limit of Work' on the Contract Drawings. Contractor shall clearly delineate the Limit of Work (LOM) with the Owner and Engineer and obtain written approvel prior to performing cleaning and grubbing.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

B. Flag limits of clearing.

3.02 PROTECTION

A. Only trees and brush within the limits of the project site shall be cleared.
   1. Protect trees and shrubs, where indicated to remain, by providing a fence around the tree or shrub at its drip line and of sufficient height so trees and shrubs will not be damaged.
   2. All areas not designated to be cleared shall be protected from damage.
   3. Clearing operations shall be conducted so that cut trees are felled and existing trees designated to remain are protected from damage.
   4. Protect control points, benchmarks and existing work.
   5. Maintain access to the site at all times.

3.03 CLEARING AND GRUBBING

A. Within the area to be cleared:
   1. Fell trees and brush.
   2. Chip all wood and waste.
   3. Remove all stumps.
   4. Grub out all roots 1 inch in diameter and larger to a depth of at least 12 inches below the existing ground surface.

3.04 CONSERVATION OF TOPSOIL

A. After the area has been cleared of vegetation, strip the existing top-soil.
   1. Stockpile in an area clear of new construction.
   2. Maintain the stockpile in a manner which will not obstruct the natural flow of drainage.
      a. Maintain stockpile free from debris and trash.
      b. Keep top-soil damp to prevent dust.
      c. Place hay bales around stockpile.

3.05 REMOVAL AND DISPOSAL

A. All debris, trees, shrubs, brush, roots, stumps and etc. cleared and grubbed from the site shall be removed from the site and disposed of in accordance with all local and Commonwealth of Massachusetts Regulations.
   1. Burning and/or burial of cleared and grubbed material on the site shall not be permitted.
   2. Depressions remaining from the removal of stumps shall be filled with gravel borrow and/or loam, whichever is appropriate to the existing ground surface.

3.06 UTILITIES

A. Protect existing utilities indicated or made known.
   1. Coordinate with utility companies and agencies as required.

END OF SECTION

SECTION 02140

SITE DRAINAGE AND DEWATERING

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide drainage and dewatering as required by the Contract Documents.
   1. In general the Contractor shall furnish all materials, equipment, labor and incidentals necessary to provide dewatering and drainage control during construction.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 01567 Environmental Protection
   2. Section 02150 Directional Drilling
   3. Section 02200 Earthwork
   4. Section 02611 Ductile Iron Pipe and Fittings
   5. Section 02616 HDPE Drainage Pipe
   6. Section 02630 HDPE Pipe and Fittings
   7. Section 02731 Plastic Sewer Pipe and Fittings

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Employ a qualified Engineer properly permitted to provide such services at the location of the work, to prepare a dewatering system plan consistent with the methods detailed in this Section and to inspect and report on the quality of its implementation.

C. Comply with all pertinent requirements of governmental agencies having jurisdiction.

1.04 SUBMITTALS

A. Submit a formal dewatering plan to the Engineer for review and approval prior to implementation.

PART 2 PRODUCTS

2.01 EROSION AND SEDIMENTATION CONTROL

A. Devices for erosion and sedimentation control for effluent of dewatering operations shall be as specified in Section 01567 Environmental Protection.

PART 3 EXECUTION

3.01 INSTALLATION

A. To insure proper conditions at all times during construction the Contractor shall provide and maintain ample means and devices with which to remove and dispose of all water entering trenches and other excavations.
   1. Means of water removal and disposal shall include but not be limited to wells, surface pumps, and/or well point systems, to the extent required to prevent "boils" or softening of the foundation soils.
   2. The Contractor shall pitch the ground around the excavation to prevent water from running into excavated areas and to prevent damage to other structures or work on adjacent property.
   3. The Contractor shall remove immediately any surface or seepage water or water from sewers, drains, creeks, or other sources, which may accumulate during the excavation and construction work.

B. Excavations shall be kept dry until the structures, pipes and appurtenances, to be built or installed therein, have been completed and backfilled to such extent that they shall not float or otherwise be damaged by water in the excavation.
   1. In no event shall water rise to cause unbalanced pressure on the pipe or other structures. The Contractor shall prevent flotation of the pipe or structures.
   2. Pipe, masonry and concrete shall not be placed in water. Water shall not submerge new masonry or concrete within four (4) hours after placement.

C. Sufficient stand-by pumping equipment shall be installed and mounted for immediate use in case of emergencies. The Contractor shall be responsible for the adequacy of their dewatering equipment and system in controlling the water and for protection to adjacent public and private property from damage. Any damage to permanent work or existing property resulting from the failure of the Contractor to provide an adequate dewatering system shall be repaired by the Contractor at their expense.
   1. Wells, well points and pump sumps shall be installed with adequate filters to prevent loss of fine grained soils.

3.02 DISPOSAL OF DRAINAGE WATER

A. All water pumped or drained from the work shall be disposed of in such a manner as to not cause injury to public health, damage to public or private property, interference with other work or adverse impacts to adjacent wetlands.
   1. Effluent from dewatering operations shall not be discharged directly to wetlands or waterways and shall not be discharged to storm drain systems prior to being filtered through a siltation basin.
   2. Discharge shall be such that no erosion occurs. Erosion protection shall be as specified in Section 01567 Environmental Protection.

B. All dewatering operations will be monitored by the Contractor and Engineer during construction. Adjustments to operations will be made as warranted by site conditions.

END OF SECTION

SECTION 02150

DIRECTIONAL DRILLING

PART 1 GENERAL

1.01 DESCRIPTION

A. Horizontally-controlled directional drilling (HDD) of pipe for the installation of high-density polyethylene (HDPE) water mains.

B. Excavate and backfill access pits. Excavation includes earthwork but is not limited to topsoil stripping, excavating, rock excavation, filling and grading to obtain required finish contours and elevations and installation of temporary casings as required.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.

1. Section 02140 Site Drainage and De-watering
2. Section 02160 Support of Excavation
3. Section 02222 Earthwork
4. Section 02611 Ductile Iron Pipe and Fittings
5. Section 02675 Disinfecting Water Mains
6. Section 02676 Testing Piping Systems

1.03 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 of this Section. Key personnel shall be required as specified in the Submittals section. These personnel shall be declared at the time of the bid and shall not be changed without prior approval of the Engineer.

B. All HDPE pipe and fittings shall be of domestic manufacture.

C. Coordinate the work of this Section with the work of other related Sections.

D. Prepare to utilize a mud/slurry drilling method for completion of the HDD to satisfy the requirements of the Work.

E. Prior to beginning any HDD work, the Contractor shall lay out each proposed drill path including starting and ending point locations using a Massachusetts licensed land surveyor.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:

1. Plan outlining the procedure and schedule to be used in performance of the Work.
2. Working Drawings and written procedure describing in detail the entire proposed operation), including, but not limited to:
    a. Size, capacity, and arrangement of equipment.
    b. Location and size of entry and exit pits.
    c. Dewatering method.
    d. Method of installing detection wire with HDPE pipe.
    e. Method of butt fusing pipe segments, type of equipment to be used for butt fusing, and training/experience certificates for field personnel who will be involved in pipe butt fusing operations.
    f. Layout of pipe fusing preparation and storage area, including location(s) of pipe rollers.
    g. Type of cutting head(s) to be used.
    h. Method of monitoring and controlling line and grade.
    i. Method for detecting surface movement.
    j. Bentonite clay, including product information, material specifications, handling procedures, Material Safety Data Sheet (MSDS), special precautions, method of mixing mud/slurry, and method of pumping mud/slurry.
    k. Certificates of Compliance for pipe (SDR 11 HDPE).
3. General Company Profile: The general company profile shall provide: a summary of the company's present size in terms of gross annual revenue; number of projects completed per year for the last five years; years of operation; number of full-time employees and engineering staff; a list of similar size projects municipal water main projects, two of which must be river or water crossing projects of at least 1,500 feet in length, that have been completed within the past five years including project name, contract amount, length, diameter, and soil conditions for the drill; and three project references with project descriptions, value of contract, and current name and phone number for a reference. The general company profile shall demonstrate that the company or a company principal has a minimum of five years continuous experience in horizontal directional drilling; owns the equipment necessary to do this project; has a minimum of two full time drillers, one of which must meet the requirements of Paragraph 1.04 - 4; and has the financial resources and meets the insurance requirements for this project.
   Engineer and Owner reserve the right to disqualify directional driller not satisfying the intent of these requirements.
4. Key Staff Resumes: Provide resumes of key staff that will be assigned to this project. Key staff shall demonstrate on their resumes that they meet the following qualifications:
    a. Driller: Minimum five years experience as a horizontal directional driller and have completed at least three (3) similar length water crossing projects with the same material and with similar tracking methods. References shall be provided with current names and phone numbers to support the experience.
    b. Superintendent: Minimum three (3) years experience with the bidding company as a superintendent and have a minimum of one similar project experience.
    c. Tracking specialist: Minimum three (3) years experience with tracking system to be employed and for projects of similar depth and length crossing

water bodies. References shall be provided with current names and phone numbers to support the experience.

Engineer must approve any variance from this requirement and reserves the right to delay commencement of the HDD operation until adequate supervisory staff are on site.

5. Estimated pull forces for each pipe segment to be drilled.
6. Tracking System Submittal, including data on the proposed guidance system, and the accuracy of the guidance system at the design drill depths. The system shall be capable of providing horizontal and vertical steering data along the entire drill path for each crossing, for the depths shown on the Drawings, plus an additional 10-ft.
7. Fuel and Hydraulic Fluid Containment and Contingency Spill Plan, including means and methods for managing, containing, and cleanup of fuel and oil spills should they occur at the site. Contractor shall dispose of all fuel, oil, or other leakage from equipment including diapers, absorbent material, and other related cleanup and spill control materials. A Fuel and Oil Spill Kit shall be on site and available for use during all drilling operations.
8. Drill Fluid Management and Contingency Release Plan, describing means and methods for containment, collecting and disposal of drill fluid during the project, including equipment and materials included in the Drill Fluid Spill Kit, and procedures to be followed to minimize damage due to frac-outs. A Drill Fluid Spill Kit shall be located at each end of the drill path during all drilling operations. Plan shall fully describe procedures to be used to remove inadvertent drill fluid releases. The plan should include the following items:
    a. Summary of drill fluid components and additives.
    b. Description of preliminary drill fluid pumping volumes proposed for the pilot hole drilling, hole reaming, and pipe pulling in relation to the hole size.
    c. Procedures for measuring and recording drill fluid properties (e.g, density, sand content, and viscosity). These measurements shall be measured in accordance with Section 2.01-D. Measurements shall be obtained on a maximum 2 hour interval during drilling and reaming operations and during the last conditioning pass prior to pulling the product into the hole.
    d. Method and equipment for monitoring and recording drill fluid pump volumes and pressure. The pump volume and pressure shall be recorded on a continual basis during all drilling operations.
    e. Procedures to be followed if a sudden loss of drill fluid, or unanticipated change in drill fluid pressure is detected.
    f. Observational procedures for monitoring for drill fluid release at the ground surface. The Contractor shall provide a vessel and operator dedicated to monitoring for fluid release in Wading River during all drilling and pulling activities. This vessel shall meet the requirements for operation within this body of water.
    g. Description of loss circulation materials (LCM's) that will be on site during drilling and which may be used to seal hydraulic fractures of the overburden.
    h. Description of on-site drill fluid spill kits including details of water and land-based drill fluid (spill) containment equipment and materials and quantities of materials that will be onsite and available for use. These kits shall be located at each end of each drill during all drilling operations.
    i. Equipment and methods to be employed in drill fluid collection and disposal for handling production drill fluid.

9. As-Built HDD Report. Upon completion of the work, the Contractor shall submit the following information to the Engineer:
   a. As-built plan and profile information for each drill path based on electronic guidance system data. At a minimum, a survey data point shall be obtained for the As-Built drill path for each drill rod. Alternatively, the driller may survey the inside of the pipes following installation for As-Built location and elevation. The plan and profile shall be referenced to the MA State Plane system and national geodetic vertical datum.
   b. Pressure test results for the pipe.
10. Cuttings, Bentonite Slurry, and Pit Spoil Disposal Submittal: Provide within 30 days of completion of the drills a list of volumes of all cuttings, bentonite slurry, and pit spoil disposed of off-site and the location of the disposal area.

1.05 STANDARDS

A. The following American Society of Testing and Materials (ASTM) standard form a part of this specification as referenced:

1.	ASTM D3261	Butt Fusion Polyethylene Fittings for Polyethylene Plastic Pipe and Tubing
2.	ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
3.	ASTM D790	Flexural Testing
4.	ASTM D638	Tensile Properties of Plastics
5.	ASTM F714	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
6.	ASTM F2160	Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)

B. The following American Water Works Association (AWWA) standards form a part of this specification as referenced:

1.	AWWA C906	Polyethylene Pressure Pipe and Fittings, 4 In. Through 63 In. for Water Distribution and Transmission

1.06 SPECIAL REQUIREMENTS

A. Permits applications have been submitted to Federal, State and Local agencies for this work and will be provided to the Contractor upon receipt. The Contractor shall be responsible for full compliance with various permit conditions. Failure to comply with permit conditions will result in the Owner shutting down the drilling operations until compliance is established and confirmed at the cost of the Contractor. Compliance with permit conditions shall be established and verified at no additional cost to the Owner.

B. The Horizontal Directional Drill (HDD) alignments shall be oriented as shown on the Drawings.
   1. Minimum depth of the HDD alignments below Wading River shall be 10 feet, as shown on the Drawings. The Contractor may elect to drill to greater depths at Contractor expense but end coordinates must still be met. The Contractor is advised that bedrock will be encountered at depths deeper than the design path. Drilling of bedrock shall be at the Contractor's expense should the Contractor elect to drill deeper than the design path tolerance.
   2. Installation tolerance shall be a five (5) foot radius circle around the design drill path centerlines, as shown on the drawings.

C. Boring logs and sieve analysis data are included in the appendix of the Specifications. The logs and data represent minimum information; if additional information or investigations are required by the Contractor for a reasonable purpose, it shall be the Contractor's responsibility to provide such services.

D. A tracking system such as Tru-Tracker, Paratrack or equivalent shall be provided by the drilling contractor and shall be capable of tracking the drill progress within the specified tolerances continually across each drill path. A walkover system shall not be permitted because of the depth and tolerances of the design drill path. The system shall be capable of providing horizontal and vertical steering data along the entire drill path for each crossing, for the depths shown on the Drawings, plus an additional 10-ft.

E. Contractor shall provide two 2-way radios to allow communication between crews. Radios shall be complete with built-in antennas, squelch and volume controls, and rechargeable battery packs. The Contractor shall not commence work until there is a working radio at each entry and exit location of an active drilling operation.

F. Contractor shall be responsible for containing and collecting all drilling fluid released inadvertently, including drilling fluids which occur within Wading River due to frac-out or other means and other remediation tasks which may be required by the Engineer or permit agencies. Such work shall be at no additional cost to the Owner.

G. Contractor shall implement the Drill Fluid Management and Contingency Release Plan. Spill kits with mitigation materials shall be present at each end of each drill spread for drill fluid.

H. Contractor shall implement the Fuel and Hydraulic Fluid Containment and Contingency Spill Plan. Spill kits with mitigation materials shall be present at each end of each drill spread for fuel and hydraulic fluid and other equipment fluids.

I. Contractor shall obtain construction-related permits for project water and road use. Contractor shall contact "Dig Safe" at 1-800-DIG-SAFE a minimum of 72 hours prior to any excavation or drilling and obtain utility clearance for all construction work. This utility clearance permit shall remain active for the duration of the project.

PART 2 PRODUCTS

2.01 GENERAL

A. High Density Polyethylene Pipe (HDPE pipe)

1. Pipe intended for transporting potable water shall be DriscoPlex™ Type 4000 PE 4710 HDPE (as manufactured by Performance Pipe, Plano, TX) or approved equal. Manufacturer's Certificate to be provided to certify that product meets "Buy American" standards. Pipe shall be DR 11 HDPE Ductile Iron Pipe Size (DIPS) manufactured from a PE 4710 resin as specified by the Plastic Pipe Institute (PPI). Diameter shall be as noted on the drawings. HDPE pipe shall meet the specifications of ASTM F714/AWWA C906. And NSF/ANSI 61. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.

2. Pipe intended for electrical, and communications conduit shall be DriscoPlex™ Type 3100 Series Conduit and Casing Pipe (as manufactured by Performance Pipe, Plano, TX) or approved equal. Manufacturer's Certificate to be provided to certify that product meets "Buy American" standards. Pipe shall be DR 11 HDPE Iron Pipe Size (IPS) manufactured as specified by the Plastic Pipe Institute (PPI). Diameter shall be as noted on the drawings. HDPE pipe shall meet the specifications of ASTM F2160. The pipe shall contain no recycled compounds except that generated in the manufacturer's own plant from resin of the same specification from the same raw material.
3. HDPE conduit shall be UL listed compliant with the National Electric Code (most recent edition).
4. All pipe and fittings to be installed by directional drilling shall be joined by heat fused butt joints. Butt Fusion Fittings shall have a manufacturing standard of ASTM D3261. Molded & fabricated fittings shall have a pressure rating equal to the pipe unless otherwise specified in the plans. Fabricated fittings are to be manufactured using Data Loggers. Temperature, fusion pressure and a graphic representation of the fusion cycle shall be part of the quality control records.
5. Each pipe length and fitting shall be clearly marked with:
    a) Manufacturer's name and trademark.
    b) Nominal pipe size.
    c) Material designation.

B. Mechanical Joint (MJ) Adapters
1. MJ Adapter shall be SDR 11 HDPE (DIPS) as manufactured by Performance Pipe or equal approved by Owner.
2. Adapter shall have a standard operating pressure of 200 psi.
3. Adapter shall come with a stainless steel stiffener, extended t-bolts and nuts, gland and gasket.
4. Adapter shall be butt-fused to the SDR 11 HDPE (DIPS) pipe in accordance with the manufacturer's written instructions.

C. HDD Machine
1. The Contractor is responsible for the final determination of the drill rig size.
2. Shall have sufficient capacity to complete the proposed drilling operations, and pipe pullback.
3. Shall consist of a hydraulically-powered system to rotate, push, and pull hollow drill pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill head.
4. Shall have a hydraulic system that is self-contained with sufficient pressure and volume to power the drilling operation for the entire length of the Work.
5. Shall have a system to monitor and record maximum pullback pressures during the pullback operation.
6. Shall have a drill head that is steerable by changing its rotation and shall provide the necessary cutting surfaces and drilling fluid jets.
7. Shall have an anchorage system to anchor drilling machine to the ground to resist thrust during operation.

D. Drilling Fluids (Mud/Slurry) System

1. Fluid shall be bentonite clay (compatible with the environment) and clean water. Water shall have a pH of 8.5 to 10. Water of a lower pH or excessive calcium shall be treated with the appropriate amount of sodium carbonate, or equal.
2. Waste oil, diesel fuel, or environmentally non-compatible polymers cannot be part of drilling mud/slurry composition.
3. Engineer shall approve all additives.
4. Water, bentonite clay, and approved additives shall be mixed thoroughly and be absent of any clumps.
5. Drilling fluid parameters (density, viscosity and sand content) must be measured and recorded every two hours, or after a noticeable change in fluid returns.
    a. Fluid density shall be measured using a balance beam scale as specified in the Equipment List. All components of the scale shall be cleaned and calibrated at the beginning of each shift and cleaned before and after each measurement is taken. If any damage is suspected to any part of the scale, the scale must be calibrated according to the manufacturer's specifications. Damaged components must be replaced immediately. Drill fluid initial density should be 1050 kg/m^3 (66.5 lb/ft^3) maximum with an allowable increase to 1120 kg/m^3 (69.9 lb/ft^3) throughout the drill.
    b. Viscosity shall be measured and recorded with a Marsh funnel as specified in the Equipment List. Viscosity shall be maintained between 50 and 80 centipoises (cP) throughout the drill.
    c. Sand content shall be measured and recorded with a sand content measurement kit. Sand content should be kept below 1% to avoid excessive increases in fluid density as well as wear and damage to equipment. Sufficient centrifuges, or Engineer-approved sand cleaning equipment, should be employed to remove sand particles without negatively affecting the drilling fluid flow rates.
6. Shall have filters in-line to prevent solids from being pumped into the drill pipe.
7. Shall have connections between the pump and drill pipe that are relatively leak-free.
8. Any spilled drilling fluid shall be fully contained in a 12-inch (minimum) height berm erected and maintained around the HDD machine, and properly disposed of.

E. Mixing System

1. A self-contained, closed drilling fluid mixing system shall be of sufficient size to mix and deliver drilling fluid composed of bentonite clay, water, and approved additives.
2. Mixing system shall be able to molecularly shear individual bentonite particles from the dry powder to avoid clumping and ensure adequate mixing.
3. Drilling fluid reservoir tank shall be of adequate size for the Work.
4. Mixing system shall continually agitate the drilling fluid during drilling operations.

F. Mud/Slurry Motors

1. Shall be of adequate power to operate the required drilling devices, if used.

G. Guidance System

1. Shall be a wireline type tracking system capable of locating the drill within a 5 foot radius inscribed around the drill path. and shall be set up and operated by field personnel trained and experienced with the system. The wire array is anticipated setting wires along the river shorelines and along the river bottoms.

H. Pipe Rollers
   1. Pipe rollers shall be of sufficient size to fully support the weight of the pipe while being butt-fused, pressure-tested, and/or during pullback operations.

I. Tracer wire shall be a minimum #10 hard drawn copper conforming to ASTM B1 furnished with a plastic coating and fixed to the water pipe.

J. PE Wall Anchor shall be installed on the SDR 11 HDPE pipe in accordance with the manufacturer's written instructions.

PART 3 EXECUTION

3.01 GENERAL

A. The Contractor is fully responsible for implementing a safe and effective drilling plan.

B. Notifications: Provide notification to the ENGINEER a minimum of 72 hours before mobilizing onto the site. Provide notification 48 hours in advance of casing installation and drilling. Provide notification 48 hours in advance of pressure and acceptance verification tests on the HDPE pipe.

C. Construct the perimeter bentonite slurry, cuttings, and pit spoil control system in accordance with Best Management Practices in the local area. The system shall provide positive containment for all drilling fluids and drainage from drill cuttings and prevent any of the drill fluid or drainage fluids or other drill fluid contaminated material or fluid from entering the river waters either by topping or breaching including under storm conditions.

D. Establish a secure and contained construction work area at the drill rig. Excavate and verify all utilities identified or marked out in the field that are within 50 ft of the work. Expose all utilities within 15 feet of the drill path and leave exposed until after completion of the pilot drill. Use an air-vacuum system to expose the utilities.

E. Maintain the work site in a clean and safe manner.

F. Excavation, backfill and compaction of access and test pits shall be in accordance with Section 02200 Earthwork. When water is encountered, provide and maintain a dewatering system of sufficient capacity to remove water. Keep all excavations and access pits free of water until backfill operation is in progress. Perform dewatering in such a manner that removal of soil particles are held to a minimum. Dewater into a sediment trap as directed by Engineer.

G. Spill and bentonite slurry management shall be in accordance with requirements stated in the project permits, and in the approved Drill Fluid Management and Contingency Release Plan, which shall include the following measures:
   1. Controls in place to stop drilling activity, assess the drill path for observable releases, and control any observable release in a timely manner. Notify the Engineer of circulation losses greater than 25% of down hole pump volumes and for all observable bentonite slurry releases at the earliest opportunity and confirm in writing by the end of the work shift.
   2. Be prepared to contain a potential observable blowout or bentonite slurry release.

On observing a slurry release, stop all drilling operations, contain the release, and clean up the release. The Contractor is responsible for all notifications, cleanup, disposal, and environmental restoration that may be required as a result of an observable release. The Contractor shall provide a silt curtain capable of reaching the lake bottom, and sufficient to contain a radius of at least 50 feet. Cleanup must be to before release conditions.

3. Equipment and personnel to monitor for fluid release. The Contractor shall provide a vessel and operator dedicated to monitoring for fluid release in Wading River during all drilling and pulling activities. This vessel shall meet the requirements for operation within this body of water.

H. Directional drilled pipe (SDR 11 HDPE) shall be installed to depths as required to permit the pipe to be laid at elevations indicated in the specifications and at the approximate location shown on the drawing. Directional drilled pipe shall be installed in one continuous pipe segment as shown on the drawings. The top of the drilled pipe shall be installed a minimum of 10 feet below the bottom elevation of the River at the crossing location. Separation shall be increased if necessary to prevent drilling operations from impacting the River.

I. The Contractor shall use electronic survey instrumentation to monitor and adjust the drill head. The survey system shall measure the horizontal and vertical location of the drill head throughout the bore and provide readings at 5-foot intervals to allow for slope adjustment. If magnetic interference affects the bearing sensors of the steering tool, the Contractor shall use appropriate methods to maintain the required slope and alignment. Obtain an accuracy range of within one inch of actual position of pipeline.

J. In each case, a pilot hole shall be drilled along the path, as shown on the drawings. Do not exceed allowable bending radius of HDPE pipe. Pilot hole shall have the following tolerances:

1. Vertical alignment plus or minus 5 foot. Vertical path of the pilot hole must not establish new high points not shown on the drawings.
2. Horizontal alignment plus or minus 5.0 foot.

K. As-built sketch of the finished pilot hole shall be furnished for approval by Engineer prior to pull-back of the pipe to be installed. Provide Engineer with tabulations of horizontal and vertical alignment.

L. Notify the Engineer immediately when forward motion of operation is stopped by an obstruction. Attempt a second installation using mud/slurry drilling method only if approved by Engineer, and consistent with the terms of Section 01025 Measurement and Payment.

L. The pilot hole shall be reamed to a diameter that is sufficiently sized in order to reduce forces applied to the pipe during pull back.

M. A swivel shall be installed between the reamer and the pipe connection to minimize torsional stress imposed on the pipe and allow the reamer to turn without rotating the pipe.

N. Fill the HDPE pipe with water and pull the pipe to the end of the drill.

O. Because of the elastic properties of the pipe, main line and service connection pipe shall be relaxed for at least one overnight period in order to return to its original pre-pull length. The pipe shall be installed past the exit tie-in point, according to manufacturer's recommendations, to accommodate thermal contraction as well as visoelastic stretch recovery in the pipe.

P. The leading edge of the pipe shall be examined for significant external damage after pull back. If the pipe is deemed by the Engineer to have suffered significant damage, the damaged pipe shall be cut off and additional pipe pulled through the hole prior to the relaxation period.

Q. The Contractor shall be responsible for the containment and disposal of all drilling fluids or bentonite mud/slurry. The Contractor shall stockpile haybales at the drilling site to contain an inadvertent bentonite mud/slurry return. Any haybales used for containment of mud/slurry shall be removed from the site and properly disposed of at the completion of the work.

R. The pull back shall be conducted in one continuous operation to limit the potential for binding of the pipe in the hole.

S. Sections of the SDR 11 HDPE pipe shall be connected by heat fusion of the pipe butt ends in accordance with the manufacturer's recommendations. Hand applied methods shall not be used.

T. Verify that the installed pipe is acceptable by successfully passing a pig with minimum outside diameter of 3/4 inch less than the inside diameter of the pipe through each pipe, and by completing a hydrostatic test on each installed pipe.

U. The Contractor shall provide all appurtenances and make pipe connections as required to ensure a complete working system. MJ adapters shall be butt fused to the HDPE pipe.

V. The access pit size shall be kept to a minimum.

W. A PE wall anchor system encased in concrete shall be used to provide adequate anchoring against Poisson forces (NEED TO SPEC A RESISTANCE FORCE TO BE USED FOR SIZING THE ANCHOR SYSTEM)

X. Settlement or displacement of surface and adjacent facilities shall be monitored closely. Notify Engineer immediately if settlement or displacement is detected. Act to maintain safe conditions and prevent damage.

Y. Should the Contractor abandon a hole for his/her convenience before the hole is completed, then seal the drill hole and re-drill at no additional cost.

3.02 PIPE TESTING AND DISINFECTION

A. The SDR 11 HDPE pipe shall be disinfected and pressure tested in accordance with Sections 02675 and 02676.

3.03 FINAL INSPECTION

A. Final inspection of the work shall include a visual inspection of each section of pipe by looking from the access pipe with the aid of reflected sunlight or illumination equipment. The pipe shall be true to both line and grade, shall show no leaks, shall be free of cracks and from protruding joint materials and contain no deposits of sand, dirt or other material which will reduce the full cross-sectional area. Structural wall joints shall be tight. All finished work shall be neat in appearance and of high quality work. The Contractor shall furnish laborers and illumination equipment to assist the Engineer in this inspection.

B. Pipe shall have passed pressure tests in accordance with Section 02676.

C. Site shall be restored as specified in Section 02930.

END OF SECTION

SECTION 02160

SUPPORT OF EXCAVATION

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide excavation support as required by the Contract Documents.
   1. In general this work shall consist of furnishing and placing timber and/or steel sheeting and shoring of the types and dimensions required for proper excavation support.

1.02 DEFINITIONS

A. Shoring shall mean the use of a steel trench box, steel sheeting, or timber sheeting braced as required.

B. Timber sheeting shall mean the use of tongue and groove wood sheeting or steel soldier beams with wood lagging braced as required.

C. Steel sheeting shall mean the use of steel sheet pilings with interlocking joints, braced by steel members as required.

1.03 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02150 Directional Drilling
   3. Section 02200 Earthwork
   4. Section 02611 Ductile Iron Pipe and Fittings
   5. Section 02616 HDPE Drainage Pipe
   6. Section 02630 HDPE Pipe and Fittings
   7. Section 02731 Plastic Sewer Pipe and Fittings

B. As established in the General Conditions of the Contract, the Contractor is solely responsible for means and methods of construction and for the sequence and procedures to be used.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. The Contractor shall not perform excavations in unstable ground and shall employ a positive means of containing the unstable ground behind shoring, before excavation may proceed.

B. Employ a qualified Engineer, properly permitted to provide such services at the location of the work, to design the shoring system and to inspect and report on the quality of its construction.

C. Comply with all pertinent requirements of governmental agencies having jurisdiction.

1.05 STANDARDS

A. The following Standards form a part of this Specification as referenced:
   1. ASTM A328, Specification for Steel Sheet Piling
   2. Massachusetts DPW Standard Specifications, Section 950 Sheeting.
   3. Code of Federal Regulations (CFR), 29 CFR 1926, OSHA Standards - Excavation.

1.06 SUBMITTALS

A. Submit shoring design to Engineer for record purposes only.

PART 2 PRODUCTS

2.01 DESIGN

A. Design a shoring system which will safely and adequately prevent collapse of adjacent materials and which will permit construction of the Work to the arrangement shown on the Drawings.

B. All shoring systems shall be designed so as to support all vertical and lateral loads and other surcharge loads imposed on the system during construction, including earth pressures, utility loads and other surcharged loads in order to provide safe and expeditious construction of the permanent structures and prevent movement and/or damage to adjacent soil, buildings, structures and utilities.

C. Secure all needed approvals, including those of governmental agencies having jurisdiction and of adjacent property owners if required, at no additional cost to the Owner.

2.02 MATERIALS

A Material shall include, but not necessarily be limited to sheet piling, solder piles, lagging, bracing members such as wales, struts, shores and tieback anchors.

B. Lumber for timber sheeting and shoring:
   1. Shall be sound Spruce, Douglas Fir, white or yellow Lodgepole, Ponderosa pine, or western hemlock plank, planed on one side and either tongue and grooved or splined.

C. Steel sheeting:
   1. Shall be of approved section and quality, either new or secondhand, conforming to the requirements of ASTM A328.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Construct and install the shoring system in strict accordance with the design engineer's requirements.
   1. When using soldier piles and lagging, where boulders or cobbles are encountered, soldier piles shall be installed in pre-augered holes over the full depth as required to prevent misalignment and damage.
   2. Vibration monitoring during installation and extraction of braced excavation shall be provided wherever the excavation is within 100 feet of existing structures.

3.03 SHEETING LEFT IN PLACE

A. Sheeting left in place, for the purpose of preventing injury to structures, utilities or other property, shall be cut-off 3 feet below finished grade.
   1. The right of the Engineer to order sheeting left in place shall not be construed as creating any obligation on his part to issue such orders. His failure to exercise his right to do so shall not relieve the Contractor from liability for damages to persons or property occurring from or upon the work occasioned by negligence or otherwise growing out of a failure, on the part of the Contractor, to leave in place sufficient sheeting to prevent movement of the ground.

3.04 SHEETING REMOVED

A. All sheeting not left in place shall be carefully removed in such manner as to not endanger the construction or other structures, utilities, or property.
   1. All voids left or caused by withdrawal shall be immediately refilled with approved material, and compacted with tools especially adapted to that purpose.
   2. Vibratory extraction methods shall be used only when it can be demonstrated that settling of pipe and structures will not occur. If such settling occurs, it shall be corrected at the Contractor's expense.

3.05 TRENCH BOX OR SHIELD

A. Use of a trench box or shield shall not relieve the Contractor of any liability for damages to persons or property growing out of a failure of the Contractor to leave in place sufficient sheeting and bracing to prevent the caving or moving of the ground or disturbance of the completed work.
   1. Care shall be taken, when a trench box or shield is moved ahead, so as not to pull apart the joints of pipe already placed or leave voids around the pipe wall.
   2. At no time shall the portable box or shield be allowed to be positioned below the spring line of the pipe.
   3. The width of the trench box or shield shall be such that a minimum 6 inch horizontal clearance is maintained between the pipe and shield at all times

4. If the pipe has moved, it shall be reset to the proper line and grade.
5. Any voids between the trench box or shield and the undisturbed trenchwall within the pipe zone (bottom of trench to top of cover material) shall be filled with crushed stone, bank run gravel, or approved material, immediately after the box or shield is positioned.

END OF SECTION

SECTION 02200

EARTHWORK

PART 1 GENERAL

1.01 DESCRIPTION

A. Work under this Section includes providing all labor, material, and equipment to complete the earthwork required by the Contract Documents.
   1. The earthwork consists of but is not limited to:
      a. Structure excavation
      b. Trenching
      c. Providing borrow and off site fill materials
      d. Backfilling
      e. Compaction of materials.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 01300 Submittals
   2. Section 02140 Site Drainage and Dewatering
   3. Section 02150 Directional Drilling
   4. Section 02160 Support of Excavation
   5. Section 02210 Site Grading
   6. Section 02227 Rock Removal
   7. Section 02513 Asphaltic Concrete Pavement
   8. Section 02611 Ductile Iron Pipe and Fittings
   9. Section 02616 HDPE Drainage Pipe
   11. Section 02731 Plastic Pipe and Fittings
   12. Section 02740 Septic System

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. Use equipment adequate in size, capacity and numbers to accomplish the work of this Section in a timely manner.
   2. Comply with requirements of governmental agencies having jurisdiction.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Testing and Samples:
   1. Test reports on backfill materials, moisture density tests, in place density tests (ASTM D1557 and D6938).

2. Representative backfill and bedding samples and gradation tests (ASTM D6913).
3. Tests shall be in conformance with paragraph 3.11; compaction requirements and testing as specified herein.

1.05 REFERENCE STANDARDS

A. The Contractor shall comply with the provisions of the following agencies as they apply to this project and as referenced:
1. Associated General Contractors of America, Inc. (AGCA) "Manual of Accident Prevention in Construction."
2. Occupational Safety and Health Administration (OSHA), United States Department of Labor Requirements.
3. American National Standards Institute (ANSI) "Safety Requirements for Construction and Demolition."

B. The following American Society for Testing and Materials (ASTM) standards form a part of this specification as referenced:
1. ASTM C33 Standard Specification for Concrete Aggregates
2. ASTM D422 Particle-Size Analysis of Soils
3. ASTM D1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
4. ASTM D6913 Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis
5. ASTM D6938 Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

C. The following Massachusetts Department of Transportation (MassDOT) Standard Specifications for a part of the specification as referenced:
1. Section M1 Soils and Borrow Materials
2. Section M2 Aggregates and Related Materials

1.06 UTILITY COORDINATION

A. Utility agencies shall be contacted and advised of proposed work prior to the start of excavation by the Contractor.

B. The Contractor shall obtain information from the proper sources and authorities concerning locations of all utilities within the scope of this work.

C. If and when encountered, utilities shall be supported and protected, and the Engineer shall be notified. Ample time shall be allowed for entrance and taking such measures as may be required for the continuance of such services by the utility owners.

D. Rules and regulations governing the respective utilities shall be observed. Utilities shall not be removed or relocated except as indicated or directed.

1.07 PROJECT/SITE CONDITIONS

A. The Contractor acknowledges that they are satisfied as to the nature and location of the work. In general:
1. Local conditions, particularly those bearing upon:

a. Transportation, disposal, and handling and storage of materials,
b. Availability of labor,
c. Availability of water and electric power,
d. Access to locus.

2. The character of equipment and facilities needed prior to and during the execution of the work, and all other matters which can in any way effect the work or the cost thereof under this contract.

B. Any existing property boundary markers, control points and datum elevation markers or bench marks shall be preserved, and all such established survey points which are displaced or destroyed by the Contractor shall be replaced by a registered Engineer or Land Surveyor with all expenses for such replacement paid by the Contractor.

C. Extreme care shall be exercised to prevent damage to existing trees, shrubs, facilities, construction, utilities, fences, and private property that are to remain. Any damage to these items as a result of work performed by the Contractor shall be repaired by the Contractor at their own expense.

D. Any failure by the Contractor to acquaint himself with all available information concerning these conditions will not relieve him from the responsibility for estimating properly the difficulty or cost of successfully performing the work.

E. Finished subgrade shall not be disturbed and shall be maintained by the Contractor in good condition until the finished surfaces shall be installed without prior observation from the Engineer.

F. The Contractor shall prevent catch basins, drainage pipes and other structures associated with a stormwater management system from receiving silt and sediment from the project site. The Contractor shall be responsible for cleaning all structures that have received silt and sediment at no expense to the Owner.

PART 2 PRODUCTS

2.01 ORDINARY FILL

A. Ordinary fill shall be used for general raise-in-grade fill in proposed landscaping areas. It shall consist of inorganic soil from on-site cut areas with a maximum particle size of 8 inches and less than 60 percent passing the No. 200 sieve. The material shall be free from ice, snow, roots, surface coatings, sod, loam, clay, rubbish, and other deleterious matter. It is anticipated that typical material excavated on site will be able to be used as ordinary fill, subject to sieve analysis and final approval by the Engineer.

2.02 GRANULAR FILL

A. Granular fill shall be used for general raise-in-grade fill below proposed building areas and in pavement areas below the base course. It shall consist of inorganic soil and shall be free from ice, snow, roots, surface coatings, sod, loam, clay, rubbish, and other deleterious matter. It is anticipated that typical material excavated on site will be able to be used as granular fill, subject to sieve analysis and final approval by the Engineer.

1. On-Site granular fill shall be non-plastic as determined by Atterberg Limit tests (ASTM D4318) and shall be well-graded.
2. Granular fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
4-inch	100
No. 4	30-95
No. 40	15-75
No. 200	0-10

2.03 COMPACTED STRUCTURAL FILL/BASE COURSE

A. Compacted structural fill shall be used in dry areas as the base course layer directly beneath the floor slab, asphalt binder course in pavement areas, as the base course layer directly below Portland cement concrete pavement, and as needed between floor slabs and concrete encased piping as shown on the Drawings. Refer to the Geotechnical Engineering Report in Appendix A for additional information.

B. On-site materials are generally not suitable for use as structural fill. Structural fill shall be obtained from an approved off-site source.

C. Structural fill shall conform to the material and gradation requirements for one of the following MassDOT materials in Standard Specifications for Highways and Bridges, latest edition: Dense Graded Crushed Stone (Item M2.01.7), or Processed Gravel for Subbase (Item M1.03.1)

1. Base course processed gravel for subbase shall meet the following gradation requirements:

Processed Gravel for Subbase (Item M1.03.1)

Sieve Size	Percent Passing by Weight
3 inch	100
1½-inch	70-100
3/4-inch	50-85
No. 4	30-60
No. 200	0-10

Dense Graded Crushed Stone (Item M2.01.7)

Sieve Size	Percent Passing by Weight
2 inch	100
1 1/2 inch	70-100
3/4 inch	50-85
No. 4	30-55
No. 50	8-24
No. 200	3-10

2.04 3/4-INCH CRUSHED STONE

A. Crushed stone shall be used directly beneath any and all footings (with or without mud mats) as the base course material and beneath mats or structure bases in lieu of structural

fill in any area that is typically below the groundwater elevation where dewatering is necessary during construction to install a structure, and as specified on the Drawings.

B. It shall consist of hard, durable processed 3/4-inch crushed stone that meets the requirements for MassDOT, Item M2.01.4, Crushed Stone reproduced from the Massachusetts Standard Specifications for Highways and Bridges, latest edition.

1. Crushed stone shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
1-inch	100
3/4-inch	90-100
1/2-inch	10-50
3/8-inch	0-20
No. 4	0-5

2.05 BEDDING MATERIAL (For Piping and Conduits)

A. Gravel Bedding:

1. Where shown on the Drawings or required by the Engineer gravel bedding shall be placed in pipe trenches.
2. Except where directed otherwise by the Engineer, material for compacted gravel bedding shall be obtained from an off-site source and shall be crushed quarry rock or crushed gravel, free of organic and decomposable substances, and shall be well graded within the following limits:

Sieve Size	Percent Passing by Weight
1-inch	100
3/4-inch	90-100
3/8-inch	20-55
No. 4	0-10
No. 8	0-5

B. Sand Bedding:

1. Where shown on the Drawings or required by the Engineer, sand bedding material shall be placed as bedding in trenches where PVC pipe and conduit are laid and for the first 12 inches of backfill over all pipe or as indicated on the Drawings.
2. Sand bedding shall consist of clean, inert, hard, durable grains of rock free from loam or clay, surface coatings and deleterious materials primarily of particles with 100 percent passing the one inch sieve and shall be well graded within the following limits:

Sieve Size	Percent Passing by Weight
1/2-inch	90-100
1/4-inch	25-60
No. 40	5-25
No. 200	0-5

2.06 3/4-INCH DOUBLE WASHED CRUSHED STONE (for Septic)

A. Material used to bed and cover all underdrains and elsewhere as directed by the Engineer shall be 3/4 inch gravel or crushed stone with no less than 85 percent passing the 3/8-inch screen and 100 percent retained on the No. 35 screen.

Sieve Size	Percent Passing by Weight
1-inch	100
3/4-inch	90-100
1/2-inch	10-50
3/8-inch	0-20
No. 4	0-5

2.07 1 1/2-INCH DOUBLE WASHED CRUSHED STONE (for Leaching Basin)

A. Where shown on the Drawings or ordered by the Engineer, 1 ½-inch crushed stone shall consist of one of the following materials:
   1. Durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock and free from a determental quantity (greater than 15 percent total weight) of thin, flat, elongated (average width greater than four times average thickness) or other objectionable pieces.
   2. Durable crushed stone obtained by artificial crushing of gravel boulders or fieldstone with a minimum diameter before crushing of eight inches.
   3. 1 ½-inch crushed stone shall have the following gradation:

Sieve Size	Percent Passing by Weight
2-inch	100
1 1/2-inch	95-100
1-inch	35-70
3/4-inch	0-25

2.08 DENSE GRADED CRUSHED STONE AND PROCESSED GRAVEL SUBBASE (Gravel Roadways)

A. Dense graded crushed stone and process gravel subbase shall consist of crusher-run coarse aggregates of crushed stone or gravel and fine aggregates of natural sand or stone screenings uniformly premixed.
   1. Coarse aggregate shall consist of hard, durable particles of fragments of stone. The percentage of wear by the Los Angeles test shall not be more than 45.
   2. Fine aggregate shall consist of natural or crushed sand.

B. Dense graded crushed stone material shall meet the requirements for MassDOT, latest edition, Item M2.01.7, as specified in this Section in Paragraph 2.03. The composite material shall be free from clay, loam or plastic material.

C. The processed gravel subbase material used below the dense graded crushed stone shall comply with MassDOT, latest edition, Item M1.03.1, as specified in this Section in Paragraph 2.03. The composite material shall be free from clay, loam or plastic material.

2.09 CONCRETE SAND (SAND BED)

A. Concrete sand shall be clean granular sand, free from organic matter and deleterious material. Sand shall not contain any material larger than 2 inches.

B. The composite material shall be free from clay, loam or plastic material and shall have the following gradation:

Sieve Size	Percent Passing by Weight
2-inch	100
No. 4	100
No. 50	10-100
No. 100	0-20
No. 200	0-5

2.10 3-INCH RIP RAP

A. Where shown on the Drawings or ordered by the Engineer riprap shall be modified rockfill in accordance with M2.02.4.

B. Modified rockfill shall consist of hard, durable angular shaped stones which are the product of the primary crushing of a stone crusher. Rounded stone, boulders, sandstone and similar soft stone or relatively thin slabs will not be acceptable.

C. Stone shall be free from overburden, spoil, shale, organic material and meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
4-inch	100
3-inch	95-100
2-inch	0-25

2.11 6-INCH RIP RAP FOR OVERFLOW OUTLETS

A. Where shown on the Drawings or ordered by the Engineer riprap shall be modified rockfill in accordance with M2.02.4.

B. Modified rockfill shall consist of hard, durable angular shaped stones which are the product of the primary crushing of a stone crusher. Rounded stone, boulders, sandstone and similar soft stone or relatively thin slabs will not be acceptable.

C. Stone shall be free from overburden, spoil, shale, organic material and meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
8-inch	95-100
4-inch	0-25
2.5-inch	0-5

2.12 1/8-INCH TO 1/2-INCH PEASTONE (for Septic)

A. Peastone shall be used and as specified on the Drawings for septic system and roof recharge system applications.

B. Peastone shall consist of hard, semi-round aggregate that is clean, dry, and free of organic/deleterious material and meet the following gradation requirements

Sieve Size	Percent Passing by Weight
1/2-inch	100
3/8-inch	85-100
No. 4	10-30
No. 8	0-10

PART 3 EXECUTION

3.01 GENERAL EXCAVATION

A. Earth shall consist of all materials not classified as Rock in Section 02227, Rock Removal.
1. The Contractor shall perform all excavations for structures, trenches and appurtenant structures of every description and of whatever substances encountered, to the widths and depths indicated on the Drawings and as otherwise specified.

B. During excavations, material determined by the Engineer to be suitable for backfilling, shall be piled in an orderly manner a sufficient distance from the banks of the excavation to avoid overloading and to prevent slides or cave-ins, but within the limits of construction activities.

C. All excavated materials not required or suitable for backfill shall be removed and legally disposed of off-site.
1. Care shall be taken not to over excavate below the depths indicated unless otherwise authorized by the Engineer.
2. Unauthorized over excavations shall be backfilled at the Contractor's expense with approved granular fill material compacted to not less than 95 percent of maximum density as defined herein in dry areas and crushed stone as defined herein in wet areas.

D. Grading shall be done as necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved methods.

E. Unless otherwise specified, all excavations shall be open cut.

F. Bottoms of excavations shall be protected from frost.
1. Pipe, structures, or concrete shall not be placed on frozen ground.

3.02 STRUCTURE EXCAVATIONS

A. The areas to be occupied by structures shall be cleared of all natural obstructions and other items which will interfere with the construction operations.

1. The excavations shall conform to the dimensions and elevations indicated on the Drawings.
2. Excavations shall extend a sufficient distance from walls to allow for placing and removal of forms, installation of utilities and for inspection.
3. Where muck, peat, organic material or other wet or unsuitable material underlies the new structures, such material shall be removed and shall be replaced with crushed stone.
4. Excavation within the final 6 to 12 inches shall be made using a smooth-bladed bucket to limit disturbance to the subgrade material. Sub-grade shall be proof-rolled with a minimum of ten passes of a 15-ton vibratory roller.
5. Exercise care to preserve the material below and beyond the lines of excavation.
   a. All disturbed material shall be removed in its entirety.
6. Excavation below elevations shown or required for installation of required base materials that has not been directed by the Engineer shall be considered as unauthorized and shall be filled and compacted at the expense of the Contractor in accordance with subsection 3.01.C in this section to the proper sub-grade elevation in preparation for base materials specified.

3.03 TRENCH EXCAVATIONS

A. Trenches shall be excavated by open cut except in reaches where sheeting and shoring may be necessary for protection of the work and for the safety of personnel.

B. The width of the trench at a point 12 inches above the top of pipe shall be such that the clear space between the barrel of the pipe and the trench shall be carefully maintained to control the loads imposed on the pipe by the backfill.

C. Maximum allowable trench width is shown on the Drawings. Should the trench be made wider than these limits, the Contractor shall provide alternate methods of assuring proper field strength of pipe, by substitution of higher class pipe or by use of concrete cradle or encasement.

D. The width of the trench greater than 12 inches above the pipe may be as wide as necessary for sheeting and bracing and the proper performance of the work.

E. Elevations of pipes shown on the Drawings are invert elevations, unless designated otherwise. The bottom of the trench shall be excavated to a depth below the bottom of the pipe as shown on the Drawings and shall be backfilled as specified under subsection 3.10. of this specification section. Rock, if encountered, shall be excavated as specified in Section 02227, Rock Removal.

F. When wet or otherwise, unstable soil that is incapable of properly supporting the pipe, is encountered at the bottom of the trench, such soil shall be removed to the depth required and the trench backfilled with processed gravel or crushed stone as required by the Engineer.

G. When working within other resource areas, special care shall be taken to separate the soil strata. The upper soil material that contains the wetland seedbed shall be separated from the underlying soils and placed in separate stockpiles. The purpose of this is to maintain the existing soil strata when backfilling the trench within resource areas.

3.04 EXTRA EXCAVATION

A. No excavation shall be made below the limits of the excavation called for on the Drawings or herein specified without prior approval by the Engineer in writing. If the Contractor excavates below grade through error, for their own convenience or through failure to properly dewater the trench, or disturbs the subgrade before dewatering is sufficiently complete, they may be directed by the Engineer to excavate below grade in which case the work of excavating below grade and furnishing, placing and compacting the refill shall be performed at their own expense.

B. Whatever the nature of unsuitable material encountered or the groundwater conditions, trench drainage shall be complete and effective.

3.05 EXCAVATION NEAR EXISTING STRUCTURES AND UTILITIES

A. It is called to the attention of the Contractor that there may be above- and below-ground utilities along the course of the work. Information shown on the Drawings as to location is from best available sources, but no guarantee is inherent or to be assumed that such information is accurate or complete.

B. The Contractor shall exercise special care during operations to avoid injury to aboveground and underground utilities and structures. The Contractor shall cooperate with, and consult with representatives of the Owner and utility companies in order to avoid damage to the pipes and structures.

C. The Contractor shall furnish and erect suitable supports and shoring or other means of protection, all at their own expense, where required. Hand methods of excavating shall be used around buried utilities and included in the work to be done under this Contract, at no additional cost to the Owner.

3.06 TEST PITS

A. Where indicated on the Drawings, the Contractor shall excavate test pits to locate underground utilities, structures or determine soil conditions.

B. Size shall be just sufficient for the purpose intended and backfill shall meet all requirements of subsection 3.10.

3.07 PAVEMENT REMOVAL

A. The Contractor shall remove only as much existing pavement as necessary to do the work. Where excavations are to be made in paved surfaces, they shall cut the pavement ahead of the excavation before breaking it with pavement-breaking apparatus.

B. All pavement shall be cut with saws or pneumatic tools. Cutting and removal shall be done so as to produce relatively clean, uniform, vertical edges without damage to the remaining pavement.

C. Pavement removed shall not be mixed with other excavated material, but shall be disposed of away from the site of the work.

3.08 MAINTENANCE OF EXCAVATION

A. Support of Excavation:
   1. The Contractor shall be fully responsible for providing adequate support and protection of excavations, slopes, and earthbanks to prevent cave-ins, to protect persons and adjacent construction, and to permit proper execution of the work.
   2. Where such support requires shoring, sheeting or bracing, the work shall be as specified in Section 02160, Support of Excavation.

B Dewatering:
   1. All dewatering and site drainage shall be as specified in Section 02140, Site Drainage and Dewatering.

3.09 FILL AND BACKFILL FOR STRUCTURES AND GRADING

A. For site grading requirements see Section 02210, Site Grading.

B. No fill or backfill material shall be placed adjacent to concrete that is less than 7 days old.

C. Placement of Fill for Embankments:
   1. Fill material, conforming to the requirements of Part 2 and in accordance with the Drawings shall be placed in horizontal layers not exceeding 12 inches in loose thickness. After spreading and prior to compaction, all stones larger than 4 inches shall be removed from the fill material.
   2. No fill material shall be placed on a surface of frozen material nor shall snow, ice or frozen earth be incorporated in the fill. Fill material shall not be placed on material which, in the opinion of the Engineer, has been affected by frost or moisture.
   3. No fill material shall be placed on muck, peat or organic material.

D. Placement of Backfill Below and Around Structures:
   1. Filling shall consist of placing fill materials to provide foundation bedding and to refill excavations for footings, mud mats, foundation walls and floor slabs. The material used for fill shall be as specified in Part 2 for the particular use intended and shall be approved by the Engineer before use.
   2. A minimum 4-inch lift of crushed stone as specified in Part 2 shall be provided as the base material directly beneath any and all footings (with or without mud mats) as the base material, beneath mats or structure bases in wet areas, that are typically below the groundwater elevation, and as required on the Drawings. Structures requiring a base material of crushed stone at a depth greater than 4-inches shall be provided with crushed stone in accordance with the specific depth shown on the Drawings.
   3. A minimum 8-inch lift of compacted structural fill as specified in Part 2 shall be provided as the base material in dry areas directly beneath floor slabs, mud mats, asphalt binder course in pavement areas, Portland cement concrete pavement, and as needed between floor slabs and concrete encased piping as shown on the Drawings.
   4. No fill material shall be placed on a surface of frozen material nor shall snow, ice or frozen earth be incorporated in the fill material.
   5. Backfilling of structures shall be performed after the permanent work in the excavation has been inspected and approved and after all forms have been removed

and the excavation cleaned of trash and debris. Excavated material approved by the Engineer or approved granular fill as specified in Part 2 shall be used for backfill around structures.

6. Properly compacted granular fill can be used as general raise-in-grade backfill between footings and the required base material beneath all floor slabs, mud mats, structure bases, asphault pavement, and Portland cement concrete pavement.
7. Properly compacted ordinary fill can be used as general raise-in-grade backfill in proposed landscaping areas.
8. The backfill shall be thoroughly compacted in 12 inch lifts, or greater as required by the Engineer.
9. Required base materials shall be placed 12 inches beyond the widths of a utility structure foundation (base) and to a depth as required by this specification.

3.10 BACKFILL FOR TRENCHES

A. Backfill for trenches shall be carried out as soon as practicable after the pipes have been placed, jointed, and noted by the Engineer.

B. Approval for backfilling may be given by the Engineer, but unsatisfactory or unapproved materials shall be replaced by the Contractor at their own expense if later tests show defects.

C. The bottom of the trench shall be backfilled and thoroughly compacted from 6 inches below the pipe to the centerline of the pipe with gravel bedding to form a bed for the pipe and to the full width of the trenches. The bed shall be formed so that at least the lower half of the pipe shall rest firmly for the full length of the barrel except at the joints which shall be back filled and tamped when the joint is completed and pipe set to final grade. The space between the pipe and the sides of the trench shall be packed full and tamped. The filling shall be carried up evenly on both sides, care being taken not to disturb the pipe. While this part of the backfilling is being done, at least one man tamping shall be provided for each man shoveling backfill material into the trench. This material shall be placed in 8 inch layers and thoroughly compacted.

D. Where ledge and boulders have been removed, the Contractor shall furnish and place gravel bedding or 3/4-inch crushed stone, as required, at no additional expense to the Owner in the same manner as above.

E. Placement of Backfill above Gravel Bedding:

1. From the centerline of the pipe to a point 12 inches above the top of the pipe granular fill shall be placed by hand and hand tamped. Above this point, backfill shall be granular fill material as specified in Part 2 if trench is located below a pavement areas or ordinary fill as specified in Part 2 if trench is located below proposed landscaped areas. This backfill shall be placed in layers 12 inches deep or greater as required by the Engineer, and each layer shall be thoroughly compacted with mechanical tampers to the satisfaction of the Engineer. This backfill shall be carried up to the bottom of base materials specified to be placed for surfacing requirements.
2. In areas where the finished surface is to be landscaped, the Contractor shall complete the backfilling with the respective specified material to thoroughly compacted depths to the bottom of the landscape layer as required by the Drawings.

3. In areas where the finished surface is to be paved, the Contractor shall install and thoroughly compact 12 inches or of gravel base course material to a depth below the finished surface as required to allow for the pavement depth.

F. Where the excavated trench intersects the boundary of a Bank or other resource area, a 12-inch thick impermeable check dam shall be provided. The impermeable check dam shall consist of clay (1 x 10-7 permeability) installed 6 inches beyond the trench limits to a depth 12 inches below the bottom of the pipe and extending 18 inches above the top of the pipe.

G. When working within a Bank or other resource areas, the material to be installed above the pipe bedding shall be backfilled in a manner to maintain the existing soil strata (i.e., the excavated soil shall be returned to the trench in the order in which it was excavated).

H. Where the existing ground surface does not permit at least 5 feet of cover over the finished pipe, as indicated on the Drawings and as required by the Engineer, the Contractor shall place and thoroughly compact fill material to the depth necessary to provide the 5 foot minimum cover, including allowance for landscaping and minimum width at top of mound of 6 feet or as otherwise shown on the Drawings or as required by the Engineer. Minimum side slopes shall be three horizontal to one vertical, and the Contractor shall provide for drainage of uphill side of embankments as indicated on the Drawings. Fill material shall be clean, dry ordinary fill capable of satisfactory compaction, all as approved by the Engineer, and shall be placed in layers not exceeding 12 inches thick and compacted.

I. The trench shall be excavated in the compacted fill and the remainder of the work shall be in accordance with the other portions of these Specifications

3.11 COMPACTION REQUIREMENTS AND TESTING

A. All backfill materials shall be thoroughly compacted by rolling, tamping or vibrating with approved mechanical or pneumatic compacting equipment so that pipe, structures, paving and other construction will not settle at the time of construction or in the future. The responsibility for thorough compaction is that of the Contractor irrespective of methods of backfill and depth of backfill layers placed.

B. All percentages of compaction specified herein shall be of the maximum dry density at the optimum moisture content as established ASTM D1557 and verified by ASTM D6938. When the term “thoroughly compacted” is used in these specifications, it shall mean compaction to at least 95% of the maximum density of the soils at optimum moisture content.

C. The following numbers and types of soil tests shall be made where required by the Engineer. These tests shall be made by qualified personnel of an independent testing laboratory, acceptable to the Engineer and paid by the Contractor. Copies of all test results shall be available to the Contractor upon written request.

1. Particle-Size analysis of Soils and Backfill Materials in accordance with ASTM D6913. A minimum of one satisfactory test from each material in the field shall be submitted to the Owner and Engineer in addition to the initial shop drawings confirming material compliance with the specifications.
2. Moisture-Density Relationship of soil in accordance with ASTM D1557, Method D. A minimum of one satisfactory test from each material in the field shall be

submitted to the Owner and Engineer in addition to the initial shop drawings confirming material compliance with the specifications.

3. In-Place Density Tests of materials in accordance with ASTM D6938. Compaction tests will be taken at random on compaction layers below and at finished surfaces. Compaction testing frequency shall occur as outlined below, or as directed by the Engineer.
   a. Building Subgrade Areas and Foundation Walls, Including 5 feet Outside of Exterior Building Lines:
      i. Not less than one compaction test for every 10,000 sq. ft. for each lift.
   b. Pavement Areas:
      i. Not less than one compaction test for every 15,000 sq. ft. for each lift.
   c. Utility Trench Backfill:
      i. Intervals not exceeding 150 feet of trench for first and every other lift of compacted trench backfill.
4. Failed tests shall be repeated at the Contractor's expense.

D. The Owner reserves the right to have additional compaction tests performed by an independent laboratory with testing costs borne by the Owner, except that failed tests shall be repeated at the Contractor's expense.

E. If any of the field density test results fail to meet the density as specified herein for the earthwork involved, then the Contractor shall remove all of the earthwork in that portion of the work involved as required by the Engineer, and shall replace it in accordance with these specifications to the required density. After the work is replaced, additional field density tests will be made by an independent testing laboratory retained by the Owner and Engineer, and the Contractor shall reimburse the Owner for all costs for such additional testing.

F. Compaction shall be to the following densities:

Fill and Backfill Location	Modified Proctor (Percent)
Under structures and pipes	95
Beside structure foundation walls	95
Under pavements	95
Trenches through unpaved areas	90
In embankment	90

G. Crushed stone shall be compacted with at least 6 passes of a 10-ton vibratory roller or with a hand operated vibratory plate compatctor until firm and stable as required by the Engineer.

H. Puddling and jetting of the backfill shall not be permitted except in special cases approved by the Engineer.

3.12 DISPOSAL OF SURPLUS AND UNSUITABLE MATERIALS

A. Materials excavated or stripped during earthwork which are unsuitable for fill and backfill shall be removed from the site and legally disposed of off the Owner’s property. The Engineer shall be notified before removal of unsuitable material.

B. Surplus excavated materials shall be removed from the site and properly disposed of after approval is given by the Engineer. When so required by the Engineer, surplus excavated materials shall be placed on approved areas within the site.

C. The Contractor shall not dispose of surplus or unsuitable materials in wetlands or other areas prohibited by the Corps of Engineers, the State, the local Conservation Commission, or any other government agency having jurisdiction in such matters.

3.13 DUST CONTROL

A. The Contractor shall perform dust control operations, as specified in Section 01567.

3.14 SAFETY AND ACCOMMODATION

A. The Contractor shall provide, at their own expense, suitable bridges over trenches where required for the accommodation and safety of the traveling public, and provide facilities for access to private driveways for vehicular use. Contractor shall erect suitable barriers around the excavation to prevent accidents to the public and shall place and maintain during the night sufficient lights on or near the work.

B. A space of twenty (20) feet must be left so that free access may be had at all times to fire hydrants and proper precautions shall be taken so that the entrances to fire hydrants and fire stations shall not be blocked or obstructed.

3.15 CLEAN-UP

A. The Contractor shall remove all surplus materials (earth, pipe, fittings, storage and office trailers, barricades, etc.), from the construction site.
   1. All paved roadways affected by the construction shall have their full width swept clean (paved edge to paved edge) using methods which control the dust.
   2. Before the Contractor may proceed to another roadway, clean up of the previous roadway must be complete.

3.16 RECORD DRAWINGS

A. The Contractor shall record ties to all subsurface and concealed work in order to prepare as-built record drawings. The Contractor shall maintain a set of drawings on the project site that indicate ties to all subsurface and concealed installations for review by the Engineer or Owner. The Contractor shall submit as-built ties with application for payment on a monthly basis. Failure to submit as-built ties with application for payment will result in an incomplete application and may be returned to the Contractor.

END OF SECTION

SECTION 02210

SITE GRADING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Excavate, backfill, compact, and grade work associated with the water treatment facility and associated features to the elevations shown on the Drawings, as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 01050 Field Engineering
   2 Section 02110 Clearing and Grubbing
   3. Section 02140 Site Drainage and Dewatering
   4. Section 02200 Earthwork

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

PART 2 PRODUCTS

2.01 SOIL

A. Fill Material:
   1. The soil to be used for grading shall be obtained from the site cuts or a designated borrow area on the site.
   2. Do not permit rocks having a dimension greater than 8 inches in the upper 12 inches of fill or embankment.

2.02 TOPSOIL

A. Where shown on the Drawings or otherwise required, provide topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoils, roots, heavy or stiff clay, stones larger than 2 inches in greatest dimension, noxious weeds, sticks, brush, litter and other deleterious matter.

B. Obtain topsoil from sources within the project limits, or provide imported topsoil obtained from sources outside the project limits, or from both sources.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINISH ELEVATIONS AND LINES

A. Comply with pertinent provisions of Section 01050, Field Engineering.

3.03 PROCEDURES

A. Utilities:
1. Unless shown to be removed, protect active utility lines shown on the Drawings or otherwise made known to the Contractor prior to excavating. If damaged, repair or replace at no additional cost to the Owner.
2. If active utility lines are encountered, and are not shown on the Drawings or otherwise made known to the Contractor, promptly take necessary steps to assure that service is not interrupted.
3. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer.
4. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

B. Protection of Persons and Property:
1. Barricade open holes and depressions occurring as part of this work, and post warning lights on property adjacent to or with public access.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout, and other hazards created by operations under this Section.

C. Dewatering:
1. Remove all water, including rain water, encountered during trench and substructure work to an approved location by pumps, drains and other approved methods as specified in Section 02140.
2. Keep excavations and site construction area free from water.

D. Use means necessary to prevent dust becoming a nuisance to the public, to neighbors, and to other work being performed on or near the site.

E. Maintain access to adjacent areas at all times.

3.04 EXCAVATING

A. Perform excavating within the limits of the Work to the lines, grades, and elevations shown on the Drawings and specified herein.

B. Satisfactory Excavated Materials:
   1. Transport to, and place in, fill or embankment areas within the limits of the Work.

C. Excavate and backfill in a manner and sequence that will provide proper drainage at all times.

D. Ditches and Gutters:
   1. Cut accurately to the cross sections, grades and elevations shown.
   2. Maintain excavations free from detrimental quantities of leaves, sticks, trash and other debris until completion of the Work.
   3. Dispose of excavated materials as shown on the Drawings or directed by the Engineer.

E. Unauthorized Excavation:
   1. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific instruction from the Engineer.

F. Ground Surface Preparation:
   1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from the ground surface prior to placement of fills.
   2. Plow, strip, or break up surfaces steeper than one vertical to four horizontal (1:4), so that fill material will bond with existing services.
   3. When existing ground surface has a density less than that specified under "compacting" for the particular area, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.
   4. At exposed soils in areas to be paved, scarify to a minimum depth of 6 inches, and recompact at a moisture content that will permit proper compaction as specified for fill.

3.05 GRADING

A. General:
   1. Uniformly grade the areas within limits of grading under this Section, including adjacent transition areas.
   2. Smooth the finished surfaces within specified tolerance.
   3. Compact with uniform levels or slopes between points where elevations are shown on the Drawings, or between such points as existing grades.
   4. Where a change of slope is indicated on the Drawings, construct a rolled transition section have a minimum radius of approximately 8 feet, unless adjacent construction will not permit such a transition or if such a transition defeats positive control of drainage.

B. Grading Outside Building Lines:
   1. Grade areas adjacent to buildings to achieve drainage away from the structures, and to prevent ponding.

2. Finish the surfaces to be free from irregular surface changes, and:
   a. Shape the surface of areas scheduled to be under walks to line, grade and cross-section, with finished surface not more than 0.10 feet above or below the required subgrade elevation.
   b. Shape the surface of areas scheduled to be under pavement to line, grade, and cross-section, with finished surface not more than 0.05 feet above or below the required subgrade elevation.

3.06 COMPACTING

A. Control soil compaction during construction to provide the minimum percentage of density specified for each area.

B. Provide not less than the following maximum density of soil material compacted at optimum moisture content for the actual density of each layer of soil material in place, and as approved by the soils engineer.
   1. Structures:
      a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 95% of maximum density.
   2. Lawn and unpaved areas:
      a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 85% of maximum density.
      b. Compact the upper 12" of filled areas, or natural soils exposed by excavating, at 85% of maximum density.
   3. Walks:
      a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 95% of maximum density.
   4. Pavements:
      a. Compact the top 8" of subgrade and each layer of fill material or backfill material to 95% of maximum density for cohesive soil material.

C. Moisture Control:
   1. Where subgrade or layer of soil material must be moisture-conditioned before compacting, uniformly apply water to surface of subgrade or layer of soil material to prevent free water appearing on surface during or subsequent to compacting operations.
   2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compacting to the specified density.
   3. Soil material that has been removed because it is too wet to permit compacting may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value as determined by moisture-density relation tests approved by the Engineer.

3.07 FIELD QUALITY CONTROL

A. If, in the Engineer's opinion based on reports of the testing laboratory, subgrade or fills which have been placed are below specified density, provide additional compacting and testing under the provisions of Section 02200, of these Specifications.

3.08 MAINTENANCE

A. Protection of Newly Graded Areas:
   1. Protect newly graded areas from traffic and erosion, and keep free from trash and weeds.
   2. Repair and re-establish grades in settled, eroded and rutted areas to the specified tolerances.

B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape and compact to the required density prior to further construction.

END OF SECTION

SECTION 02227

ROCK REMOVAL

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Remove all rock encountered while excavating for structures, roadways, or utility trenches as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02200 Earthwork

1.03 DEFINITIONS

A. Rock excavation: Rock which requires explosives, wedging or impact hammer for its removal. Concrete shall be classified as rock.

B. Boulders, slabs or other single pieces of material encountered, which are less than one (1) cubic yard shall not be considered rock.

1.04 STANDARDS

A. All handling of explosives and blasting shall be in compliance with the pertinent sections of 527 Code of Massachusetts Regulations (CMR) 13.00.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Comply with all pertinent requirements of governmental agencies having jurisdiction.

1.06 SUBMITTALS

A. Submit plans for proposed pre-blast survey (Record purposes only).

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.01 NOTIFICATION

A. When rock is encountered, it shall be uncovered and the Engineer notified.
   1. The Contractor shall provide the Engineer with cross sections of the rock surface or a profile of the rock where trenches are concerned.
   2. The Engineer shall be present when the cross sections or profiles are taken.
   3. The average end area method shall be used in computing the volumes wherever practicable.

3.02 LIMITS OF EXCAVATION IN ROCK

A. Excavation in rock shall be performed, so that no projection shall come within vertical planes twelve (12) inches outside of the structure being built or twelve (12) inches below the bottom of the structure base slab and footings.

B. In trenches, the rock shall be removed to the limits shown on the typical trench section.
   1. Where excavation is carried beyond the above determined limits, the additional space shall be refilled at the Contractor's expense with concrete or other specified materials.

3.03 BLASTING

A. Pre-Blast Survey: Prior to any blasting, the Contractor shall submit a pre-blast survey.
   1. The survey shall satisfy the insurance requirements of the Contractor and be acceptable to the Contractor's insurance carrier, as well as provide data to assess damages to personal property and real estate due to blasting operations.
   2. The survey shall be complete as warranted by the nature of the work.

B. Take all precautions necessary to warn and/or protect any individuals exposed to his operations. Such precautions shall include but not be restricted to the following:
   1. Present written certificate of insurance showing evidence that his insurance includes coverage for blasting operations, before doing any blasting work.
   2. Make necessary arrangements as may be required by the applicable Federal, State, County or Municipal codes, rules, regulations and laws, and shall be responsible for compliance.
   3. Obtain a permit from the local authorities to perform blasting operations.
      a. The Engineer shall be notified in writing that such permit has been obtained.
   4. Schedules for blasting shall be thoroughly coordinated with the proper authorities – Federal, State and Local.
      a. No blasting shall be done unless the Contractor has notified all concerned parties that he may blast.
      b. The Contractor shall also notify any commercial installation in the immediate area whose operations or instrumentation may be affected by blasting, at least twenty four (24) hours prior to blasting operations.
   5. Seismographic recordings shall be made of all blasting operations on the project by a qualified testing agency hired and coordinated by the Contractor.
      a. A copy of these recordings shall be made available to the Engineer.
   6. Blasting shall be performed by persons who are licensed to use explosives.

7. The Contractor shall keep an accurate record of each blast and submit a copy to the Engineer. The record shall show the date, time, exact stationing of the blast, the depth and number of drill holes, and kind and quantity of explosive used, and any other data required for a complete record.
8. The Contractor shall be fully responsible for damages caused by his blasting operations.
9. If rock below the limits of excavation is shattered by blasting, caused by holes drilled to deep, too heavy a charge of explosives or any other circumstance due to blasting, the shattered rock shall be removed and the void refilled with gravel borrow at the expense of the Contractor.
    a. Gravel borrow shall be as specified in Section 02200 Earthwork.

3.04 DISPOSAL AND REPLACING OF ROCK

A. Remove and dispose of all pieces of rock which are not suitable for use in other parts of the Work.
    1. Rock disposed of by hauling away to spoil areas shall be replaced by surplus excavation obtained elsewhere on the site, insofar as it is available.

B. Fragments of rock approximately twenty five (25) pounds or less may be used in the fill areas of the site (roadway areas excluded).
    1. The Contractor shall place these pieces of rock in thin layers alternating them with layers of earth to be sure that all voids between the rock are completely filled with earth.
    2. If in the opinion of the Engineer the quantity is excessive, he may order the removal and disposal of the rock.

C. Be responsible for obtaining spoil locations and the removal of all excess rock from the site.

END OF SECTION

SECTION 02273

GEOTEXTILE FABRIC

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide nonwoven geotextile fabric in foundation preparation for separation of existing soil from screened gravel or crushed stone.

B. Provide woven geotextile fabric for temporary road reinforcement and riprap separation as indicated or specified.

1.02 RELATED WORK

A. Documents affecting the work of this section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these Specifications
   1. Section 02200 Earthwork
   2. Section 02210 Site Grading
   3. Section 02513 Asphaltic Pavement

1.03 STANDARDS

A. American Society for Testing and Materials (ASTM) Publications:
   1. D4355: Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon ARC Type Apparatus.
   2. D4491: Test Methods for Water Permeability of Geotextile by Permittivity.
   3. D4533: Test Method for Trapezoid Tearing Strength of Geotextiles.
   4. D4632: Test Method for Grab Breaking Load and Elongation of Geotextiles.
   5. D4751: Test Method for Determining Apparent Opening Size of a Geotextile.
   6. D4833: Test Method for Index Puncture Resistance of Geotextiles, Geomembrances and Related Products

1.04 SUBMITTALS

A. Submit the following in accordance with Section 01300:
   1. At least two weeks prior to shipment, submit manufacturer's certificate of compliance and physical property data sheet indicating that requirements for materials and manufacture are in conformance as specified.
   2. For informational purposes only, submit manufacturer’s printed installation instructions.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Producer of geotextile fabric to maintain competent laboratory at point of manufacture to insure quality control in accordance with ASTM testing procedures. Laboratory to maintain records of quality control results.

C. Do not expose geotextile fabric, except the geotextile fabric for silt fence, to ultraviolet radiation (sunlight) for more than 14 days total in period of time following manufacture until geotextile fabric is installed and covered with fill or backfill material.

D. Take all precautions to protect geotextile fabric from damage resulting from any cause. Either repair or replace geotextile fabric to Engineer's satisfaction at no additional cost to the Owner.

1.06 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01610.

B. Provide geotextile fabric in rolls wrapped with protective covering to protect geotextile fabric from mud, dirt, dust, and debris. Label each roll of geotextile fabric with number or symbol to identify production run.

C. Protect geotextile fabric from sunlight during transportation and storage. Do not leave geotextile fabric exposed to sunlight for more than two weeks during installation operations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide the following nonwoven geotextile fabric:
1. Geotex 501 as manufactured by Propex.
2. Mirafi 160N as manufactured by TenCate Geosynthetics.
3. 150 EX as manufactured by Thrace – LINQ, or acceptable equivalent product.

B. Provide the following woven geotextile fabric except for silt fence:
1. 200 ST as manufactured by Propex.
2. Mirafi 500X as manufactured by TenCate Geosynthetics.
3. GTF 200 as manufactured by Thrace-LINQ, or acceptable equivalent product.

2.02 MATERIAL

A. Geotextile fabric shall conforms to test requirements for minimum average roll value (weakest principle direction) for strength properties of any individual roll tested from manufacturing lot or lots of particular shipment in excess of minimum average roll value (weakest principle direction) as specified hereafter:

B. Physical Properties of Minimum Average Roll of the nonwoven geotextile fabric shall be:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs	150 (min.)
2. Grab Elongation	D4632	%	50 (min.)
3. Trapezoidal Tear Strength	D4533	lbs	60 (min)
4. Puncture Strength	D4833	lbs	75 (min.)
5. Permittivity	D4491	sec -1	1.3 (min.)
6. Apparent Opening Size	D4751	Sieve Number	70-100
7. Ultraviolet Stability	D4355	Percent	70 (min.)

C. Woven geotextile fabric, except for silt fence, shall be:

Property	ASTM Test Method	Units	Value
1. Grab Strength	D4632	lbs	200 (min.)
2. Grab Elongation	D4632	%	15 (min.)
3. Trapezoidal Tear Strength	D4533	lbs	75 (min.)
4. Puncture Strength	D4833	lbs	80 (min.)
5. Permittivity	D4491	sec -1	0.02 (min.)
6. Apparent Opening Size	D4751	Sieve Number	30-70
7. Ultraviolet Stability	D4355	Percent	70 (min.)

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install geotextile fabric in accordance with manufacturer's printed instructions.

B. Place geotextile fabric on the foundation subgrade prior to placing the screened gravel or crushed stone.

C. Overlap geotextile fabric 18 inches minimum for unsewn lap joint. Overlap fabric 6 inches at seam for sewn joint.

D. Do not permit traffic or construction equipment to travel directly on geotextile fabric.

E. Place geotextile fabric in relatively smooth condition to prevent tearing or puncturing. Lay geotextile fabric loosely but without wrinkles or creases so that placement of the

backfill materials will not stretch or tear geotextile fabric. Leave sufficient slack in geotextile fabric around irregularities to allow for readjustments.

F. Patch all tears in geotextile fabric by placing additional section of geotextile fabric over tear with a minimum of 3 feet overlay.

G. Extend the geotextile fabric and wrap around the screened gravel or crushed stone along the perimeter of the foundation.

3.02 CONTRACT CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02513

ASPHALTIC PAVEMENT

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide asphaltic pavement and appurtenant items as required by the Contract Documents.
   1. In general the Contractor shall provide all labor, equipment, and materials, and perform all operations in connection with the installation of asphaltic pavement, berms, pavement markings, calcium chloride, final grade adjustments of valve boxes, manhole and catch basin castings, and preparation of the trench.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02200 Earthwork

1.03 STANDARDS

A. All paving shall comply with the Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges, hereinafter called Standard Specifications, as referenced.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

PART 2 PRODUCTS

2.01 GRAVEL SUBBASE

A. Shall be as specified in Section 02200, Earthwork.

2.02 ASPHALTIC PAVEMENT

A. Bottom and Top Course:
   1. Shall be Class I asphaltic pavement conforming to Sections 420, 460 and M3 of the Standard Specifications.

2.03 ASPHALT TACK COAT

A. Shall consist of either emulsified asphalt, grade RS-1 conforming to Section M3.03.1, or cutback asphalt, grade RC-70 or RC-250 conforming to Section M3.02.0 of the Standard Specifications.

2.04 PAVEMENT MARKING PAINT

A. Shall be High Heat Rapid Drying Traffic Marking Material conforming to Section M7.01.08 (White High Heat Rapid Drying Traffic Marking Material) and Section M7.01.09 (Yellow High Heat Rapid Drying Traffic Marking Material) of the Standard Specifications, as applicable.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FINAL PREPARATION OF SUBGRADES

A. Gravel Subbase:
   1. Minimum compacted depth shall be shown on details, of 12 inches as measured from the bottom of the pavement.
   2. Spread and compacted in layers not exceeding 6 inches in depth, compacted measurement.
   3. All layers shall be compacted to not less than 95 percent of the maximum dry density of the material as determined by the standard AASHTO Test Designation T99 Compaction Test Method C at optimum moisture content.

3.03 GENERAL

A. All asphaltic pavement thickness referred to in this Section shall be compacted thickness.

B. No asphaltic pavement shall be placed when the air temperature is below forty (40) degrees Fahrenheit, or when the material on which the mix is to be placed contains frost.

C. Maintain asphaltic pavement under this Contract during the guarantee period of one (1) year.
   1. Promptly refill and re-pave all areas which have settled or are otherwise unsatisfactory for traffic.

3.04 PLACEMENT OF ASPHALTIC CONCRETE PAVEMENT

A. Temporary Pavement
   1. Place after underground facilities have been installed.
   2 Pavement shall be the type as specified in this Section except that “cold-mix” will be acceptable for repairs during seasonal closure of the asphalt concrete supplier.

3. Compacted thickness shall be 2 inches unless otherwise detailed on the Drawings.

B. Bottom Course:
1. Shall be utilized as the base course of the permanent resurfacing.
2. Remove temporary pavement, square up all edges and prepare base course as specified in this Section.
3. Edges of the trench shall be cut back in a neat true line, twelve (12) inches outside all limits of the excavation with a water cooled abrasive saw.
4. Edges of the existing pavement shall be brushed clean and the specified tack coat applied.
5. Pavement compacted thickness shall be a minimum of two (2) inches, placed in a single lift unless otherwise detailed on the Drawings.
6. Placed with a self-propelled spreader.
7. Compaction shall be accomplished with a self-propelled roller, with a weight of approximately 285 pounds per inch of roller width.
8. Bottom course pavement shall be maintained by the Contractor until permanent top course pavement is placed.

C. Trench Top Course Resurfacing:
1. Bottom course pavement shall remain in place.
2. The bottom course shall be swept clean of all foreign matter and loose material.
3. Depressions in the bottom course resurfacing shall have a leveling course applied before the top course paving begins.
4. The surface receiving the top course shall be completely dry prior to the application of the tack coat.
5. Tack coat shall be applied at the rate of 0.25 gallons per square yard. The contact surface of the curbing, castings and other structures shall be painted with the tack coat.
6. All castings (frames and covers, valve boxes), shall be raised to finish grade before the top course is applied.
7. The equipment used for spreading and finishing shall be a mechanical self-powered paver capable of spreading and finishing the mixture true to line, grade, width and crown by means of fully automated controls for both longitudinal and transverse slope.
8. Top course pavement compacted thickness shall be as detailed on the Drawings.
9. Compaction shall be accomplished with a self-propelled roller with a weight of approximately 285 pounds per inch of roller width.

D. Full Width Cold Plane and Overlay
1. The Contractor shall, in preparation for overlay, mill the entire width of roadway to be paved in the area required by the Drawings.
2. The surface of the original pavement shall be thoroughly patched, cleaned, and tack coated just prior to applying the overlay.
3. The surface receiving the overlay resurfacing shall be completely dry prior to the application of the tack coat.
4. Tack coat shall be applied at the rate of 0.25 gallons per square yard.
   a. The contact surface of the curbing, castings and other structures shall be painted with the tack coat.
5. The full depth of the overlay shall consist of a 2-inch hot mix asphaltic concrete wearing course.

6. Part of the temporary trench pavement shall not be removed by the milling process. Approximately 3-inches shall remain in place after milling.
    a. The Contractor shall remove and replace any loose or broken paving or cold patch with asphaltic concrete pavement as required.
7. After all loose and broken paving has been removed and replaced, the Contractor shall bring to subgrade, low or settled areas of temporary pavement and the existing pavement with a leveling course of asphaltic concrete.
8. The equipment used for spreading and finishing shall be a mechanical self-powered paver capable of spreading and finishing the mixture true to line, grade, width and crown by means of fully automated controls for both longitudinal and transverse slope.
9. The overlay shall be keyed to the existing pavement at its beginning, end, side streets and driveways by cutting a four (4) inch wide by one (1) inch deep key into the existing pavement.
    a. The key shall have tack coating applied.
    b. After the overlay has been placed a sand seal shall be applied to these edges.
10. Pavement markings shall be provided as specified in this Section.

3.05 CASTING ADJUSTMENTS

A. Where asphaltic pavement is to be applied, manhole and catch basin frames and valve boxes are to be adjusted to the grade of the new pavement.
    1. A neat line shall be cut in the pavement around the existing frames and valve boxes.
    2. The material; gravel, pavement and concrete collar (if applicable) shall be removed down to six (6) inches below the frame.
    3. The frame shall be freed from its existing grout bed and shimmed with steel shims of the appropriate thickness, at a minimum of four (4) alternate locations, so as to ensure that the frame will not rock. The frame shall then be set into a full bed of grout, and a concrete collar placed around the frame, up to within two (2) inches of finish grade.
    4. The frame shall be protected from damage from traffic until the concrete has taken a firm set.

3.06 BERMS

A. Asphaltic Pavement Berms:
    1. Berms shall be class I asphaltic Type I-1.
    2. The mixture shall be placed and compacted with a machine acceptable and approved by the Engineer, for the type of berm required.
    3. Placing and forming of berms by hand shall not be allowed.

3.07 DUST CONTROL TREATMENT

A. Calcium chloride shall be applied only upon direction of the Engineer.
    1. The roadway shall be swept clean and calcium chloride spread at a uniform rate over the prepared gravel trench surface.

3.08 PAVEMENT MARKINGS

A. Pavement markings shall be applied as shown on the contract drawings or at locations directed by the Engineer.
   1. Pavements shall have been in place 48 hours prior to the application.
   2. The surface shall be prepared to accept the application in compliance with the paint manufacturer's requirements.
   3. Applied to a dry film thickness of fifteen (15) mils.
   4. The temperature of the pavement shall be between forty (40) degrees and one hundred twenty (120) degrees Fahrenheit.
   5. No thinners are to be used for the pavement markings.
   6. The equipment used for the application of pavement markings, shall be of standard commercial manufacturer. All other equipment and devices necessary for the application of pavement markings and protection thereof and for the protection of the traveling public, shall be as usually required for work of this type, and shall be furnished by the Contractor.
   7. Pavement markings shall be either a single continuous line or broken line, four (4) inches wide.
   8. If for any reason material is spilled or tracked on the pavement or any markings applied by the Contractor the Contractor shall remove such material.
      a. The material shall be removed by a method that is not injurious to the roadway surface and is acceptable to the Engineer.
      b. Clean the roadway surface and prepare the surface for a re-application of the pavement markings.

END OF SECTION

SECTION 02514

SIDEWALKS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: The work of this Section shall consist of furnishing all labor, materials and equipment required for installing sidewalks to conform to lines and grades shown on the Drawings.

B. Additional Work: The work in this Section shall consist of furnishing and installing all labor, materials and equipment required for install of either driveway or sidewalk transitions adjacent to or abutting concrete or bituminous sidewalks. In general, the Contractor shall match the material types and adjust cement or bituminous pavement for any changes in grade.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
1. Section 02200 Earthwork
2. Section 02513 Asphaltic Pavement
3. Section 03300 Cast-In-Place Concrete

PART 2 PRODUCTS

2.01 CEMENT CONCRETE SIDEWALKS

A. Cement concrete for sidewalks shall conform to Class A cement concrete (3500 psi) as specified in Section 03300.

B. Curb ramps and driveway transitions shall conform to Class A concrete (3500 psi) as specified in Section 03300.

2.02 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. Gradation requirements for gravel subbase shall be as specified in Section 02222 for structural fill.

2.03 BITUMINOUS CONCRETE SIDEWALKS

A. Bituminous concrete for bituminous sidewalks shall be as specified in Section 02513.

PART 3 EXECUTION

3.01 CEMENT CONCRETE SIDEWALKS

A. The subgrade for the sidewalks shall be shaped parallel to the proposed surface of the walks and shall be thoroughly compacted.

B. After the subgrade has been prepared, a foundation of gravel shall be placed upon it. After being compacted thoroughly, the foundation shall be at least 8 inches in thickness and parallel to the proposed surface of the walk. The gravel shall be compacted to not less than 95% of maximum density as defined in Section 02222.

C. Side forms and transverse forms for sidewalks shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the proposed walk.

D. The edge shall conform to the grade of the finished walk and shall have sufficient pitch to provide for surface drainage and shall not exceed 1/4 of an inch per foot.

E. The cement concrete sidewalks shall be placed in alternate slabs 24 feet in length except as otherwise ordered. The slabs for sidewalks shall be separated by transverse preformed expansion joint fillers 3/8 inch in thickness. Sidewalk and driveway expansion joints shall be 3/8" x 4" preformed ethylene vinyl acetate or closed cell polyethylene foam material.

F. Preformed expansion joint filler shall be placed adjacent to or around existing structures as directed.

G. The cement concrete shall be placed in such quantity that after being thoroughly consolidated in place it shall be 4 inches in depth. At driveways, the sidewalks shall be 6 inches in depth. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel-troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. After troweling, the surface shall be brushed by drawing a soft bristled push broom with a long handle over the surface of the cement concrete to produce a non-slip surface.

H. The surface of all cement concrete sidewalks shall be uniformly scored into block units of areas not more than 24 square feet. The depth of the scoring shall be at least one quarter of the thickness of the sidewalk.

I. The application of neat cement to surfaces in order to hasten hardening is prohibited.

J. The finishing of concrete surface shall be done by experienced and competent cement finishers. When completed the walks shall be kept moist and protected from traffic and weather for at least 3 days.

K. At driveways or street intersections the cement concrete shall be blended or tappered to cap the end of either concrete or granite curbing to form a smooth transition.

3.02 CURB RAMPS AND DRIVEWAYS

A. The subgrade for the sidewalks shall be shaped parallel to the proposed surface of the walks and shall be thoroughly compacted.

B. After the subgrade has been prepared, a foundation of gravel shall be placed upon it. After being compacted thoroughly, the foundation shall be at least 8 inches in thickness and parallel to the proposed surface of the walk.

C. Side forms and transverse forms for sidewalks shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the proposed walk.

D. The edge shall conform to the grade of the finished walk and shall have sufficient pitch to provide for surface drainage and shall not exceed 1/4 of an inch per foot.

E. The concrete ramps and driveway transitions shall be placed in alternate slabs 24 feet in length except as otherwise ordered. The slabs for sidewalks shall be separated by transverse preformed expansion joint fillers 3/8 inch in thickness. Ramps and driveway expansion joints shall be 3/8" x 4" preformed ethylene vinyl acetate or closed cell polyethylene foam material.

F. Handicap ramps and curb ramps at intersections shall be constructed in accordance with the Americans with Disabilities Act (ADA) Accessibility Guidelines (Jan 1998 edition) and in accordance with dimensions and minimum slopes presented in the design drawing(s) details.

G. Preformed expansion joint filler shall be placed adjacent to or around existing structures as directed.

H. The cement concrete in driveways shall be placed in such quantity that after being thoroughly consolidated in place it shall be 6 inches in depth. The cement concrete in sidewalk or curb ramps shall be 4 inches in depth except in conjunction with driveway areas. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel-troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. After troweling, the surface shall be brushed by drawing a soft bristled push broom with a long handle over the surface of the cement concrete to produce a non-slip surface.

I. At driveways, street intersections or sidewalk ramps the concrete shall be blended or tapered to cap the end of either concrete or granite curbing to form a smooth transition.

3.03 REMOVAL AND RELAYING OF EXISTING SIDEWALKS

A. The Contractor shall maintain access to all abutting business for the full duration of the Contract.

B. The Contractor shall remove and reset all existing castings in the sidewalk layout. If the existing castings are damaged as part of the Contractors sidewalk removal operations, the casting shall be replaced at the Contractor's expense. The work shall include any

coordination required with public or privately owned utilities with equipment set in the sidewalk layout.

C. The Contractor shall make every effort to minimize damage to existing tree and root systems. In the case of excessive damage, which if determined by the OWNER will result in the death of the tree, the Contractor will be held fully responsible for replacement of the trees at no additional expense to the OWNER.

A. All existing curbs, bituminous sidewalks, brick sidewalks, concrete sidewalks, private or public walks, fences, stone walls and other similar items removed for the construction of the services, connections, water and/or storm drain lines shall be replaced in a manner equal or better than their original condition.

3.04 TRANSITIONS TO WALKWAYS AND DRIVEWAYS

A. The Contractor shall furnish and install a transition to the existing sidewalks and driveways to match the existing grades. The transition can vary from 6 inches to 3.0 feet wide depending on the location. The transition shall meet the Americans with Disabilities Act (ADA) requirements as specified herein under Item 3.02(F). The Contractor shall match the existing walk or driveway material type (i.e. cement concrete of asphaltic pavement). Any damage to the existing sidewalks or driveways, as a direct result of the Contractor's operations. shall be restored by the Contractor to the original conditions at no additional expense to the OWNER.

B. All costs related to replacement, furnishing, and installing the transitions shall not be measured for separate payment.

END OF SECTION

SECTION 02515

GRANITE CURBS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: The work of this Section shall consist of furnishing all labor, materials and equipment required for installing and setting curb(s), curb corners and edging on a gravel foundation, to conform with lines and grades shown on the Drawings.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
1. Section 02200 Earthwork
2. Section 02514 Concrete Sidewalks
3. Section 03300 Cast-In-Place Concrete

PART 2 PRODUCTS

2.01 GRANITE CURBING

A. Granite curbing shall type VA-4 conforming to the requirements specified in Subsection M9.04.1 of the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

B. All granite curb and edging shall be light gray in color, free from seams and other structural imperfections or flaws which would impair its structural integrity, and of a smooth splitting appearance.

C. Whenever curbing is sawed, all surfaces that are to be exposed shall be thoroughly cleaned and any iron rust or iron particles removed by sand blasting or other approved method and any saw mark in excess of 1/8 inch shall be removed.

2.02 CURB CORNERS (Bullnose Corners)

A. The granite for curb corners shall conform to M9.04.0 and shall have horizontal Beds. The curbs shall match the adjacent curbing in size, color and quality. The front arris lines shall extend through ¼ of a circle having a radius of 2 feet Type A curb corners. The back arris line shall be straight. The plane of back shall be normal to top.

2.03 GRANITE CURB INLETS (Throat Stone)

A. The granite curb inlets shall conform to Subsection M9.04.0 of the Mass Highway Department Standards. The curb inlets shall be horizontal bed with tops free from wind.

B. The curbing shall be sawn or peen hammered on top and the front face shall be straight split, free from drill holes.

C. The inlet curb shall be six (6) feet in length and 16-19 inches in depth. The curb shall be six (6) inches wide at the top and at least six inches wide at the bottom.

D. The mouth of the curb inlet shall be at least three (3) inches in depth and at least two (2) feet in length. The inlet curb shall be cut in the front face of the stone and the inlets shall match the adjacent curbing in color.

2.04 GRAVEL

A. Gravel shall conform to the requirements of Subsection M1.03.0 Type C of the Massachusetts Highway Department Standard Specifications for Highways and Bridges.

PART 3 EXECUTION

3.01 EXCAVATING TRENCH AND PREPARING FOUNDATION

A. The trench for the curb shall be excavated to a width of 18 inches. The subgrade of the trench shall be a depth below the proposed finished grade of the curb equal to 6 inches plus the depth of the curbstone. The trench for the curb corner shall extend 6 inches beyond the front and back of curb corner to the full depth of foundation.

B. The foundation for the curb shall consist of gravel spread upon the subgrade and after being thoroughly compacted by tamping shall be 6 inches in depth.

3.02 SETTING CURB AND EDGING

A. All spaces under the curb, curb corners or edging shall be filled with gravel thoroughly compacted so that the curb, curb corners or edging will be completely supported throughout their length.

3.03 FILLING ABOUT TRENCH

A. After the curb, curb corners, curb inlets and edging is set, the space between it and the wall of the trench shall be filled with gravel thoroughly tamped to the depth directed, care being taken not to affect the line or grade of the curb, curb corners, curb inlets and edging.

3.04 POINTING

A. The joints between curbstones or edging shall be carefully filled with cement mortar and neatly pointed on the top and front exposed portions. After pointing, the curbstones or edging shall be satisfactorily cleaned of all excess mortar that may have been forced out of the joints.

3.05 TRANSITION CURB FOR WHEELCHAIR RAMPS

A. Transitions from normal curb settings to wheelchair ramps shall be accomplished with transition curb as shown on the Drawings. Transitions shall be of the same type of curb and similar to that abutting and, if on a curve, of the same radius.

END OF SECTION

SECTION 02611

DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Provide buried ductile iron water mains, fittings, and other appurtenances as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.

1. Section 02140 Site Drainage and Dewatering
2. Section 02160 Support of Excavation
3. Section 02200 Earthwork
4. Section 02640 Buried Valves and Appurtenances
5. Section 02645 Hydrants
6. Section 02650 Thrust Blocks and Joint Restraints
7. Section 02675 Disinfection of Water Mains and Water Storage Facilities
8. Section 02676 Testing Piping Systems

1.03 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 of this Section.

B. Coordinate the work of this Section with the work of other related Sections.

C. All pipe materials and lubricants in contact with water shall be NSF approved for use with potable water.

D. All pipe materials and lubricants in contact with water shall be NSF approved for use with potable water.

1.04 INSPECTION, TESTS AND ACCEPTANCE

A. All pipe delivered to the job site shall be accompanied by test reports certifying that the pipe conforms to AWWA C151 for Ductile Iron Pipe, Centrifugally Cast.

B. All tests shall be made in accordance with the methods prescribed by the above mentioned AWWA Standard, and the acceptance or rejection shall be based on the test results.

C. Pipe which does not conform to the requirements of this contract shall be immediately removed from the site and replaced by the Contractor with pipe which does conform.

1.05 STANDARDS

A. The following American Water Works Association (AWWA) standards form a part of this specification as referenced:
   1. AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   2. AWWA C105 Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. AWWA C110 Ductile-Iron and Gray-Iron Fittings.
   4. AWWA C111 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. AWWA C150 Thickness Design of Ductile-Iron Pipe.
   6. AWWA C151 Ductile-Iron Pipe, Centrifugally Cast.
   7. AWWA C153 Ductile-Iron Compact Fittings.
   8. AWWA C600 Installation of Ductile Iron Mains and Their Appurtenances.

1.06 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

PART 2 PRODUCTS

2.01 PIPE

A. Ductile Iron Pipe (Buried Service):
   1. All pipe shall meet the requirements of ANSI/AWWA C151/A21.51.
   2. Class: 52
   3. Joints:
      a. Mechanical meeting the requirements of ANSI/AWWA C111/A21.11.
      b. Push-on meeting the requirements of ANSI/AWWA C111/A21.11.
   4. Gaskets: Conform to ANSI/AWWA C111/A21.11.
   5. Lining: Conforming to ANSI/AWWA C104/A21.4
   6. Thickness of cement-mortar lining:
      a. 1/8 inch for pipes 12 inches and smaller.
      b. 3/16 inch for pipe 14 inches and larger.
   7. Cement-mortar lining to be seal coated per AWWA C104.
   8. Accessories: Pipe shall be provided with all necessary accessories to make-up the joint (glands, tee head bolts, hex nuts, etc.).

2.02 FITTINGS

A. Fittings:
   1. Comply with ANSI/AWWA C153/A21.53.
   2. Pressure rating: 350 psi.
   3. Lining and coating: Same as pipe.
   4. Joint: Mechanical joint in compliance with ANSI/AWWA C111/A21.11.
   5. Markings on fittings: Comply with ANSI/AWWA C110/A21.10.

2.03 SPECIAL FITTINGS

A. Locking Hydrant Tees: Shall be mechanical joint, each having a bell and plain end, with a split mechanical joint on the plain end. Gate valve shall be secured directly to the tee by using the standard mechanical joint gasket and standard bolts.

B. Retainer Glands: See Section 02650, Thrust Blocks and Joint Restraints.

C. Couplings: Shall be cast or ductile iron, consisting of a middle ring, two (2) rubber gaskets, and the followers with stainless steel bolts and nuts. Coupling and gasket shall be sized for the particular application intended. Couplings shall be as manufactured by Smith-Blair.

D. Plugs: Shall be ductile iron with mechanical or push-on joint and retainer feature.

E. Sleeves: Shall be ductile iron with mechanical joint, long body style meeting or exceeding the requirements of ANSI/AWWA C110/A21.10 or latest revision thereto.

F. Transition Couplings: As required for joining pipes of different diameters shall be furnished as required and designed for compatibility with the pipe and operating pressures encountered.
   1. Transition couplings shall be Dresser Style 162 as manufactured by Dresser Industries Inc., or an approved equal.

G. Caps: Shall be ductile iron with mechanical or push on joint and shall be provided with joint restraint.

2.04 IDENTIFICATION DEVICES

A.. Warning Tape
   1. Material: Polyethylene, 4-mil gauge with detectable strip.
   2. Color: Blue
   3. Width: Minimum 6 inches
   4. Designation: Warning on tape that water pipe is located below tape.
   5. Identifying Letters: Minimum 1-inch-high permanent black lettering imprinted continuously over entire length.
   6. Manufacturers and Products:
      a. Panduit; Type HTDU.
      b. Reef Industries; Terra Tape.

2.05 FIELD APPLIED PIPE INSULATION

A. The insulation shall be a minimum of two (2) inches thick having a density of 2.0 lbs. per cubic foot, and having a K-Factor of 0.14. The insulation shall be fabricated in half sections of three-foot lengths. The half section shall fit tightly over the pipe to be insulated except for the joint and fitting locations where an oversized cover shall be made to allow for any hardware.

B. Insulation shall be Trymer 2000 as manufactured by Insulated Piping Systems, Inc. or approved equal.

C. Jacketing to go over the insulation below ground shall be C.I. Wrap 50 as manufactured by Insulated Piping Systems, Inc. or approved equal. The jacket shall be wrapped around the circumference of the insulation and held in place with a 4-inch butt strip at each seam.

2.06 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which the work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure precise fit of the items.

3.03 GENERAL

A. Earthwork:
1. Trench, backfill and compact for the work of this Section in strict accordance with the pertinent provisions of Section 02200, Earthwork.
2. Shoring for the work of this Section shall be in strict accordance with Section 02160, Support of Excavation.
3. Control of ground and surface water shall be in strict accordance with Section 02140, Site Drainage and Dewatering.

3.04 PIPE HANDLING

A. Handling:
1. 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.
2. Pipe shall be stored a minimum 4 inches above ground at a height no greater than 5 feet, and with even support for the pipe barrel.
3. Only nylon-protected slings shall be used for handling the pipe. No hooks or bare cables shall be permitted.
4. Gaskets shall be shipped in cartons and stored in a clean area, away from grease, oil, heat, direct sunlight and ozone producing electric motors.

3.05 INSTALLATION

A. Pipe:
1. Installation and jointing of ductile iron pipe shall be in accordance with AWWA C600 Sections 9b and 9c, latest revision, as applicable.
2. In general, jointing of ductile iron push-on pipe and fittings shall be done as follows.

3. The last 8 inches of the outside of the spigot end of the pipe and the inside of the bell end of pipe shall be thoroughly cleaned.
4. The joint surfaces and the gasket shall be painted with a lubricant, provided by the pipe manufacturer, just prior to making up the joint. The spigot end shall then be gently pushed home into the bell.
5. The position of the gasket shall be checked to insure that the joint has been properly made and is watertight.
6. Care shall be taken not to exceed the manufacturer's recommended maximum deflection allowed for each joint.
7. When laying is not in progress, including lunch time, the open ends of the pipe shall be closed by a watertight plug.
8. When cutting of pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe.
   a. Cut ends of pipe to be used with a push-on type bell shall be beveled to conform to the manufactured spigot end.
   b. Cement lining shall be inspected for damage and shall be remortared as required to ensure a continuous lining.

B. Caps and Plugs:
1. Shall be provided with a threaded corporation or bleeder valve so that air and water pressure can be relieved prior to future connection.

C. Thrust Blocking for Fittings:
1. As specified in Section 02650, Thrust Blocks and Joint Restraints.

D. Couplings:
1. Contractor shall provide all adapters and fittings such as transition couplings, as determined in the field, necessary to complete all tie-ins, whether or not specifically stated in the Specifications or on the Contract Drawings.

3.06 SPECIAL CONDITIONS

A. Under no conditions shall ductile iron pipe be installed within 5 feet of gas lines without written permission from the Engineer at the discretion of the Owner.

3.07 TESTING

A. Comply with the pertinent sections of Section 02676, Testing Piping Systems.

3.08 DISINFECTING

A. Comply with the pertinent sections of Section 02675, Disinfection of Water Mains and Water Storage Facilities.

END OF SECTION

SECTION 02616

HDPE DRAINAGE PIPE

PART 1 GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish HDPE pipe and fittings, joining materials, labor, tools, and equipment necessary to install the pipe as indicated on the Drawings and as herein specified.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02200 Earthwork
   4. Section 02700 Precast Concrete Structures

1.03 SUBMITTALS

A. Manufacturer's Certificate of Compliance, shop drawings and descriptive literature shall be required for approval of HDPE pipe and fittings showing pipe dimensions, joint details, method of construction, and technical specifications for each type, class, and size of pipe to be furnished.

B. All pipe delivered to the job site shall be accompanied by test reports and notarized affidavits certifying that the pipe and fittings conform to the requirements of the specifications.

1.04 ACCEPTABLE MANUFACTURERS

A. The HDPE pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the pipe to be furnished.
   1. The pipe shall be designed, constructed, and delivered in accordance with the best practices and methods.

PART 2 PRODUCTS

2.01 CORRUGATED POLYETHYLENE PIPE

A. Pipe for drainage work shall be pipe conforming to ASTM F405, Standard Specification for Corrugated Polyethylene Pipe, unless otherwise indicated on the drawings. The pipe shall be Advanced Drainage Systems (ADS) N-12 as manufactured by Eastern Pipe Products Company (EPPCO) or approved equal. The pipe joints shall be soil-tight and gaskets, when applicable, shall meet the requirements of ASTM F477.

B. The pipe shall be installed in accordance with manufacturer's recommendations and guidelines.

PART 3 EXECUTION

3.01 PIPE HANDLING

A. The Contractor shall arrange for the delivery of the pipe sections at approved locations in the vicinity of that portion of the line in which the pipe sections are to be laid. To this end, he shall do such work as is necessary for access and for delivery of the pipe.

B. Pipes shall be stored in an approved, orderly manner so that there will be a minimum of rehandling from the storage area to the final position in the trench and so that there is a minimum obstruction and inconvenience to any kind of traffic.

1. All pipe is to be loaded, unloaded and stockpiled in strict conformance with the manufacturer's recommendations.
2. All stockpiled pipe shall be stored on a flat shaded area in order to provide uniform support of the full pipe barrel and minimize bowing of the pipe.
3. Pipe shall be covered with tarpaulin or other approved material to protect the pipe from ultraviolet damage.
4. Deliveries shall be scheduled so that the progress of the work is at no time delayed and also so that large quantities of pipe shall not be stored for excessive lengths of time in crowded locations or in locations where large storage areas might be considered objectionable.
5. Storage of pipe will be restricted to approved or permitted areas.
6. Each pipe section shall be handled into its position in the trench in such a manner recommended by the manufacturer as to cause no injury to the workmen, pipe or to any property.
7. The Contractor shall be required to furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from delivery areas to the trench shall be restricted to operations that can cause no injury to the pipe units.
8. Under no circumstances shall the pipe be dropped from trucks or into the trench.
9. The Contractor shall have on the job site with each pipe laying crew all the proper tools to handle and cut the pipe.

3.02 CONTROL OF ALIGNMENT AND GRADE

A. The Contractor shall established benchmarks along the route of the pipeline at convenient intervals for reference in checking the pipe and manhole invert and other elevations throughout the project.

B. The Contractor shall use a laser beam to assist in setting the pipe and shall demonstrate satisfactory skill in its use.

1. The laser beam projector shall be rigidly mounted with two-point suspension to its support platforms.
2. The Contractor shall ensure that all ground equipment vibrations will be kept to a minimum to permit the laser beam to project itself coaxially through the center of the pipe.

3. All units shall have equipment to control atmospheric conditions in the pipe that could affect the acceptable standard of construction.
4. The laser shall be operated by competent, trained personnel.
5. The Contractor shall establish centerline and offset stakes at each manhole, plus one intermediate centerline and offset stakes as a checkpoint between manholes.
6. Laser aligning shall not be used to establish a continuous line in excess of 600 feet.

C. During construction, the Contractor shall provide the Engineer, at his request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, taking quantities and checking location of the work, including the furnishing of one (1) or two (2) rodmen or chainmen as needed at intermittent times.

3.03 PREPARATION OF BED

A. As soon as the excavation is completed to the normal grade of the bottom of the trench, gravel bedding shall be placed immediately in the trench and compacted, and then the pipe shall be firmly bedded in the gravel bedding to conform accurately to the lines and grades indicated on the Drawings.
1. The compacted bed shall be shaped so that the bottom quadrant of the pipe shall rest firmly for the full length of the barrel.
2. Suitable holes for bells or couplings shall be dug around the pipe joints to provide ample space for making tight joints.
3. It shall be the Contractor's responsibility to control any water in the trench below the pipe invert and he shall place clay or other impermeable material in the bedding at intervals to prevent horizontal movement of the groundwater, which might induce settling of the bed, or make it difficult to handle water in the trench.

3.04 LAYING PIPE

A. All pipe shall be laid with extreme care as to grade and alignment.
1. Each pipe shall be laid so as to form a close joint with next adjoining pipe and to bring the inverts continuously to required grade.
2. Each pipe length shall be inspected for excessive discoloration, blisters, pitting, cracks, holes, foreign inclusions, straightness and other injurious defects before lowering in place.
3. In order to insure minimum amount of movement or disturbance, no more than two lengths of pipe may be laid before backfilling with gravel to a minimum of twelve inches over the pipe.
4. Pipe shall be laid in the dry and at no time shall water in the trench be permitted to flow into the pipe.
5. The pipe shall be laid on the trench bedding as shown on the Drawings.
6. Laying and jointing shall be in accordance with the manufacturer's instructions and appropriate ASTM Standards, and the Contractor shall have on hand for each pipe-laying crew, the necessary tools, gauges, mechanical saws, mechanical bevelers, etc., necessary to install the pipe in a good workmanlike manner.

END OF SECTION

SECTION 02640

BURIED VALVES AND APPURTENANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide buried valves, valve boxes, and valve accessories, as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02200 Earthwork
   4. Section 02611 Ductile Iron Pipe and Fittings

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. An exploded view diagram with a materials list.

1.04 STANDARDS

A. The following American Water Works Association (AWWA) standards form a part of this specification as referenced:
   1. AWWA C515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
   2. AWWA C504 Rubber-Seated Butterfly Valves.

1.05 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All of the types of valves and appurtenances shall be products of established firms who are experienced in the manufacture of the particular item to be furnished.
   1. All valves and their appurtenances shall be of domestic manufacture.

PART 2 PRODUCTS

2.01 VALVES

A. Resilient Seated Gate Valves: Shall be used on all water mains less than sixteen (16) inches in diameter and all hydrant branches.
   1. Valves shall be as manufactured by Mueller or approved equal.
   2. Meet or exceed the requirements of ANSI/AWWA C515.
   3. Joints: Mechanical joint conforming to ANSI/AWWA C111/A21.11.
   4. Ductile iron body.
   5. Bronze stem.
   6. Resilient sealed wedge type:
   a. Wedge: Fully encapsulated; no exposed iron.
   7. Triple O-ring seal stuffing box.
   8. Non rising stem.
   9. Two (2) inch square operating nut.
   10. Rated for 250 psi and tested to 500 psi.
   11. Open: Clockwise (right).
   12. All internal and external surfaces except rubber coatings shall be coated with fusion bonded epoxy to a minimum thickness of 8 mils:
      a. Coating shall be non-toxic, impart no taste to water and shall conform to AWWA C-550.

B. Butterfly Valves: Shall be used on all water mains sixteen (16) inches in diameter and larger:
   1. Designed specifically for underground service meeting or exceeding ANSI/AWWA C504, Class 250B, or approved equal.
   2. Joints: Mechanical joint conforming to ANSI/AWWA C111/A21.11.
   3. Cast iron body meeting or exceeding the requirements of ASTM A126, Class B.
   4. Disc shall be ductile iron:
      a. Disc edge shall be 316 stainless steel.
   5. Type 304 stainless steel shaft.
   6. Shaft seal shall be 'V'-type Chevron.
   7. Totally enclosed and permanently sealed gearing.
   8. Two (2) inch square operating nut.
   9. Rated for 250 psi and tested to 500 psi.
   10. Open: Clockwise (right).
   11. All internal iron surfaces shall be coated with fusion bonded epoxy to a minimum thickness of 8 mils:
      a. Coating shall be non-toxic, impart no taste to water and shall conform to AWWA C-550.
   12. Valves shall be Mueller Co. Lineseal XP or approved equal.

2.02 VALVE BOXES

A. Valve boxes shall be provided for each buried valve. They shall be:
   1. Domestic manufacture.
   2. Cast iron with a cast iron cover.
   3. Cover shall have the word "WATER" cast into the cover in raised letters.
   4. Valve box barrel shall not be less than (5-¼) inches in diameter.
   5. Shall be two (2) piece sliding type, providing a minimum overlap of six (6) inches.

6. The lower section shall enclose the operating nut and stuffing box/gear box of the valve and shall have a minimum diameter of 8 inches.
7. The box shall not transmit shock or stress to the valve.

PART 3 EXECUTION

3.01 HANDLING AND INSPECTION

A. 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.

B. All operating mechanisms operated to check their proper functioning, and all nuts and bolts checked for tightness. Valves which do not operate easily or are otherwise defective shall be replaced at the Contractor's expense.

3.02 INSTALLATION

A. General:
1. Construction methods for the work under this Section shall conform to the applicable portions of Section 02611, Buried Ductile Iron Pipe and Fittings, details as shown on the Contract Drawings, manufacturer's recommended installation procedures, and procedures specified herein.

B. Valves and Appurtenances:
1. Generally, valves shall be set and aligned plumb, supported by a flat stone or solid concrete block, with the trench bottom being firmly compacted.
2. Valve boxes shall be set centered and plumb over the operating nuts of all, direct burial valves. The top of each valve box shall be set to finished grade with at least 10 inches of overlap remaining between the upper sections for future vertical adjustment. Minimum overlap for lower, extension pieces shall be 6 inches.
3. Valves, bolts and all other appurtenances shall be thoroughly cleaned and given a shop coat of asphaltum varnish.
4. Ferrous surfaces obviously not to be painted shall be given a shop coat of grease or other suitable rust-resistant coating.

END OF SECTION

SECTION 02645

HYDRANTS AND SAMPLING STATIONS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide hydrants and sampling stations as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02222 Earthwork
   2. Section 02611 Ductile Iron Pipe and Fittings
   3. Section 02640 Buried Valves and Appurtenances
   4. Section 02650 Thrust Blocks and Joint Restraints
   5. Section 02660 Service Connections

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed, to insure compliance with the specified requirements.

1.04 STANDARDS

A. The following American Water Works Association (AWWA) Standards form a part of this specification as referenced:
   1. AWWA C502 Dry-Barrel Fire Hydrants.

B. All of the types of valves and appurtenances shall be products of established firms who are experienced in the manufacture of the particular item to be furnished.
   1. All valves and their appurtenances shall be of domestic manufacture.

PART 2 PRODUCTS

2.01 HYDRANTS

A. Hydrants shall be Mueller Centurion A-423, American Darling B62-B, or approved equal:
   1. Barrel sections shall be 5-1/4 inch diameter.
   2. Five (5) foot six (6) inch bury.
   3. Two (2) 2-1/2 inch hose nozzles.
   4. One (1) 4 inch NST pumper outlet.
   5. Replaceable brass nozzles.

6. Breakaway flange.
7. Mechanical joint shoe.
8. Open: Clockwise (right).
9. Be in full compliance with AWWA C502.

B. Hydrants shall conform to National Standard Spcification sizes in threads and nuts. Caps shall have retainer chains and rubber gaskets.

2.02 HYDRANT EXTENSION

A. Extension Kit: If required to meet grade on site:
1. Shall be provided by the hydrant manufacturer.
2. Length shall be as needed to meet finish grade.

2.03 SAMPLING STATIONS

A. Sampling stations shall be 5-foot bury, with a ¾" FIP inlet and untreaded nozzle, and shall be Eclipse No. #88 manufactured by Kupferle Foundry Company, St. Louis, MO, or equal.
1. Station shall be enclosed in a lockable, non-removable, aluminum-cast housing.
2. When opened, the station shall not require a key for operation and shall shall flow in all brass waterway.
3. All working parts shall be of brass and removable from above ground with no digging.
4. Exterior casing pipe shall be brass.
5. A copper vent tube will enable station to be pumpedfree of standing water to prevent freezing and to minimize bacteria growth.
6. Accessories shall include:
a. Vinyl cap to protect sampling nozzle (Kupferle Part No. 88-25).
b. Aluminum base (Kupferle Part No. X882).
c. Large drain pump (Kupferle Part No. Z88PS).

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and condition under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 FIELD MEASUREMENTS

A. Make necessary measurements in the field to assure fit of items.

3.03 PROPOSED HYDRANT LOCATIONS

A. All new hydrant and sampling station locations shown on the Contract Drawings shall be subject to field location approval by the Owner or the Engineer.

3.04 INSTALLATION

A. Hydrants and Sampling Stations:

1. Trench, backfill and compact for the work of this Section in strict accordance with pertinent provisions of Section 02222, Earthwork.
2. The hydrant drainage pit shall be approximately three (3) feet in diameter and filled with compacted crushed stone. While backfilling, place additional crushed stone to at least six (6) inches above the hydrant drain ports.
3. After being thoroughly cleaned, all iron work set below ground shall be painted with two coats of asphalt varnish as specified in AWWA C504.
4. Thrust blocking shall be placed behind the shoe of the hydrants, taking care not to block the drain outlets.
5. Hydrants and sampling stations shall be set plumb and to the proper grade and shall remain properly supported until it is backfilled.
6. All iron work left above ground shall be shop painted with two coats of paint of quality and color to correspond to the present standard of the Owner.
7. After the hydrant has been set, it shall be entirely draped with burlap and remain covered until the water distribution system has been accepted and put into service.

END OF SECTION

SECTION 02650

THRUST BLOCKS AND JOINT RESTRAINTS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide thrust blocks and joint restraints for the water mains as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02222 Earthwork

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed, to insure compliance with the specified requirements.

PART 2 PRODUCTS

2.01 POURED CONCRETE THRUST BLOCKS

A. Concrete shall be as specified in Section 03300, Cast-In-Place Concrete.
   1. Minimum concrete strength shall be 3,000 psi after 28 days.

2.02 PRECAST THRUST BLOCKS

A. Thrust blocks shall be precast concrete blocks.
   1. Minimum concrete strength shall be 3,000 psi after 28 days.
   2. Precast concrete blocks shall have built in recessed handles for lifting.

2.03 JOINT RESTRAINTS

A. Mechanical joint restraint shall be Megalug 1100 Series as manufactured by EBAA Iron Sales Inc., Eastland, Texas, or an approved equal
   1. All mechanical joint restraint glands shall come complete with all required accessory packs as needed
   2. Glands shall be manufactured of ductile iron conforming to ASTM A536.
   3. Restraint devices for mechanical joint fittings and appurtenances conforming to either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53.

4. Restraint devices for nominal pipe sizes 3 inch through 48 inch shall consist of multiple gripping wedges incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10.
5. The devices shall have a working pressure rating of 350 psi for 3-16 inch and 250 psi for 18-48 inch. Ratings are for water pressure and must include a minimum safety factor of 2 to 1 in all sizes.
6. Gland body wedges and wedge actuating components shall be cast from grade 65-45-12 ductile iron material in accordance with ASTM A536.
7. Ductile iron gripping wedges shall be heat treated within a range of 370 to 470 BHN.
8. Three (3) test bars shall be incrementally poured per production shift as per Underwriter's Laboratory (U.L.) specifications and ASTM A536. Testing for tensile, yield and elongation shall be done in accordance with ASTM E8.
9. Chemical and nodularity tests shall be performed as recommended by the Ductile Iron Society, on a per ladle basis.
10. An identification number consisting of year, day, plant and shift (YYDDD)(plant designation)(Shift number), shall be cast into each gland body.
11. All physical and chemical test results shall be recorded such that they can be accessed via the identification number on the casting. These Material Traceability Records (MTR's) are to be made available, in hard copy, to the purchaser that requests such documentation and submits his gland body identification number.
12. Production pieces that are too small to accommodate individual numbering, such as fasteners and wedges, shall be controlled in segregate inventory until such time as all quality control tests are passed. These component parts may then be released to a general inventory for final assembly and packaging.
13. All components shall be manufactured and assembled in the United States. The purchaser shall, with reasonable notice, have the right to plant visitation at his/her expense.
14. Mechanical joint restraint shall require conventional tools and installation procedures per AWWA C600, while retaining full mechanical joint deflection during assembly as well as allowing joint deflection after assembly.
15. Proper actuation of the gripping wedges shall be ensured with torque limiting twist off nuts.
16. Restraint devices shall be Listed by Underwriters Laboratories (3" through 24" inch size) and Approved by Factory Mutual (3" through 12" inch size).

2.04 OTHER MATERIALS

A Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 THRUST BLOCKS

A. Concrete thrust blocks shall be provided at all hydrants and fittings.
1. The backs of thrust blocks shall be placed against undisturbed earth and the sides shall be formed.
2. Felt roofing paper shall be placed to protect pipe joints.
3. Concrete shall not be placed over bolts or nuts.

3.02 JOINT RESTRAINTS

A. Mechanical joint restraint devices shall be installed at all fittings in accordance with the manufacturer's written instructions.

END OF SECTION

SECTION 02660

SERVICE CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Work included: Provide potable water service connections as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02222 Earthwork
   2. Section 02611 Ductile Iron Pipe, Valves, Apputenances and Fittings

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed, to insure compliance with the specified requirements.

1.04 STANDARDS

A. The following Standards form a part of these Specifications as referenced:
   1. AWWA C800 Underground Service Line Valves and Fittings.
   2. ASTM B-88 Type K Copper Tubing

1.05 QUALITY ASSURANCE

A. Codes and Standards
   1. Plumbing Code Compliance: Comply with applicable portions of National Standard Plumbing Code pertaining to selection and installation of potable water system materials and products.
   2. Water Purveyor Compliance: Comply with requirements of Purveyor supplying water to project, obtain required permits and inspections.

B. Compliance
   1. The Owner may require an affidavit from the manufacturer or vendor that the products furnished comply with all applicable provisions of AWWA C800 and ASTM B-88.

1.06 COMPLIANCE WITH REDUCTION OF LEAD IN DRINKING WATER ACT AND SECTION 1417 OF THE SAFE DRINKING WATER ACT (SDWA)

A. All pipes, pipe fittings, plumbing fittings and fixtures must meet the requirements of the 2011 Reduction of Lead in Drinking Water Act and amendments to SDWA Section 1417 for potable water use.

B. Certification of compliance shall be provided for all applicable materials herein.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials shall be of domestic manufacture.

B. The Owner has standardized on the following products listed in this Section for service connections.

2.02 SERVICE TUBING

A. Copper Water Tubing
1. Conform to to the provisions of ASTM B-88.
2. Size: As indicated on the Drawings.
3. Type K annealed (soft).
4. Seamless.

2.02 CORPORATION STOPS

A. Corporation Stop: Shall be as manufactured by Mueller, Ford, or an approved equal.
1. Test Pressure: 175 psi.
2. Full keyway and rigid liners.
3. Compression ends.
4. Size: As required by the service tubing.
5. Comply with AWWA C800, Underground Service Line Valves and Fittings.

2.03 CURB STOPS

A. Shall be as manufactured by Mueller, Ford, or an approved equal.
1. Open: Counterclockwise (Left).
2. Full key with rigid liners.
3. Compression ends.

2.04 CURB BOXES

A. Curb boxes shall be of domestic manufacture by Ford, Hayes, or Mueller.
1. Erie type, tar coated, cast iron, arch pattern base with inlaid covers.
2. Covers shall be arch base style with brass pentagon nut, flush mounted, plug cover, with a 24-inch rod and the word “water” shall be cast into the cover.
3. Curb box shaft shall have a minimum inside diameter of 1-inch.

2.05 SERVICE SADDLE

A. Service saddle shall be of domestic manufacture as manufactered by Mueller or equal.
   1. Rated for 200 psi working pressure.
   2. Double strap design.
   3. Brass body.
   4. O-ring sealed outlet.
   3. Epoxy coated ductile iron body.
   4. AWWA threads with Buna-N rubber gasket.
   5. Meet all applicable parts of ANSI/AWWA C800.

PART 3 EXECUTION

3.01 INSPECTION

A. Service tubing which does not conform to the requirements of this specification shall be immediately removed from the site by the Contractor

3.02 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.

3.03 SERVICE LOCATIONS AND SHUT-DOWNS

A. All new service locations shown on the Contract Drawings shall be subject to field location approval by the Engineer and/or Owner.

B. Where a water service must by shut-down, it shall be the Contractor's responsibility to contact the party owning the service to arrange a shut-down schedule prior to doing any work.
   1. All such schedules must be approved prior to shut-down.
   2. Shut-down time shall be kept to a minimum so as to keep service off for the shortest possible time.

3.04 INSTALLATION OF TUBING

A. Service Tubing.
   1. Where directed by the Engineer, the Contractor shall install new services including 1-inch and 2-inch tubing.
   2. For services outside the paved areas, trench excavation shall be utilized, with tubing being carefully laid in the bottom of the trench, backfill placed and compaction completed.
      a. Care shall be taken to insure against kinks or crushed areas.
   3. Backfill around and to one (1) foot over the tubing shall not contain stones greater than one (1) inch in diameter.
   4. For services to be installed beneath paved surfaces, a pneumatic drive device such as “Hole Hog” or equal, trenchless method, shall be utilized to drive the new service beneath the pavement, where feasible. No additional payment shall be made if services are installed by other methods of construction.

5. Service tubing between the corporation stop and the curb stop shall be one (1) piece.
6. Service tubing between the curb stop and the house shall be one (1) piece. Coupling shall not be allowed except for two (2) inch services greater than 200 feet in length.
7. Tubing shall be connected to the curb stop and compression joints tightened.
8. Duct tape shall be installed over the outlet end of curb stops, to be left for future connections.
9. A no. 12 trace wire shall be installed on all service lines.
    a. The trace wire on the service tubing between the corporation and curb stops shall be stripped at both ends, connected to the corporation and curb stop and looped around the service tubing every three (3) feet.
    b. The trace wire on the service tubing between the curb stop and residence shall be stripped at both ends, connected to the curb stop and the one (1) inch angle valve, and looped around the service tubing every three feet.

3.05 HOUSE CONNECTIONS

A. For complete service connections to homes, service tubing shall be laid as shown on the Drawings (see par. 3.03).
    1. Contractor shall coordinate work on private property with the individual homeowners.
    2. Contractor shall inspect the property and interior service entrance locations prior to installation to become fully aware of potential obstructions.

3.06 APPURTENANCES

A. Corporation Stops.
    1. Provide the necessary tap, sized for the fitting.

B. Curb Stops and Boxes.
    1. Install curb stops where shown on the Drawings.
    2. Place valve box over stop, taking care that it is installed plumb.
    3. Curb stops shall be key checked after adjustment of curb box to final grade.
        a. If curb stop is not centered in the box the box shall be removed and reset over the curb stop.

END OF SECTION

SECTION 02675

DISINFECTION OF WATER MAINS AND WATER STORAGE FACILITIES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Disinfecting water mains and their appurtenances, as required by the Contract Documents.

B. The procedure for disinfecting water mains, as described in this section, generally consists of the following steps:
1. Inspecting materials to be used to ensure their integrity.
2. Preventing contaminating materials from entering the water main during storage, construction, or repair and noting potential contamination at the construction site.
3. Removing, by flushing or other means, those materials that may have entered the water main or appurtenances.
4. Preventing contamination of existing mains from cross-connection during flushing, pressure testing, and disinfection.
5. Pressure testing the water main to ensure the main meets the specified allowable leakage rate. Hydrostatic pressure tests should be conducted with potable water.
6. Chlorinating and adequately documenting the process used for disinfection.
7. Flushing the chlorinated water from the main. Refer to ANSI/AWWA C655 Field Dechlorination for dechlorination procedures, if dechlorination is required.
8. Determining the bacteriological quality of water samples collected from the pipe by laboratory test after disinfection.
9. Final connecting of the newly disinfected water main to the active distribution system without sacrificing sanitary practices and conditions.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
1. Section 02611 Ductile Iron Pipe and Fittings
2. Section 02676 Testing Piping Systems

1.03 SUBMITTALS

A. The Contractor shall prepare a plan for disinfecting water mains and their appurtenances that describes the proposed schedule, the location of all sampling and flushing points, and the overall procedure for disinfecting. The plan shall also present the proposed chemicals to be employed, the strength of the chemicals and the equipment employed to apply them. The plan shall be presented to the Engineer for review not less than two weeks prior to the proposed time for disinfecting the water mains.

B. Copies of all test results, as specified herein, shall be submitted directly to the Engineer from the laboratory that conducted the tests.

1.04 STANDARDS

A. The following standards form a part of this specification as referenced:
   1. AWWA C651 Disinfecting Water Mains (most recent edition)
   2. AWWA C652 Disinfection of Water Storage Facilities

1.05 COSTS ASSOCIATED WITH TESTING

A. All costs associated with disinfecting water mains, tanks, and storage facilities, including water, chemicals and bacteriological analysis of samples, as further described in this Section, shall be paid for by the Contractor.
   1. Duplicate samples collected by Engineer for bacteriological analysis will be paid for by the Owner.

B. The Owner shall furnish water free for flushing and testing the water main if hydrants or other connection points are convenient to the work. Otherwise, the Contractor shall be responsible for securing an acceptable potable water supply at no additional cost to the Owner. Additional water required for flushing and re-testing as a result of bacteriological testing or Contractor's error shall be billed to the Contractor at the DPW's normal billing rate.

C. The Contractor shall be responsible for maintaining all water mains and tanks in a disinfected condition up to the date of Substantial Completion. The Contractor shall be responsible for performing bacteriological testing within three days (3) of the Contractor's request for Substantial Completion to demonstrate compliance with this requirement.

PART 2 MATERIALS

2.01 WATER

A. Water for flushing of water mains, preparation of chlorine solutions and filling of water mains for disinfection shall be potable drinking water.

2.02 CHEMICALS

A. Chlorine for preparation of chlorine solutions for disinfection shall be sodium hypochlorite or calcium hypochlorite and shall conform to the requirements of ANSI/AWWA B300, AWWA C651, and AWWA C652.

B. Chlorine solutions shall be neutralized prior to disposal using sodium bisulfite, sodium sulfite or sodium thiosulfate.

2.03 WATER SAMPLE BOTTLES

A. Sterile water sample bottles shall be obtained from a state certified laboratory.
   1. Sterile bottles for bacteriological analyses shall be treated with sodium thiosulfate to neutralize any residual chlorine.
   2. Two samples are required at each specified sampling point. One sample shall be analyzed for the presence of coliform bacteria and one sample shall be analyzed for the presence of heterotrophic plate count (HPC) bacteria.

PART 3 EXECUTION

3.01 WATER LINES

A. After completion of all water main related construction, except water service connection installation, all water mains, valves, hydrants, hydrant connections and other appurtenances installed under this Contract shall be disinfected in accordance with AWWA Standard C651, Section 4.4.3 (Continuous Feed Method), as modified herein.

1. Taps for flushing, chlorination and sampling shall be installed by the Contractor at no additional expense to the Owner.
2. Flush the new water mains with potable water to remove any contaminants and debris that may have entered the water mains during construction.
3. The flushing velocity in the new water mains shall not be less than 3.0 feet per second. In the absence of a flow meter, flow rate shall be determined either by placing a pitot gage at the discharge or by measuring the time to fill a container of a known volume.
4. Prepare a chlorine solution that will be continuously fed into the potable water that is used to fill the new water mains.
5. The chlorine solution shall be applied to the new water mains with a chemical feed pump designed to feed chlorine solutions.
6. Completely fill the new water mains with the chlorinated, potable water to remove any air pockets. The point of application shall be no more than 10 feet downstream from the beginning of the new water mains.
7. The chlorine solution shall be of sufficient strength to provide a minimum residual chlorine concentration of 25 milligrams per liter (mg/L) in the filled water mains.
8. The disinfection solution in HDPE pipe must not exceed 12 percent active chlorine.
9. New valves and hydrants shall be operated to ensure their proper disinfection.
10. Isolation valves shall be maintained in a closed position to prevent chlorinated water from entering the existing water distribution system.
11. Chlorinated water shall remain in the main for a minimum of 24 hours.
12. The minimum residual chlorine concentration at the end of the 24 hour holding period shall be 10 mg/L.
13. After the 24 hour retention period, chlorinated water shall be flushed from every hydrant branch on the main until the chlorine concentration leaving the main is no higher than that generally in the system or less than 1.0 mg/L.
14. Chlorinated water shall be discharged in a manner that will not adversely affect flora and fauna or drainage courses and shall conform to applicable State regulations for waste discharge.
15. Chlorinated water that is flushed from the mains shall be neutralized by the addition of a dechlorinating agent so that the residual chlorine concentration is zero.
16. The location of the discharge for the dechlorinated water shall be approved by the Engineer and the Owner.

3.02 WATER STORAGE FACILITIES

A. All surfaces of the water storage facilities (wetwells and clearwells) and their appurtenances shall be disinfected in accordance with these specifications and the requirements of the State/County Department of Health, the Local Water Department and AWWA C652, as modified herein.

1. All surfaces of the water storage facilities shall be cleaned thoroughly using a high pressure water jet, sweeping, scrubbing, or equally effective means.
2. All water, dirt and debris accumulated in this cleaning operation shall be removed before disinfecting.
3. Chlorination shall be by any of the three methods described in AWWA C652.
4. The surfaces to be chlorinated shall be the floor and walls in the wetwell.
5. Chlorinated water shall be pumped out of the wetwell and disposed of as described in subsection 3.01 A (16).

3.03 TESTING

A. A minimum of 48 hours after flushing and before the new water mains are placed in service, the Contractor shall collect water samples for testing of the bacteriological quality of the water.
   1. No hose or fire hydrant shall be used in the collection of samples.
   2. A sampling tap shall consist of a standard corporation stop installed in the main with a PVC or copper gooseneck assembly.
   3. Samples for bacteriological testing shall be collected in sterile bottles treated with sodium thiosulfate and furnished by the state certified laboratory that will perform the tests.
   4. A private company specializing in this field shall chlorinate the main.
   5. Unless otherwise directed by the Engineer or the Owner, the minimum number of samples for bacteriological analysis shall be as follows:
      a. Sample sets every 1,000 linear feet of newly installed water mains.
      b. Sample sets at the end of the newly installed water mains.
      c. Sample sets at each branch that is greater than one pipe length.
   6. One round of sampling shall be conducted on water distribution systems that continuously maintain a chlorine residual.
   7. Two rounds of sampling shall be conducted on water distribution systems that do not continuously maintain a chlorine residual. The second round of sampling shall be conducted a minimum of 24 hours after the first round of samples is taken.

B. Bacteriological tests
   1. Two bacteriological tests shall be performed on all samples:
      a. One coliform bacteria, and
      b. One heterotrophic plate count (HPC) bacteria.
   2. Test results on all samples and a copy of the chain of custody shall be made available to the Engineer following sampling and testing.
   3. The disinfection procedure shall be considered satisfactory only if the results of all tests confirm the following:
      a. The absence of coliform bacteria in all samples taken, and
      b. The HPC bacteria are less than 500 colony forming units per milliliter (cfu/mL) in all samples taken (unless the water supplier has established a stricter HPC limit from baseline data for their water distribution system, in which case the results of the HPC bacteria tests shall meet the stricter limit).
   4. The new water mains may be placed in service if the results of the disinfection procedure are satisfactory and the Engineer and Owner have granted their permission.

5. If the initial disinfection procedure fails to produce satisfactory results, the new water mains shall be flushed and resampled as described above at no additional cost to the Owner. If the test results from the resampling also fail to produce satisfactory results, the entire disinfection procedure shall be repeated at no additional cost to the Owner.

END OF SECTION

SECTION 02676

TESTING PIPING SYSTEMS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Provide pressure/leakage tests as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 02150 Directional Drilling
   2. Section 02611 Ductile Iron Pipe and Fittings
   3. Section 02640 Buried Valves and Appurtenances
   4. Section 02675 Disinfection of Water Mains and Water Storage Facilites

1.03 STANDARDS

A. The following American Water Works Association Standard shall form a part of this specification as referenced:
   1. AWWA C600 Installation of Ductile Iron Water Mains and Their Appurtenances.

PART 2 PRODUCTS

2.01 WATER

A. The Owner shall furnish water free for flushing and testing the water main if hydrants or other connection points are convenient to the work. Otherwise, the Contractor shall be responsible for securing an acceptable potable water supply at no additional cost to the Owner. Additional water required for flushing and re-testing as a result of Contractor's error or defective work shall be billed to the Contractor at the Owner's normal billing rate.

PART 3 EXECUTION

3.01 TESTING

A. A formal pressure/leakage test shall be required of the water mains, valves and appurtenances in the system constructed.
   1. The pressure/leakage test shall be conducted in accordance with these specifications and the applicable requirements of AWWA C600, Section 5.

2. Where any section of a water main is provided with concrete thrust blocks, the test shall not be made until at least 5 days have elapsed since the concrete was placed.
3. If high-early-strength cement is used in the concrete thrust blocks, the test shall not be made until at least 2 days have elapsed since the concrete was placed.
4. Prior to testing the pipeline or section thereof, the section to be tested shall be thoroughly flushed and all air expelled. All air shall be expelled by appropriate methods including the use of corporation stops installed by the Contractor, at no additional cost to the Owner, at high points along the water main.
5. After all the air has been expelled and the corporation stops closed, the test pressure shall be applied by means of a pump connected to the pipe.
6. The pump, pipe connections, and all necessary apparatus including gages, shall be furnished by the Contractor.
7. Unless otherwise specified, the test pressure shall be 150 psi or 150 percent of the working pressure, whichever is greater, but in no case shall the pressure exceed 250 psi.
8. This pressure shall be maintained for 2 hours.
9. Any excessive indicated leakage as determined by the pressure test shall be located and repairs made. The total leakage from the pipeline or sections thereof shall not exceed the amount shown in Table 1 of this Specification Section.
10. Should the pipeline or sections thereof not come within the permissible leakage limits, the Contractor (at his own expense) shall be required to excavate and locate the source of leakage and make repairs.
11. After the Contractor has notified the Engineer that repairs have been made, the test shall be repeated until the pipeline or sections thereof are within the allowable leakage.

Table 1

Ductile and Gray Cast Iron mains
Allowable Leakage per 1000 Ft.

Avg. Test Pressure (psi)	Nominal Pipe Diameter (inches)						
	6	8	10	12	16	20	24
350	0.76	1.01	1.26	1.52	2.02	2.53	3.03
300	0.70	0.94	1.17	1.40	1.87	2.34	2.81
250	0.64	0.85	1.07	1.28	1.71	2.14	2.56
200	0.57	0.76	0.96	1.15	1.53	1.91	2.29
150	0.50	0.66	0.83	0.99	1.32	1.66	1.99
100	0.41	0.54	0.68	0.81	1.08	1.35	1.62

* Leakage allowable based on gallons per hour per 1000 feet of main.

END OF SECTION

SECTION 02700

PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide precast concrete manholes as required by the Contract Documents.
   1. In general: Provide the precast concrete manholes.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02200 Earthwork
   2. Section 02726 Covers/Grates and Frames

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the Work.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 PRODUCT HANDLING

A. Delivery, Storage and Handling:
   1. Deliver the work of this Section to the job site in such quantities and at such times as to assure the continuity of construction.
   2. Store units at the job site in a manner to prevent physical damage, and in a manner to keep markings visible.
   3. Lift and support the units only at designated lifting points or supporting points.

PART 2 PRODUCTS

2.01 DESIGN

A. Precast concrete manhole sections shall conform to:
   1. ASTM C478 Specification for Precast Reinforced Concrete Manhole Sections,
   2. PCI 116,
   3. CRSI "Manual of Standard Practice",
   4. In the event of conflict between or among standards, the more stringent provision shall govern.

2.02 PRECAST CONCRETE SECTIONS

A. General:
   1. Wall thickness shall not be less than five (5) inches for a forty eight (48) inch diameter reinforced section, six (6) inches for a sixty (60) inch diameter reinforced section, seven (7) inches for a seventy two (72) inch diameter reinforced section and nine (9) inches for a ninety six (96) inch diameter reinforced section.
   2. All sections shall have tongue and groove joints.
   3. Concrete compressive strength shall be 5000 psi after 28 days.
   4. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of H-20 loading plus the weight of the soil above.
   5. Top sections of manholes shall be eccentric cones to provide a vertical wall from ground surface to manhole base, except that precast reinforced concrete slabs shall be used where cover over the top of the pipe is less than 5 feet.
   6. The inside clear diameter of the opening at the top of the cone or in the slab shall be 30 inches.
   7. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.
   8. Precast concrete bases shall be constructed and installed as shown on the Drawings. The thickness of the bottom slab of the precast bases shall not be less than the manhole barrel sections or top slab, whichever is greater.

2.03 JOINTS

A. Precast Sections:
   1. Tongue and groove joints of precast sections shall be sealed with an "O"-ring conforming to ASTM C443 or a flexible joint sealant such as Kent Seal No. 2 or an approved equal.

2.04 BRICK MASONRY

A. Bricks for leveling manhole frames inverts and tables shall comply with ASTM C62, Grade SW.

2.05 MORTAR

A. For use in brickwork:
   1. Composed of one (1) part Type II Portland Cement conforming to ASTM C150, to two (2) parts sand,

2. For each bag of cement a small amount (not to exceed 10% by weight) of hydrated lime may be added. Lime shall conform with ASTM C207, Type N.

2.06 COVERS/GRATES AND FRAMES

A. Shall be furnished under Section 02726, Covers/Grates and Frames, and installed under the work of this Section.

2.07 MANHOLE STEPS

A. Manhole steps shall be aluminum alloy 6061 T6, extruded, safety-type, or 1/2 inch diameter, grade 60 steel reinforcing bar continuous throughout the step, bent to shape and encased in a co-polymer polypropylene plastic, with a tread design.
1. Steps shall be fourteen (14) inches wide,
2. Steps may be cast in place or inserted after casting,
3. Steps shall be set at twelve (12) inches on center.

2.08 CONNECTIONS TO MANHOLES

A. Connection to the precast structures shall be accomplished by the following:
1. "Kor-n' Seal" joint with stainless steel clamp,
2. "Lock-Joint Flexible Manhole Sleeve" shall be cast into the manhole base section. Strap shall be stainless steel.
3. A fixed connection at the precast structure shall not be allowed.

2.09 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PRECAST INSTALLATION

A. Work shall be protected against flooding and flotation.
1. Precast bases of the structure to be placed on a compacted six (6) inch layer of screened gravel.
2. Precast barrel sections shall be set plumb with all sections in true alignment and joints sealed watertight.
3. Grade at the top of the precast manhole shall be as such as to allow a maximum of twelve (12) inches of brickwork to bring the frame and cover to finish grade.
4. Grout all lifting holes with non-shrink grout.

3.03 MANHOLE PIPING CONNECTIONS

A. Shall be as stated in paragraph 2.08 of this Section.

3.04 BRICKWORK

A. Invert Table and Grade Adjustment:
   1. Brick for invert shall be laid on edge.
   2. Brick for table and grade adjustment shall be laid flat.
   3. Table shall be constructed to an elevation even with the top of the pipe.
   4. Table shall slope up from the pipe to the edge of the manhole.

3.05 COVERS/GRATES AND FRAMES

A. Shall be set in a full bed of mortar on the grade adjusting brick course.
   1. Shall be set to the finish grade.
   2. Frames and covers which are not on the same plane as the final grade shall be reset.
   3. Maximum height allowable for grade adjustment (between manhole and frame) shall be twelve (12) inches.

3.06 TESTING

A. Vacuum Test:
   1. Plug all openings with non-shrink grout and plug all pipes with suitable plugs.
   2. An initial vacuum of ten (10) inches Hg. shall be drawn.
   3. Test time shall be determined by the time required for the vacuum to drop from ten (10) inches Hg. to nine (9) inches Hg.
      a. Allowance test times are listed below.

Manhole Depth	Minimum Test Time
0 to 10 feet	1 minute
10 to 15 feet	1 1/4 minutes
15 to 25 feet	1 1/2 minutes

   4. Manholes which fail to meet the above minimum test times shall be repaired using methods approved by the Engineer.
   5. After the manhole has been repaired it shall be re-tested using the same vacuum test procedure. Following a second vacuum test failure, the manhole shall be repaired and tested using the water exfiltration method.

B. Exfiltration Test:
   1. All pipes and openings shall be suitably plugged and braced to prevent blowouts.
   2. Fill manhole to the top of the cone section or the opening in the flat top section if a cone section is not used.
   3. Seal all visible leaks.
   4. Allow a period of time for absorption by the concrete and refill as required.
   5. The test period shall be eight (8) hours.
   6. At the end of the test period, the manhole shall be refilled to the top of the cone, measuring the volume of water added. This amount shall be extrapolated to a 24-hour rate and the leakage determined on the basis of depth.

a. The leakage for each manhole shall not exceed one (1) gallon per vertical foot for a twenty-four (24) hour period.

b. If the manhole fails this requirement, and the leakage does not exceed three (3) gallons per vertical foot per day, repairs by approved methods may be made to bring the leakage within the allowable rate of one (1) gallon per foot per day.

c. Leakage due to a defective section or joint or exceeding the three (3) gallon per vertical foot per day, shall be the cause for the rejection of the manhole.

d. It shall be the Contractors responsibility to uncover the manhole as necessary and to disassemble, reconstruct or replace it. The manhole shall then be re-tested by the vacuum test or the water exfiltration test, at the discretion of the Engineer.

7. If the groundwater table is above the highest joint in the manhole, and if there is no leakage into the manhole, such a test can be used to evaluate the water-tightness of the manhole.

3.06 CLEANING

A. All new manholes shall be thoroughly cleaned of all silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 02701

PRECAST CONCRETE HANDHOLES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide precast concrete handholes as required by the Contract Documents.
   1. In general provide the required handholes at the locations shown on the Contract Drawings for the underground electrical and instrumentation raceways.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02200 Earthwork
   2. Section 02726 Covers, Grates and Frames
   2. Section 16402 Underground Systems

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.05 PRODUCT HANDLING

A. Delivery, Storage and Handling:
   1. Deliver the work of this Section to the job site in such quantities and at such times as to assure the continuity of construction.
   2. Store units at the job site in a manner to prevent physical damage, and in a manner to keep markings visible.
   3. Lift and support the units only at designated lifting points or supporting points.

PART 2 PRODUCTS

2.01 HANDHOLE

A. Precast concrete handholes shall be Heavy Duty Handhole as manufactured by Oldcastle Infrastructure or an approved equal:
   1. Concrete strength: 4,500 psi,
   2. Cover slab with 30-inch diameter opening,
   3. Design loading per AASHTO HS20,
   4. Comply with ASTM C478,
   5. Exterior dimensions: 5’-10” by 4’-6” by 3’-2” high,
   6. Four (4) 6” x 24” knockouts,
   7. 1” diameter holes per side for pulling eyes,
   8. PCI 116,
   9. CRSI “Manual of Standard Practice”,
   10. In the event of conflict between or among standards, the more stringent provision shall govern.

2.02 BRICK MASONRY

A. Bricks for leveling manhole frames shall comply with ASTM C62, Grade SW.

203 MORTAR

A. For use in brickwork:
   1. Composed of one (1) part Type II Portland Cement conforming to ASTM C150, to two (2) parts sand,
   2. For each bag of cement a small amount (not to exceed 10% by weight) of hydrated lime may be added. Lime shall conform with ASTM C207, Type N.

2.04 COVERS/GRATES and FRAMES

A. Shall be furnished under Section 02726, Covers/Grates and Frames and installed under the work of this Section.

2.05 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 PRECAST INSTALLATION

A. Handholes shall be placed on a compacted twelve (12) inch layer of crushed stone.
   1. Grade at the top of the precast handhole shall be as such as to allow a maximum of twelve (12) inches of brickwork to bring the frame and cover to finish grade.

3.03 BRICKWORK

A. Grade Adjustment:
   1. Brick for grade adjustment shall be laid flat.

3.04 COVERS/GRATES AND FRAMES

A. Shall be set in a full bed of mortar on the grade adjusting brick course.
   1. Shall be set to the finish grade.
   2. Frames and covers which are not on the same plane as the final grade shall be reset.

3.05 CLEANING

A. All new handholes shall be thoroughly cleaned of all debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

SECTION 02726

COVERS/GRATES AND FRAMES

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide Covers/Grates and Frames as required by the Contract Documents.

B. Aluminum access hatches are specified in Section 08306 Aluminium Floor Hatches.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02200 Earthwork
   2. Section 02700 Precast Concrete Manholes
   3. Section 08306 Aluminum Floor Hatches

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. All castings shall be of domestic manufacture:
   1. Comply with ASTM A48 Gray Iron Castings.

1.04 SUBMITTALS

A. Comply with the pertinent provisions of Section 01300.
   1. Manufacturer's catalog cuts, specifications and other data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.01 COVERS/GRATES AND FRAMES

A. Castings shall be manufactured in accordance with ASTM A48-83, Class 30B specifications with a minimum tensile strength of 30,000 psi.
   1. All frames covers and grates shall be of domestic manufacture.
   2. All frames, covers and grates, of the same pattern or catalog number, shall be interchangeable.

B. Manhole frames and covers in the roadway right of way shall have a 22-inch clear opening, and shall be manufactured by EJ Group, Inc., Neenah Foundry Co., or Campbell Foundry Co., or approved equal.

C. Manhole frames and covers which are to be installed off the roadway shall be medium duty frames and covers manufactured by EJ Group, Inc., or an approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. See Specification Section 02700, Precast Concrete Manholes for installation requirements.

END OF SECTION

SECTION 02731

PLASTIC SEWER PIPE AND FITTINGS

PART 1 GENERAL

1.01 DESCRIPTION

A. Work Included: Provide all the plastic sewer pipe and fittings as required by the Contract Documents.

B. In general the work of this Section shall include but not be necessarily limited to providing all plastic sewer pipe and fittings, joining materials, labor, tools, and equipment necessary to install the pipe and fittings as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting the work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02140 Site Drainage and Dewatering
   2. Section 02160 Support of Excavation
   3. Section 02227 Rock Removal
   4. Section 02222 Earthwork
   5. Section 02740 Septic System

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section;
   2. Manufacturer's specifications, installation procedures, and other data needed to prove compliance with the specified requirements;
   3. All pipe delivered to the jobsite shall be accompanied by test reports and notarized affidavits certifying that the pipe and fittings conform to the requirements of the Specifications.

1.04 ACCEPTABLE MANUFACTURERS.

A. The plastic sewer pipe and fittings shall each be furnished by a single manufacturer who is fully experienced, reputable, and qualified in the manufacture of the pipe to be furnished. The pipe shall be designed, constructed, and delivered in accordance with the best practices and methods.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) GRAVITY SEWER PIPE, 4 INCH DIAMETER TO 8 INCH DIAMETER

A. The polyvinyl chloride (PVC) gravity sewer pipe and fittings shall conform to ASTM Specification D3034, SDR 35.
   1. Minimum pipe stiffness (F/delta Y) at 5 percent deflection shall be 46 psi for all sizes when tested in accordance with ASTM Method of Test D2412, “External Loading Properties of Plastic Pipe by Parallel-Plate Loading”.
   2. Pipe (6” long section) shall be subjected to impact from a free falling tup (20-lb. Tup A.) in accordance with ASTM Method of Test D2444.
   3. The bell end of the pipe shall consist of an integral wall section with a solid cross-section rubber ring, factory assembled, securely locked in place to prevent displacement during assembly.
   4. Each length of pipe shall be marked with the nominal pipe size, manufacturer's name or trademark, and the PVC cell classification.
      a. All fittings shall be marked also.
   5. Gravity sewer pipe shall be furnished in the longest laying length manufactured, approximately 20 feet.
   6. Pipe exterior barrel section shall be smooth wall.
      a. Ribbed profile is not acceptable.

2.02 PIPE JOINTS

A. Joints for the gravity sewer pipe shall be of the bell and spigot type (push-on) with elastomeric gasket seal conforming to ASTM Specification D-3212, "Joints for Drain and Sewer Plastic Pipe using Flexible Elastomeric Seals".
   1. Gaskets shall be manufactured of a continuous elastomeric ring which is oil resistant (Neoprene compound).
   2. Shall be tested by the manufacturer at his expense as specified in ASTM F 477.
      a. The test results shall be furnished to the Owner (Engineer) for at least two specimens of each size selected at random from the lot to be furnished for this Contract.
   3. The elastomeric gaskets shall be factory installed and securely locked in place with each length of pipe furnished.

2.03 FITTINGS

A. All fittings and accessories for the sewer pipe shall be as manufactured by the pipe supplier.
   1. Have bell and spigot configurations compatible with that of the pipe.
   2. Locked in rubber ring.

PART 3 EXECUTION

3.01 INSTALLATION

A. 4 Inch to 8 Inch Diameter Pipe:

1. Except as otherwise specified herein or shown on the Drawings, installation of gravity polyvinyl chloride pipe shall be in accordance with ASTM D2321, "Underground Installation of Flexible Thermoplastic Sewer Pipe".

B. All trenching, backfilling, compacting and bedding and covering of the pipe shall be conducted in full accordance with the provisions of Section 02222, Earthwork

3.02 PIPE HANDLING

A. The Contractor shall arrange for the delivery of the pipe sections at approved locations in the vicinity of that portion of the line in which the pipe sections are to be laid. To this end, he shall do such work as is necessary for access and for delivery of the pipe.
1. Pipes shall be stored in an approved, orderly manner so that there will be a minimum of rehandling from the storage area to the final position in the trench and so that there is a minimum obstruction and inconvenience to any kind of traffic.
2. All pipe is to be loaded, unloaded and stockpiled in strict conformance with the manufacturer's recommendations.
3. Deliveries shall be scheduled so that the progress of the work is at no time delayed and also so that large quantities of pipe shall not be stored for excessive lengths of time.
4. Provide slings, straps and/or other approved devices to provide satisfactory support of the pipe when it is lifted.
5. Under no circumstances shall the pipe be dropped from trucks or into the trench.

3.03 CONTROL OF ALIGNMENT AND GRADE

A. The Contractor shall establish bench marks along the route of the pipeline at convenient intervals for his reference in checking the pipe and manhole inverts and other elevations throughout the project.

B. The Contractor shall use a laser beam for setting the pipe.
1. All units shall have equipment to control atmospheric conditions in the pipe that could affect the acceptable standard of construction.
2. The laser shall be operated by competent, trained personnel.
3. The Contractor shall establish center line and offset stakes at each manhole, plus one intermediate center line and offset stakes as a check point between manholes.
4. Laser aligning shall not be used to establish a continuous line in excess of 600 feet.

C. During construction, the Contractor shall provide the Engineer at his request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, taking quantities and checking location of the work.
1. Assistance shall include the furnishing of one or two men as needed at intermittent times.
2. The Contractor shall carefully preserve bench marks, reference points and stakes.
   a. In cases of willful or careless destruction by his own men, he will be charged with the resulting expense and shall be responsible for any mistakes or delay that may be caused by their unnecessary loss or disturbance.

3.04 PREPARATION OF BED

A. As soon as the excavation is completed to the normal grade of the bottom of the trench, pipe bedding, shall be placed immediately in the trench and compacted.

B. The compacted bedding shall be shaped so that the bottom quadrant of the pipe shall rest firmly for the full length of the barrel. Suitable holes for bells or couplings shall be dug around the pipe joints to provide ample space for making tight joints.
   1. The pipe shall be firmly bedded and covered to conform accurately to the lines and grades.

C. It shall be the Contractor's responsibility to control any water in the trench below the pipe invert and he shall place clay or other impermeable material in the bedding at intervals to prevent horizontal movement of the groundwater which might induce settling of the bed, or make it difficult to handle water in the trench.

3.05 LAYING PIPE

A. All pipe shall be laid with extreme care as to grade and alignment.
   1. Each pipe shall be laid so as to form a close joint with the next adjoining pipe and to bring the inverts continuously to the required grade.
   2. Each pipe length shall be inspected for excessive discoloration, blisters, pitting, cracks, holes, foreign inclusions, straightness and other injurious defects before lowering in place.
   3. In order to insure minimum amount of movement or disturbance, no more than two lengths of pipe may be laid before backfilling to a minimum of twelve inches over the pipe.
   4. Pipe shall be laid in the dry and at no time shall water in the trench be permitted to flow into the sewer pipe.
   5. Laying and jointing shall be in accordance with the manufacturer's instructions and appropriate ASTM Standards.
   6. The Contractor shall have on hand for each pipe-laying crew, the necessary tools, gauges, mechanical saws, mechanical bevelers, etc., necessary to install the pipe.
   7. The length of the incoming and outgoing pipe at manholes shall be a maximum of 2'-0".
      a. Measurements shall be made from the outside of the manhole wall.
      b. Shorter lengths of pipe shall be furnished as necessary to allow proper locations for wyes and manholes.
      c. In no case shall other than the specified joints be installed.
   8. Where pipe stubs are called for on the Drawings, for future connections or services, the stubs shall be closed on the exterior end of the stub with a gasketed PVC pipe cap or plug of the same material as the pipe.
      a. Cap or plug shall be furnished by the pipe manufacturer.

3.06 WYES AND TEES

A. Installation
   1. At locations determined in the field, the Contractor shall provide six (6) inch branch, wyes or tees on the proposed sewer main for the property service connection.

2. Watertight end caps shall be installed on the wye or tee branch until the service connection is installed.

B. Measurements
1. No wyes or tees shall be backfilled before location measurements have been taken.
2. The depth of cover from the road surface to the top of the fitting shall be recorded.
3. The distance from the down stream manhole shall be recorded.

3.07 TESTING FOR GRAVITY SEWERS

A. At intervals along the sewer work, usually not more than 1000 feet, at the option of the Engineer, all portions of all sewers shall be subjected to leakage tests witnessed by the Engineer.
1. The Contractor shall have on hand all plugs, pumps, weirs, water trucks, compressors, etc., necessary to conduct the tests.

B. Low Pressure Air Test: Leakage testing by means of low pressure air shall be in accordance with the procedures described in UNI-B-6, "Recommended Practice for Low Pressure Air Testing of Installed Sewer Pipe", published by the Uni-Bell Plastic Pipe Association.
1. The equipment shall be provided with an air regulator valve or an air safety valve so set that the internal air pressure in the pipeline cannot exceed eight (8) psig.
2. The leakage test shall be made on each manhole-to-manhole section of pipeline.

C. Deflection Test: All polyvinyl chloride pipe shall be deflection tested no sooner than 90 days after its installation and backfill to insure sufficient settling and compaction of the backfill has occurred.
1. The maximum allowable pipe deflection (reduction in vertical inside diameter) shall be 5 percent (5%) when tested, using a rigid "Go-No-Go" mandrel made as recommended by ASTM D 3034, but using a 5 percent deflection.

2. The gauge shall be pulled through the line by hand using a smooth and easy motion.
a. If an obstruction is encountered, pull lightly to see if the gauge will clear the obstruction.
b. If the gauge will not clear the obstruction, record the distance from the manhole and pull the gauge back out.
3. All sewer lines with a deflection angle of greater than 5 percent shall be excavated, repaired by rebedding or replacement of pipe and the deflection test repeated as specified above; all at the Contractor's expense.

3.08. INFILTRATION

A. Sewer Pipe:
1. Ground water infiltration rate shall not exceed 50 gallons, per inch of diameter, per mile, per 24 hours.

3.09 CLEANING

A. At the conclusion of the Work, the Contractor shall thoroughly clean all of the new pipelines by flushing with high pressure water or other means to remove all dirt, stones, pieces of wood, or other material which may have entered during the construction period. Debris, cleaned from the lines, shall be removed from the lowest manhole.

1. After the pipelines are cleaned, and if the groundwater level is above the pipe the Engineer will examine the pipe for leaks.
    a. If defective pipes or joints are discovered at this time, they shall be repaired at the Contractor's expense.

3.10 CONNECTIONS TO EXISTING SEWERS AND MANHOLES

A. The Contractor shall make all connections to the existing facilities as required by the Contract Documents.
    1. Provide all pipe, fittings, and appurtenances.
    2. Shall do all excavation and backfill as required.
    3. The pipe entrance to existing manholes shall be drill cored to the required diameter.
    4. Special attention shall be made to protect the existing sewers and structures.

END OF SECTION

SECTION 02740

SEPTIC SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide a subsurface sewage disposal system as shown on the Drawings and as specified herein.

B. Related work: Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 01610 Product Handling
   2. Section 02726 Cover/Grates, and Frames
   3. Section 02740 Septic System
   4. Section 02750 Precast Concrete Structures

1.02 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.03 CODES AND REGULATIONS

A. Conform to the latest edition of the following: where one or more of the references noted conflict, the more stringent shall govern.
   1. 310 CMR 15.00 Title Five (5) of the Massachusetts State Environmental Code,
   2. Local Board of Health requirements.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section,
   2. Manufacturer's specifications, catalog cuts, and other data to prove compliance with the specified requirements.

1.05 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01610.

PART 2 PRODUCTS

2.01 SEPTIC TANK

A. Septic tank shall be of the following capacity:
   1. 2,000 gallons; Equal to Shea Concrete Products, Item No. TK-M20002CH or approved equal.
   2. Inlet and outlet locations shall be provided with an access cover to gain access to those areas.
   3. Shall have a manhole opening of twenty-four (24) inches.
   4. Liquid depth shall have a minimum depth of four (4) feet.
   5. Inlet and outlet shall be baffled.
   6. Shall be constructed for a H20 loading.
   7. See Section 02750 of these Specifications for ACI requirements.

2.02 DISTRIBUTION BOX

A. The distribution box shall be equal to Shea Concrete Products, Item no. B-9DBR12 or approved equal.
   1. Minimum five outlets.
   2. One inlet.

2.03 PERFORATED PVC PIPE AND FITTINGS

A. Pipe and fittings shall comply with ASTM D2729.
   1. All pipe and fittings shall be marked as specified in ASTM D2729.
   2. Size shall as noted on the drawings.

2.04 SOLID PVC PIPE AND FITTINGS

A. Pipe and fittings shall comply with ASTM D2665.
   1. All pipe and fittings shall marked as specified in ASTM D2665.
   2. Size shall be as noted on the drawings.

2.05 EFFLUENT DISPOSAL SYSTEM

A. Effluent disposal system size and configuration shall be as shown on the Drawings and consist of the following materials:
   1. Leaching chambers shall each be High-Capacity Leaching Chamber Recharger 180 as manufactured by Cultec, Inc. or approved equal. Redesign required due to using substitute product at contractor's expense.
   2. Effluent stone shall be ¾" to 1-1/2" double washed stone in accordance with 310 CMR 15.247.
   3. Pea Stone shall be 1/8" to ½" double washed stone in accordance with 310 CMR 15.247.
   4. Replacement soil materials shall be clean coarse washed sand or other granular material in accordance with 310 CMR 15.255.
   5. Effluent disposal system vents shall be provided with an activated carbon filter. The filters shall be an Orenco Activated Carbon Filter, CF-4 with weather cap or approved equal.

2.06 WASHED STONE

B. All washed stone shall be double washed as stated in 310 CMR 15.00 Title Five (5) of the Massachusetts State Environmental Code.

2.07 FRAME AND COVER

A. See Section 02726 of these Specifications.

2.08 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.02 INSTALLATION

A. Comply with the pertinent section of 310 CMR 15.000, Title Five (5) of the Massachusetts State Environmental Code.

END OF SECTION

SECTION 02750

PRECAST CONCRETE STRUCTURES

PART 1 GENERAL

1.01 DESCRIPTION

A. The work under this section shall consist of furnishing all equipment, materials and labor to install the wet well and valve chamber shown on the Drawings and/or specified herein.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, Sections in Division 1 of these Specifications.
1. Section 02221 Earthwork for Sewers and Drains
2. Section 02740 Septic System

1.03 SUBMITTALS

A. The Contractor shall submit six copies of shop drawings which shall include manufacturer's literature on frames and covers, and dimensioned construction drawings for precast structures.

B. Provide shop drawings for fabricating the precast structure. Show all required reinforcing bars and all accessories on shop drawings in accordance with ACI 315 and AASHTO HS20.

C. Include with shop drawings layout of the construction joints and all erection information.

D. Floor plans, sections, and elevations showing wall sleeve locations.

E. Design calculations to plan and prevent floatation of pumping chamber and valve vault.

F. Frames and hatches.

1.04 STANDARDS

A. The following American Society for Testing and Materials (ASTM) standards form a part of this specification as referenced:
1. ASTM A48 - Gray Iron Castings,
2. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement,
3. ASTM A615 - Specification for Deformed and Plain Bilet-Steel Bars for Concrete Reinforcement,
4. ASTM C32 - Specification for Sewer and Manhole Brick (Made from Clay or Shale),
5. ASTM C144 - Specification for Aggregate for Masonry Mortar
6. ASTM C150 - Specification for Portland Cement,
7. ASTM C207 - Specification for Hydrated Lime for Masonry Purposes,

8. ASTM C478 - Specification for Precast Reinforced Concrete Manhole Sections.

1.05 INSPECTION

A. The quality of all materials, the process of manufacture and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or on the work after delivery, or at both places, and the sections shall be subject to rejection at any time on account of failure to meet any of the Specification requirements; even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. All sections which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, entirely at Contractor's expense.

B. At the time of inspection, the sections will be carefully examined for compliance with the ASTM designation specified below and these Specifications, and with the approved manufacturer's drawings. All sections shall be inspected for general appearance, dimension, "scratch-strength", blisters, cracks, roughness, soundness, etc. The surface shall be dense and close-textured.

C. Imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at the end of seven (7) days and 5,000 psi at the end of 28 days, when tested in 3-inch by 6-inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

PART 2 PRODUCTS

2.01 GENERAL

A. Type II cement shall be used, except as otherwise approved. Structures shall be of 5,000 psi concrete and shall conform to the loading requirements in AASHTO HS20. Reinforcing shall be welded wire fabric conforming to ASTM A185.

B. Horizontal joints between sections shall be tongue and groove with round rubber O-ring gaskets conforming to ASTM C443 or preformed flexible butyl resin sealant. Sealant shall be Concrete Sealants, Inc. CS-102 or CS-202, Concrete Products Supply E-Z Stik All-Weather Butyl Sealant, Concrete Systems, Inc. C-S 146, or approved equal.

C. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before five days after fabrication and/or repair, whichever is longer.

D. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.

E. Where required, steps shall be inserted into the units during the process of manufacture and not in the field.

F. Manufacturer to verify anti-floatation ring requirements. If necessary, the base of the pumping station shall be firmly anchored to a reinforced concrete slab designed such that the pumping station shall resist flotation when the groundwater elevation is at the finished ground surface elevation. Include the dead weight of the structure and base plus soil load above the structure for flotation. Do not utilize skin friction; soil friction; or weight of equipment in the structure in the calculation. Flotation safety factor shall be not less than 1.15. The Contractor shall submit to the Engineer for review, plans and calculations of reinforced concrete slab and anchoring systems designed and stamped by a professional structural engineer registered in the Commonwealth of Massachusetts. Bolting of the structure to the base slab shall be with Type 304 stainless steel bolts.

G. Connections to the precast structures shall be accomplished by the following:
1. "Kor-n-Seal" joint with stainless steel clamp and stainless steel expansion ring.
2. Mechanical link seals for force main pipe connection.
3. A fixed connection at the precast structure shall not be allowed.

H. Foundations bearings on the naturally deposited sand or on compacted structural fill should be designed for a maximum bearing pressure of 2.0 tons per square foot (tsf) where at least lateral dimension (width) of at least 3.0 ft. is provided. Foundations with a width less than 3.0 feet should be limited to an allowable bearing pressure, in tsf, of 0.67 times the width as measured in feet. In no case should footings be less than 18-in in width.

I. Precast concrete barrel sections, and precast bases shall conform to Section 02605, ASTM Designation C478, and shall meet the following requirements:
1. The wall thickness shall not be less than 1 1-in for the 120-in diameter reinforced barrel sections.
2. Barrel sections shall have tongue and groove gasketed joints.
3. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.
4. Precast concrete barrel sections with precast top slabs shall be designed for a minimum of HS-20 loading plus the weight of the soil above.
5. The data of manufacture and the name and trademark of the manufacturer shall be clearly marked on the inside of each precast section.

J. Entrance hatches shall be HS-20 loaded and shall be I/4-in aluminum diamond plate pattern, double leaf complete with upper guide holder, chain holder, cable holder and flush steel drop handle. All hardware shall be stainless steel. All hatches shall be watertight. Provide lift assisting spring hinges for ease in opening and closing. Hatch shall open 90 degrees. Provide hold-open arm, with red vinyl grip handle, to automatically lock cover in open position against wind. Forged brass case padlocks with hardened steel shackle shall be furnished with five keys, which are compatible with the Department of Public Works master locking system. The frame shall be securely mounted directly above the pumps. The hatch installation shall be in accordance with manufacturer's instructions. A prefabricated safety post extension device shall be furnished and installed at each station. When engaged this device shall prevent closure of access hatch. The hatch shall be equipped with a removable safety net that covers the entire hatch opening.

PART 3 EXECUTION

3.01 GENERAL

A. The precast structures shall be constructed to the dimensions shown on the Drawings and as specified in these Specifications.

B. Precast base section shall be placed on a minimum of 12 inches of stone bedding as specified in SECTION 02221, Earthwork for Sewers and Drains or as indicated otherwise on the drawings. The excavation shall be properly dewatered while placing the bedding material and setting the base. All work shall be protected against flooding and flotation.

C. Precast sections shall be set so as to be vertical and with sections in true alignment with a 1/4-inch maximum tolerance to be allowed. The outside and inside joint shall be filled with non-shrink mortar and finished flush with the adjoining surfaces. Allow joints to set for 24 hours before backfilling. Backfilling shall be done in a careful manner, bringing up the fill evenly on all sides.

D. Holes in the concrete sections required for handling or other purposes shall be plugged with a non-shrinking grout or non-shrinking grout in combination with concrete plugs, and finished flush on both the inside and outside.

E. Where holes must be cored in the precast sections to accommodate pipes or sleeves, coring shall be done prior to setting any pipe or sleeve in place to prevent any subsequent jarring which may loosen joints.

F. All openings, inside and out, and completed joints shall be filled with non-shrink grout, unless ordered otherwise by the Engineer.

END OF SECTION

SECTION 02830

CHAIN LINK FENCE

PART 1 GENERAL

1.01 DESCRIPTION

A. Work includes: Provide chain link fencing and accessories, all as required by the Contract Documents.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 01300 Submittals
   2. Section 02831 Chain Link Cantilever Slide Gate
   3. Section 03300 Cast-In-Place Concrete

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
   3. Shop Drawings showing details of each frame type, details of openings, and details of construction, installation and anchorage.
   4. Manufacturer's recommended installation procedures which, when approved by the Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.

1.04 STANDARDS

A. The total vinyl PVC coated chain link fence system shall meet or exceed the standards of the Chain Link Fence Manufacturers Institute, New York, NY, except as otherwise indicated on the Contract Drawings or specified as herein.

B. The following American Society for Testing and Materials (ASTM) standards form a part of this specification as referenced:

1.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
2.	ASTM A121	Metallic-Coated Carbon Steel Barbed Wire.
3.	ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4.	ASTM F626	Fence Fittings.
5.	ASTM F668	Polyvinyl Chloride (PVC), Polyolefin and Other Polymer-Coated Steel Chain-Link Fence Fabric.

6.	ASTM F900	Industrial and Commercial Steel Swing Gates.
7.	ASTM F1083	Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
8.	FS RR-F-191	Fencing Wire and Post, Metal (and Grates, Chain-Link Fabric, and Accessories).

PART 2 PRODUCTS

2.01 FENCE POSTS AND APPURTENANCES

A. All posts, gate frames, braces, and horizontal rails shall meet ASTM F1083 for Standard Weight Galvanized Pipe.
1. Type I round post.
2. Minimum tensile strength of 50,000 lb./in^2.
3. Minimum yield strength of 25,000 lb./in^2.
4. Line post cross-section shall be 2-3/8-inch outside diameter steel pipe weighting not less than 3.65 lbs/lf.
5. End, corner, and pull posts cross-section dimensions shall be 2-7/8-inch outside diameter steel pipe weighing not less than 5.79 lbs/lf.
6. All tubular and pipe posts shall be capped unless a barbed wire extension arm assembly acts as a cap.
7. Posts, other fence framework, accessories, fittings, and miscellaneous items shall be hot dipped galvanized and have an extrusion bonded black PVC coating, minimum of 10 mils thick.
9. Galvanized finish shall have not less than the following weight of zinc per square foot:
   a. Pipe: 1.8 oz., complying with ASTM A53.
   b. Hardware and accessories: Comply with Table I of ASTM A153.
10. Minimum cross section dimension for the top railings and top, middle, and bottom braces between terminal posts and adjacent line posts shall be 1-5/8-inch OD steel pipe weighing not less than 2.26 lbs/lf.
11. Diagonal truss braces for gauge framework between terminal and adjacent line posts shall not be less than 3/8-inch diameter steel rod.
12. Fittings shall be galvanized press steel, malleable or cast steel as specified in ASTM F626 and Federal Specification RR-F-191.
13. Where posts do not have provisions for weaving fence fabric to posts, tension or stretcher bars for attaching fabric to terminal posts such as end, corner, gauge and pull posts, shall be flat bars with nominal dimension no less than 3/16-inch by 3/4-inch for use with fence fabric having mesh larger than 1-inch, of a length equal to full height of the fence fabric, and used with bar bands, bolts and nuts. Bar bands shall be no thinner than No. 11 gauge coated sheet steel. Bolt diameter shall not be less than 3/8-inch for use with bar bands.
14. Ties for fastening fence fabric to line posts and rails shall be not less than No. 9 AWG steel wire with the same coating as the fence fabric or other approved bands.
15. Coating: extrusion bonded black PVC coating, minimum of 10 mils thick

2.02 FABRIC – PVC COATED

A. Fabric shall be supplied with black Class 2A (extrusion bonded) vinyl coating.

1. Manufactured in accordance with Federal Specifications RR-F-191 and ASTM F668.
2. Coating shall be applied over a galvanized steel core wire.
3. Final coating thickness shall be 0.015 – 0.025-inch.
4. Core wire size diameter shall be 0.148-inch.
5. Wire size: 9 gauge.
6. Height shall be 8 feet with a mesh size of 2-inches.
7. Selvage: top edge shall be twisted, bottom edge shall be knuckled.

B. PVC coating shall be free of voids, dense and impervious, of plasticized or epoxy modified, high specific gravity PVC with a resistance to tear and suitable hardness.
1. Shall not support combustion and shall withstand an accelerated aging and weathering test a minimum of 2,000 hours at 145°F with ultraviolet and salt spray without cracking or peeling the PVC coating, and without corrosion of the base metal.
2. The PVC coating shall withstand a mandrel bending test of ten times the thickness of the base metal at minus 25°F without cracking.
3. The PVC coating shall not separate from the metal or sheeting.
4. The black color used in PVC coating shall be stabilized so that it will not fade under long exposure to sunlight.

2.03 GATES

A. Swing Gates: shall be swing type complete with latches, stops, keepers, hinges and provisions for three (3) strands of barbed wire above the fabric. Swing gates shall conform to ASTM F900.
1. All gate materials and appurtenances shall be the same type as used in the fence construction unless otherwise specified.
2. Gate post shall be zinc-coated steel and sized in accordance with ASTM F900.
   a. Gate posts shall be 4-inch outside diameter.
3. All gate posts shall be of sufficient strength so the total deflection of the gate and the gate post at the end of the gate leaf shall not exceed the lesser of 2 percent of the gate width or 4 inches. When necessary to meet this requirement due to the total weight of the gate leaf, the next larger size post shall be used.
4. Gate frames shall be constructed of 2-inch outside diameter tubular members welded at all corners.
   a. All steel welds shall be painted with zinc-based paint.
5. All gate leaves shall have horizontal interior bracing. Double gate leaves shall have both horizontal and vertical interior bracing.
6. Fabric shall be the same type as used in the fence construction.
7. Hinges shall be of adequate strength for gate, and with large bearing surfaces for clamping into position.
   a. The hinges shall not twist or turn under the action of the gate.
   b. The hinges shall permit the gate to swing to a full 180° in accordance with ASTM F900.
8. Double Gates:
   a. Provide drop rod to hold inactive leaf.
   b. Provide gate stop pipe to engage center drop rod.
   c. Provide locking device and padlock eyes as an integral part of latch, requiring one padlock for locking both gate leaves.
9. Post braces shall be provided for each gate.

10. Keepers shall be provided for each gate leaf. Keepers shall consist of a mechanical device for securing the free end of the gate when in the full open position.
11. Posts, other fence framework, accessories, fittings, and miscellaneous items associated with the gates shall be hot dipped galvanized and have an extrusion bonded black PVC coating, minimum of 10 mils thick

B. Chain Link Cantilever Slide Gate:
1. Chain link cantilever slide gate shall be as specified in Section 02831.

2.04 FITTINGS AND ACCESSORIES

A. All fittings shall be of malleable or heavy pressed steel construction conforming to ASTM A153.

B. All materials shall be in accordance with Federal Specifications RR-F-191, Type IV, Class 1B.

C. Coating: Extrusion bonded black PVC coating, minimum of 10 mils thick

2.05 BARBED WIRE

A. Barbed wire shall be three lines of double strand No. 12-1/2 AWG wire, conforming to ASTM A121, with No. 14 AWG 4-point barbs placed 5-inches apart.

B. Barbed wire support arms shall project outward from the top of line posts at 45°, and shall be vertical at terminal posts.
1. Shall support 250 pounds applied downwards at the outermost wire attachment.
2. Shall have formed tongues or other approved provision for attachment of three strands of barbed wire, with the outside strand located approximately 12-inches horizontally away from the fence, and other strands spaced evenly.

2.06 CONCRETE

A. Concrete for post bases (footings) shall be as specified in Section 03300, Cast-In-Place Concrete.
1. 28 day strength: 3,000 psi.

2.07 WARRANTY

A. Prior to installation, the Contractor shall provide the fence manufacturer's notarized certification that all components are fully warranted by the manufacturer for 15 years from Substantial Completion against rust and corrosion.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Fence shall be erected by skilled mechanics in accordance with the recommendations of the manufacturer and these specifications. These specifications shall

take precedence over the recommendations of the manufacturer if any discrepancy exists between them.

B. Posts:

1. Posts shall be set true to the line and grade of the proposed fence in concrete bases, as shown on the Drawings.
2. Line posts shall be spaced at a maximum of 10 feet, center to center.
3. Concrete post foundations shall be concrete cylinders with a minimum diameter of 12-inches, and shall extend into the ground to the dimensions shown on the Drawings. Posts shall be set in the full depth of the foundations except for 6-inches of concrete under terminal posts and 4-inches of concrete under line posts. If foundation holes are excavated in unsuitable material, the Engineer shall be notified for determination of suitable construction precautions.
4. If solid rock is encountered without an overburden of soil, poles shall be set into the rock a minimum depth of 12-inches for line posts and 18-inches for terminal posts, such as end, corner, gate and pull posts, and grounded into solid rock with the post hole diameter a minimum of 1-inch larger than that of the post.
5. Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set into the rock as specified above. The total pole setting depth shall not exceed the depths required for setting in earth.
6. Any change in direction of fence line of 30° or more shall be considered a corner. Pull posts shall be used at all abrupt changes in grade. Maximum area of unbraced fence shall not exceed 1,500 square feet.
7. Terminal posts such as end, corner, gate and pull posts shall be braced to the adjacent post(s) with horizontal rail braces used as compression members and diagonal truss braces with truss tighteners for tension members, with the lower ends at the terminal post in each panel of fence framework.

B. Top Rails:

1. Top rails shall pass through intermediate or line post tops, form a continuous brace with all splices made by approved couplings, and shall be fastened to terminal posts.

C. Chain Link Fabric:

1. Shall be stretched taut, with the bottom edge following the finish grade, and shall be a continuous mesh between terminal posts.
2. Each span of fabric shall be attached independently at terminal posts.
3. Where terminal posts do not have provisions for weaving fabric to posts, stretcher bars shall be placed through the end weave of the fabric and secured to the post with bar bands spaced not more than 12-inches apart on the post.
4. Shall be attached with ties to line posts at intervals of not more than 14-inches (and to the top railing and braces at intervals not exceeding 24-inches).
5. Bottom tension wire shall be interlaced in the weave of the fabric, pulled taut and fastened to terminal posts.

D. Barbed Wire:

1. Shall be stretched taut and fastened at each support.

E. Gates:

1. Gates shall open 180° outward unless otherwise specified on the Contract Documents. The Contractor shall propose modifications to the operational

direction if grade and clearance, gate obstruction, or other field conditions are determined to interfere with gate operation, as approved by the Engineer.

2. Install gates true to opening and plumb in a closed position.
3. Chain Link Cantilever Slide Gate shall be installed as specified in Section 02831.

END OF SECTION

SECTION 02831

CHAIN LINK CANTILEVER SLIDE GATE

PART 1 GENERAL

1.01 DESCRIPTION

A. Work includes: Provide chain link cantilever slide gate with enclosed aluminum track and hardware as required by the Contract Documents.

B. Gate shall be 8 feet high and located as shown on the Drawings.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
   1. Section 01300 Submittals
   2. Section 02830 Chain Link Fence
   3. Section 03300 Cast-In-Place Concrete

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 30 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements;
   3. Shop Drawings showing details of cantilever gate, frame material, details of trucks and guide wheels, details of supports, and construction, installation and anchorage.
      a. Detail drawings of locking devices for gates.

1.04 STANDARDS

A. The following American Society for Testing and Materials (ASTM) standards form a part of this specification as referenced:

1.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
2.	ASTM A121	Metallic-Coated Carbon Steel Barbed Wire.
3.	ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
4.	ASTM F626	Fence Fittings.
5.	ASTM F900	Industrial and Commercial Steel Swing Gates.
6.	ASTM F1083	Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
7.	FS RR-F-191	Fencing Wire and Post, Metal (and Grates, Chain-Link Fabric, and Accessories).
8.	ASTM F1184	Cantilever Slide Gates, Type II Class 2.

1.05 SPECIAL WARRANTY

A. Provide manufacturer's written warranty covering the cantilever slide gate and truck assembly against failure resulting from normal use for a period of five (5) years from date of Substantial Completion.
   1. Failure is defined as any defect in manufacturing that prevents the gate from operating in a normal manner.

PART 2 PRODUCTS

2.01 GATE FRAME

A. Gate frame shall be made of 2-inch square aluminum tubing, alloy 6063-T6, weighing a minimum of 0.94 pounds per linear foot.
   1. Shall be welded at all corners to form one rigid piece.
   2. Fabric shall be securely stretched and held on all four sides in the 2-inch square tubing by use of hook bolts and tension rods.
   3. Provide diagonal adjustable length truss rods of 1-5/8 inch galvanized steel in each panel of gate frames.

2.02 CHAIN LINK CANTILEVER SLIDE GATE

A. Cantilever slide gate shall be manufactured by Tymetal Corp., Greenwich, NY, or approved equal.
   1. Manufacturer shall provide independent certification to document compliance to the AWS D1.2 welding code. Upon request, Individual Certificates of Welder Qualification documenting successful completion of the requirements of the AWS D1.2 code shall also be provided.

B. Gate Leaf:
   1. Length of gate overhang shall be as required by the manufacturer's standard counter balance for the specified gate opening size.

C. Enclosed Track:
   1. Aluminum extrusion track and rail.
   2. Total weight of 3.72 lb/ft.
   3. Withstand a reaction load of 2,000 pounds.

D. Zinc Die Cast Trucks:
   1. Swivel type.
   2. Four sealed lubricant ball-bearing wheels.
   3. 2-inch diameter by 9/16-inch width.
   4. Two side rolling wheels shall be provided for each gate leaf.
   5. Trucks shall be held to post brackets by 7/8-inch diameter ball bolts with 1/2-inch shank.
   6. Truck assembly shall be designed to take the same reaction load as the track.

E. Gate hangers, latches, brackets, guide assemblies and stops shall be galvanized after fabrication. Positive latch shall be provided with accessible suitable latches and provisions for padlocking.

F. Guide Wheel Assemblies:
   1. Provide for each supporting post.
   2. Shall consist of two four-inch diameter wheels attached to the post.
   3. Wheels shall be adjusted to maintain proper gate alignment and keep gate frame plumb.

G. Gates shall be installed on 4-inch outside diameter Schedule 40 galvanized posts weighing 9.1 lbs/ft.

H. Concrete for post foundation shall be as specified in Section 03300, Cast-In-Place Concrete.
   1. Grout for posts set in solid rock shall consist of one part Portland Cement and three parts clean, sharp, well graded sand.
   2. Grout shall be thoroughly worked into the hole to leave no voids.

I. Posts, other fence framework, accessories, fittings, and miscellaneous items associated with the gates shall be hot dipped galvanized and have an extrusion bonded black PVC coating, minimum of 10 mils thick.

2.03 FABRIC

A. Shall be attached at each end of the gate frame by standard fence industry tension bars and tied at each vertical member with standard fence industry ties, and leaving no leading or bottom edge protrusions.

B. Fabric shall be as specified in Section 02830, Chain Link Fence.

2.04 FITTINGS AND ACCESSORIES

A. All fittings shall be of malleable or heavy pressed steel construction conforming to ASTM A153.

B. All materials shall be in accordance with Federal Specifications RR-F-191, Type IV, Class 1B.

2.05 BARBED WIRE

A. Barbed wire shall be as specified in Section 02830, Chain Link Fence.

2.06 CONCRETE

A. Concrete for post bases (footings) shall be as specified in Section 03300, Cast-In-Place Concrete.
   1. 28 day strength: 3,000 psi.

2.07 SLIDE GATE OPERATOR

A. Slide gate operator shall be HySecurity model SlideDrive 40 (222 E ST) with Smart Touch Controller, or approved equal.

B. Slide gate operators shall comply with UL325 and be listed by a testing laboratory. All electrical work shall be complete according to local codes and the National Electrical Code.

C. Slide gate operator shall generate a minimum horizontal pull of 300 punds and be capable of operating a gate weighing up to 4,000 pounds. Gate panel velocity should not be less than 1.0 foot per second.

D. Slide gate operator components:
1. Shall include "soft stop" feature controlled by two adjustable hydraulic break valves (one for each direction).
2. Supporting arms shall be cast aluminum channel and incorporate fully brushed 1-1/2-inch bronze bearing surface acting on arm pivot pins.
3. Arm pivot pins shall be 3/4-inch diameter, stainless steel, with integral tables for removal.
4. Tension spring shall be 2-1/2-inch heavy duty, 800-pound capacity.
5. Tension adjustment shall be hand tightened nut, no tools required.
6. Drive release must instantly release tension on both drive wheels and disengage the wheels from contact with drive rail in single motion for manual operation.
7. Limit switches shall be fully adjustable, toggle types, with plug connection to control panel.
8. Electrical enclosure shall be metal with hinged lid, gasketed, and provide space for accessories.
9. Chassis shall be 1/4-inch steel base plate with 12-gauge sides and back welded and ground smooth.
10. Cover shall be 16-gauge zinc plated steel with tectured TGIC polyester powder fisnish coat, proven to withstand 1,000-hour salt spray test. All welded joints.
11. Two (2) 6-inch diameter drive wheels composed of high strength composite hub with polyurethane over mold.
12. Drive rail shall be extruded 6061-T6, not less than 1/8-inch thick, and incorporate alignment pins for replacement or splicing. Pins shall enable perfect butt splice.
13. Hydraulic hose shall be 1/4-inch synthetic, rated to 2750 psi.
14. Hydraulic valves shall be individually replaceable cartridge type, in an integrated hydraulic manifold.
15. Hose fittings at manifold shall be quick-disconnect type. Others shall be swivel type.
16. Hydraulic fluid shall be high performance type with viscosity index greater than 375 and temperature range -40°F to 167°F.
17. 0 to 2,000 psi pressure gauge mounted on manifold for diagnostics.
18. Hydraulic fluid reservoir shall be formed from a single piece of metal, non-welded, and shall be powered on the inside and the outside to prevent fluid contamination.
19. Two (2) through beams, Infrared Photocell IRB-325.
20. Two (2) gate edges.
21. Two (2) obstruction loop detectors.

E. Electrical components:
1. All components shall have overload protection.
2. Pump motor: 1 HP, 56C, TEFT, continuous duty motor, 1.15 service factor or greater. Three phase, 480 volt.
3. Controls shall be Smart Touch Controller Board with 256K of program memory, or approved equal. Controlls shall include:
   a. Inherent entrapment sensor;

b. Built-in “warn before operate” system;
c. Built-in timer to close;
d. Liquid crystal display for reporting functions;
e. 26 programmable output relay options;
f. Anti-tailgate mode;
g. Built-in power surge/lightning strike protection;
h. Menu configuration, event logging and system diagnostic accessbile with PC and HySecurity free START software;
i. RS232 port for connection to PC and RS485 connection for network interface;
j. Transformer: 75 VA, non-jumpered taps.
k. Control circuit: 24VDC.

F. Warranty: 5-year limited warranty from the date of purchase.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Fence shall be erected by skilled mechanics in accordance with the recommendations of the manufacturer and these specifications. These specifications shall take precedence over the recommendations of the manufacturer if any discrepancy exists between them.

B. Posts:
1. Gate posts shall be set true to the line and grade in concrete bases.
2. Support posts for cantilever gate shall be spaced as required by gate manufacturer.
3. All posts shall be set in 3,000 psi concrete.
4. Concrete post foundations shall be concrete cylinders with a minimum diameter of 18-inches and a wider diameter at the base as shown on the Drawings, and shall extend into the ground to the dimensions shown on the Drawings. Posts shall be set in the full depth of the foundations except for 12-inches of concrete under the posts. If foundation holes are excavated in unsuitable material, the Engineer shall be notified for determination of suitable construction precautions.

C. Fabric and barbed wire shall be installed as specified in Section 02830.

D. Slide Gate Operator:
1. Slide gate operator shall be installed per the manufacturer’s instructions, and mounted on a concrete pad as shown on the Contract Drawings.
2. Through beams shall be installed to protect the gate from striking an object in both open and close direction of travel. Through beams shall be installed a maximum of 5-inches from the face of the gate and between 21 and 27.5 inches from the surface of the roadway.

3. Gate edge sensors shall be installed on both leading and trailing edges of the gate. The gate shall stop and reverse for two seconds if the gate edge comes into contact with an object.
4. One obstruction loop detector shall be installed on the exit side of the gate, and one obstruction loop detector shall bein stalled on the entrance side of the gate, at locations as identified on the Contract Drawings.

END OF SECTION

SECTION 02845

PARKING BUMPERS

PART 1 GENERAL

1.01 DESCRIPTION

A. Provide parking bumpers at locations as directed by the Engineer and as specified herein.

B. Related work:
1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Sections in Division 1 of these Specifications.

1.02 QUALITY ASSURANCE

A Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B Fabricated by a firm regularly engaged in the manufacturer of precast units for similar and comparable work.

C Design in accordance with pertinent recommendations contained in:
1. ACI 304.
2. ACI 309.
3. ACI 311.
4. ACI 318.
5. ACI 347.
6. CRSI "Manual of Standard Practice".
7. PCI 116.
8. ASTM A615, Grade 60.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.
1. Product data: Submit manufacturer's specifications and other data to prove compliance with the specified requirements.

PART 2 PRODUCTS

2.01 PRECAST PARKING BUMPERS.

A. Precast parking bumpers shall be manufactured by Wachusett Precast, Inc., Sterling, MA. or an approved equal.
1. Shall be six (6) feet long,
2. Single sided,
3. Nine (9) inches wide by six (6) inches high,
4. Concrete strength at 28 days shall not be less than 4000 psi,

5. Two (2) 3/4-inch pin down holes in each bumper,
6. Approximate weight, 380 lbs. each,
7. 5/8-inch diameter by nineteen (19) inches hold down pins.

PART 3 EXECUTION

3.01 GENERAL

A Provide parking bumpers at locations as shown on the Drawings.
1. Align bumpers in a straight line.
2. Anchor them to the pavement with hold down pins provided.

END OF SECTION

SECTION 02900

LANDSCAPING

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide landscaping as required by the Contract Documents.
   1. Generally the Work consists of topsoiling, seeding and fertilizing all areas not covered by pavement or gravel, and where the property is disturbed by the construction work.
   2. Provide the specified quantity and size of plantings as shown of the Drawings.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to Sections in Division 1 of these Specifications.
   1. Section 02200 Earthwork
   2. Section 02210 Site Grading

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil stripped from the site and stored, shall be approved before reuse.
   1. Topsoil from the site shall be treated to conform to the requirements for topsoil furnished from offsite sources.
   2. If the required quantity of suitable topsoil is not available from stripping of the site, or if it is not approved, topsoil from outside sources shall be furnished.
   3. Stockpiled topsoil used for this work shall be screened before being spread.
   4. Surplus topsoil not required to fulfill the requirements of the Contract shall be legally disposed of unless otherwise directed by the Owner.

2.02 TOPSOIL FURNISHED FROM OFFSITE SOURCES

A. Topsoil shall be fertile, friable, typical of the locality, and obtained from a well-drained site.
   1. It shall be without admixture of subsoil or slag.

2. Shall be screened.
3. Topsoil as delivered to the site shall have an acidity range of pH 5.0 to 6.5 and shall contain not less than 5% organic matter as determined by loss on ignition of moisture-free samples dried at 100 degrees Centigrade.
4. If required, limestone shall be added to the topsoil to adjust the pH, so that it complies with the required limits.

B. Mechanical Analysis: Topsoil shall meet the following mechanical analysis

	% Passing	% Retained
1-1/4" screen	100	0
1/2" screen	97-100	0-3
No. 100 mesh sleeve	60-40	40-60

2.03 TREATING TOPSOIL WITH LIMESTONE OR ALUMINUM SULFATE

A. When the hydrogen-ion value is below the specified level, add ground limestone at the rate of 2-1/2 lbs. per cubic yard of topsoil to raise pH one full point.

B. The following table shows the amount of limestone needed for various soil reactions on the basis of 1,000 sq. ft. and on the basis of one (1) acre:

pH	pH Desired	Lbs. per 1000 sq. ft.	Tons per Acre
6.0	6.5	0-46	0-1
5.5	6.5	46-92	1-2
5.0	6.5	92-138	2-3

1. Limestone shall be raw, ground agricultural limestone containing not less than 90% calcium carbonate and shall be ground to such fineness that 50% will pass through a 100-mesh sieve and 90% will pass through a 20-mesh sieve.
2. When hydrogen-ion value is above specified level, add aluminum sulfate at the rate of 2-1/2 lbs. per cubic yard of topsoil to lower the pH one full point. Aluminum sulfate shall be unadulterated and delivered in containers with the name of the material, name of the manufacturer, and net weight of contents.

2.04 FERTILIZER

A. Fertilizer shall be furnished in containers plainly marked with the chemical analysis of the product and showing one of the following compositions by weight.

	10-6-4	8-6-4	7-7-7
Nitrogen	10% min.	8% min.	7% min.
Available Phosphoric Acid	6% min.	6% min.	7% min.
Water Soluble Potash	4% min.	4% min.	7% min.

1. Fertilizer shall be stored so that when used it will be dry and free flowing.

2.05 SEED

A. Seed shall be the commercial product of an approved reputable manufacturer and shall be certified to be not more than one (1) year old and of the general proportions by weight of the following seed types:

For Lawns and Other Undisturbed Areas Except as Defined Below:

Botanical Name	Common Name	Proportion by Weight	Minimum % Purity	Minimum % Germination
Poa Pratensis	Kentucky Blue Grass	35%	85%	85%
Festuca rubra var. creeping	Red Fescue	35%	98%	90%
Lolium Perene perennial	Rye Grass	15%	95%	90%
Agrostis Alba	Red Top	10%	92%	90%
Trifolium repens	White Clover	5%	90%	90%

For Cross Country Areas

Botanical Name	Common Name	Proportion by Weight	Minimum % Purity	Minimum % Germination
Colium Perene-perennial	Rye Grass	100%	95%	90%

1. Seed shall be furnished and delivered premixed in the proportions specified above.
2. All seed shall comply with State and Federal seed laws.
3. A certificate of compliance with the specifications shall be submitted by the manufacturer with the shipment of the seed. The certificate shall include the guaranteed percentage of purity, weed content and germination of the seed, net weight and date of shipment.
4. No seed shall be sown until the Contractor has submitted the above-mentioned certificate to the Engineer.

2.06 PLANTINGS

A. Refer to Drawings for planting schedule.
B. Contractor shall provide additional plantings as noted on Contract Drawing C-8, Buffer Enhancement Plan or as required by Mansfield Conservation Commission

PART 3 EXECUTION

3.01 APPLICATION

A. Application of Topsoil
1. Topsoil shall be applied to the prepared subgrade specified in Section 02210, Site Grading.
2. Topsoil shall be spread to a compacted depth of:
a. Four (4) inches for cross country areas.
b. Six (6) inches for lawn areas.
c. Areas to have topsoil applied to them shall be scarified or otherwise roughened, just prior to the application.

B. Seedbed Preparation
1. Grade areas to be seeded to a smooth uniform grade.
2. Roll, scarify, rake and level as necessary to obtain true, even lawn surfaces
3. Meet existing grades.
4. All lawn areas shall slope to drain.
5. All finish grades shall meet approval before grass seed is sown.

C. Application Rates of Limestone, Aluminum Sulfate, Fertilizer and Seed
1. Limestone or Aluminum Sulfate shall be applied and thoroughly incorporated in the layer of loam or topsoil to adjust the acidity of the material.
2. The rate of application of the limestone will be determined by the pH value.
3. Fertilizer shall be applied at the rate of 20 pounds per 1000 square feet.
4. The seed mixture shall be sown at the rate of 5 pounds per 1000 square feet.

D. Fertilizing and Liming
1. Fertilizing and liming shall be done when the soil is in a moist condition and at least 24 hours before the sowing of the seed.
2. The fertilizer and lime shall be applied to the soil by means of a mechanical spreader or other approved method capable of maintaining a uniform rate of application.
3. Thoroughly harrowed, raked or otherwise mixed with the soil to a depth of not less than 2 inches.
4. The fertilizer and lime shall not be applied together.

E. Time of Seeding
1. The recommended seeding periods are from April 1 to June 1, and from August 15 to October 1.
2. The Contractor may choose to seed at other times but regardless of the time of seeding he shall be responsible for a full growth of grass.
3. When directed he shall re-fertilize and reseed areas on the project which do not develop a satisfactory growth of grass.

4. Re-fertilizing and reseeding shall be incidental to the original seeding item requirements.

3.02 SEEDING METHODS

A. Fertilizer, limestone, and mulch material, if required, and seed of the type specified may be placed by one of the following methods, provided an even distribution is obtained.

B. Dry Method

1. Power Equipment: Mechanical seeders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other approved mechanical seeding equipment or attachments may be used when seed, limestone, and fertilizer are to be applied in dry form.
2. Manual Equipment - On areas that are inaccessible to power equipment, permission may be given to use hand-operated mechanical equipment when the materials applied are in dry form. The use of hand shovels to spread the materials shall not be allowed.
3. When the dry method is used, limestone and fertilizer shall not be mixed together prior to their application, but shall be worked into the soil together to a depth of at least 2 inches.
4. At least 24 hours shall elapse between the time fertilizer is incorporated into the topsoil and seed is spread.
5. Areas covered with park seed shall be raked, and, rolled with a roller weighing not more than 100 pounds per foot of roller width to firm the soil but not to pack it. The rolling shall be done the same day as the seeding unless otherwise permitted.
6. Lawn areas constructed in the spring after April 15 shall be covered with a 1 inch loose layer of clean wheat or oat straw. The straw shall be kept wet until a catch of grass is established. Loose straw shall be removed from the site.
7. Grass on slopes or banks may be established by another method subject to approval. Special care shall be exercised to prevent erosion or washouts.

C. Hydraulic Method

1. The application of grass seed, fertilizer, limestone, and a suitable mulch, if approved, may be accomplished through the use of an approved spraying machine.
2. The materials shall be mixed with water in the machine and kept in an agitated state in order for the materials to be uniformly suspended in the water.
3. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of limestone, fertilizer, and grass seed shall be equal to the required rates.
4. Prior to the start of work, the Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.
5. The hydraulic seeding and fertilizing machine shall be completely flushed and cleaned each day before seeding is started.
6. If the results of the spray operations are unsatisfactory, the Contractor shall be required to abandon this method and apply the materials in accordance with the dry method.
7. When the hydraulic method is used, compaction or rolling shall be required.

3.03 MAINTENANCE

A. The Contractor shall be responsible for the proper care of the seeded areas during the period when the grass is becoming established.
   1. This period shall extend for two months after a successful uniform stand of grass is produced.
   2. The Contractor shall reseed all areas as necessary to obtain a uniform stand of grass, free from bare spots.
   3. Any seeded areas which fail to show a uniform stand of grass shall be reseeded until all areas are covered
   4. Any and all additional seeding shall be at the Contractor's expense.
   5. If necessary, barricades of brush or other materials and suitable signs shall be placed to protect the seeded areas.
   6. The seeded areas shall be carefully and suitably watered as necessary to produce a satisfactory growth.
   7. Areas seeded shall be mowed whenever necessary to keep the growth between 3 inches and 4 inches.
   8. Any washout that occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

3.04 PLANTINGS

A. Planting installation shall be as follows:
   1. Season for planting shall be as recommended by the nursery supplying the plantings.
   2. Do not plant in muddy or frozen ground.
   3. Field stake/layout plantings as shown on the DRAWINGS. CONTRACTOR shall notify the OWNER prior to installation for approval.
   4. Horizontal limit of topsoil shall extend 4 feet from the center of the plantings.
   5. Minimum depth of topsoil shall extend from the crown of the root ball to 6 inches below the root ball.
   6. Plant pits shall be two feet greater in diameter than the root ball and excavated with vertical sides. Plant pits shall not be backfilled until the ENGINEER has approved the installation.
   7. Plantings shall be set plumb and straight in the center of the pits. Crown of the plant shall be set at finished grades indicated on the DRAWINGS.
   8. The pits shall be backfilled to within eight inches of finished grade and then soaked in water and allowed to settle. Backfill shall consist of planting soil thoroughly mixed with fertilizer. Backfill to finished grade after settlement.
   9. Mulch material shall be placed over entire planting to a depth of four inches after settlement, not later than one week after planting. No mulch shall be applied prior to the first watering of plant materials.

END OF SECTION

SECTION 02930

LOAM AND SEED

PART 1 GENERAL

1.01 DESCRIPTION

A. Work included: Provide loam and seed as required by the Contract Documents.
   1. Generally the Work consists of topsoiling, seeding and fertilizing all disturbed areas of the water main easements.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 01610 Product Handling
   2. Section 02015 Test Pits
   3. Section 02110 Clearing and Grubbing
   4. Section 02210 Site Grading
   5. Section 02222 Earthwork
   7. Section 02900 Landscaping

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
   1. Use equipment adequate in size, capacity, and numbers to accomplish the work in a timely manner.

B. If the results of the hydraulic seeding operation (if utilized) are unsatisfactory, the method shall be abandoned and seeding shall be required by the sowing method.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Section 01300.

B. Product data: Within 35 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
   1. Materials list of items proposed to be provided under this Section.
   2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements.

C. If hydroseeding application is to be used, a written description containing seed analysis, fertilizer and lime addition data is to be submitted for review of the Owner.

1.05 PRODUCT HANDLING

A. Comply with pertinent provisions of Section 01610.

B. Immediately remove from the site, materials which are not true to name, and do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Topsoil stripped from the site and stored, shall be approved before reuse.
   1. Topsoil from the site shall be treated to conform to the requirements for topsoil furnished from offsite sources.
   2. If the required quantity of suitable topsoil is not available from stripping of the site, or if it is not approved, topsoil from outside sources shall be furnished.
   3. Stockpiled topsoil used for this work shall be screened before being spread.
   4. Surplus topsoil not required to fulfill the requirements of the Contract shall be properly disposed of unless otherwise directed by the Owner.

2.02 TOPSOIL FURNISHED FROM OFFSITE SOURCES

A. Topsoil shall be fertile, friable, natural topsoil typical of the locality, and obtained from a well-drained site.
   1. It shall be without admixture of subsoil or slag.
   2. Shall be screened.
   3. Topsoil as delivered to the site shall have an acidity range of pH 5.0 to 6.5 and shall contain not less than 5% organic matter as determined by loss on ignition of moisture-free samples dried at 100 degrees Centigrade.
   4. If required, limestone shall be added to the topsoil to adjust the pH, so that it complies with the required limits.

B. Mechanical Analysis: Topsoil shall meet the following mechanical analysis

Size	% Passing	% Retained
1-1/4" screen	100	0
1/2" screen	97-100	0-3
No. 100 mesh sleeve	40-60	40-60

2.03 TREATING TOPSOIL WITH LIMESTONE OR ALUMINUM SULFATE

A. When the hydrogen-ion value is below the specified level, add ground limestone at the rate of 2-1/2 lbs. per cubic yard of topsoil to raise pH one full point.

B. The following table shows the amount of limestone needed for various soil reactions on the basis of 1,000 sq. ft. and on the basis of one (1) acre:

pH	pH Desired	Lbs. per 1000 sq. ft.	Tons per Acre
6.0	6.5	0-46	0-1
5.5	6.5	46-92	1-2
5.0	6.5	92-138	2-3

1. Limestone shall be raw, ground agricultural limestone containing not less than 90% calcium carbonate and shall be ground to such fineness that 50% will pass through a 100-mesh sieve and 90% will pass through a 20-mesh sieve.
2. When hydrogen-ion value is above specified level, add aluminum sulfate at the rate of 2-1/2 lbs. per cubic yard of topsoil to lower the pH one full point. Aluminum sulfate shall be unadulterated and delivered in containers with the name of the material, name of the manufacturer, and net weight of contents.

2.04 LIME

A. Lime shall be ground limestone containing not less than 85 percent calcium and magnesium carbonates.
1. Ground to such fineness that at least 50 percent will pass through a 100-mesh sieve and at least 90 percent shall pass through a 20-mesh sieve.

2.05 GRASS SEED (UPLANDS)

A. General: Provide grass seed which is:
1. Free from noxious weed seeds, and recleaned.
2. Grade A recent crop seed.
3. Treated with appropriate fungicide at time of mixing.
4. Delivered to the site in sealed containers with dealers guaranteed analysis.

B. Proportions by Weight (Level Areas):

1.	Chewing Fescue	60 percent.
2.	Red Top	10 percent.
3.	Annual Ryegrass	10 percent
4.	Kentucky Blue	20 percent.

C. Proportions by Weight (Slopes):

1.	Creeping Red Fescue	50 percent.
2.	Perennial Rye Grass	20 percent
3.	Red Clover	10 percent.
4.	Winter Rye	15 percent
5.	Ladino Clover	5 percent

D. Requirements:
1. Seed shall be furnished and delivered premixed in the proportions specified above.
2. All seed shall comply with State and Federal seed laws.
3. A certificate of compliance with the specifications shall be submitted by the manufacturer with the shipment of the seed. The certificate shall include the

guaranteed percentage of purity, weed content and germination of the seed, net weight and date of shipment.

4. No seed shall be sown until the Contractor has submitted the above mentioned certificate to the Engineer.

2.06 GRASS SEED (WETLANDS)

A. Proportions by Weight

1.	Lurid Sedge	>10%
2.	Fowl Manna Grass	>10%
3.	Fringed Sedge	>10%
4.	Woolgrass	>10%
5.	Other Wetland Seeds	<60%

B. Germination Minimum

1.	Lurid Sedge	80%
2.	Fowl Manna Grass	80%
3.	Fringed Sedge	80%
4.	Wool Grass	80%
5.	Other Wetland Seeds	80%

C. Requirements:

1. Grass seed mixture for the compensatory storage areas shall be a fresh, clean, new crop seed. Seed may be mixed by an approved method on the site or may be mixed by the dealer. All seed shall comply with State and Federal seed laws. If the seed is mixed on the site, each variety shall be delivered in the original containers bearing the dealer's guaranteed analysis. If the seed is mixed by the dealer, the dealer's guaranteed statement of the composition of the mixture and the percentage of purity, weed content, net weight, and germination of each variety shall be provided. No seed shall be sown until contractor has submitted the guaranteed statement of the composition to the Engineer.
2. Seed shall be the commercial product of an approved reputable manufacturer and shall be certified to be not more than one (1) year old and shall be composed of the follwoign varieties, The seed mix shall be New England wetmix as manufactured by New England Wetland Plants Inc. Amherst, MA. or approved equal.
3. The application rate shall be one pound per 5,000 square feet. The seed shall be mechanical spread or broadcasted by hand works creating an even distribution. The seed mix shall be sown early spring or late fall for increased germination.
4. Contractor shall provide additional conservation seed mix as noted on Contract Drawing C-8, Buffer Enhancement Plan or as required by Mansfield Conservation Commission.

2.07 FERTILIZER

A. Fertilizer shall be furnished in containers plainly marked with the chemical analysis of the product and showing one of the following compositions by weight.

Constituent	10-6-4	8-6-4	7-7-7
Nitrogen	10% min.	8% min.	7% min.
Available Phosphoric Acid	6% min.	6% min.	7% min.
Water Soluble Potash	4% min.	4% min.	7% min.

1. Fertilizer shall be stored so that when used it will be dry and free flowing.

2.08 HYDRAULIC SPRAY MACHINE

A. Shall be designed specifically for seed dissemination.

B. Shall allow materials to be mixed with water in the machine and kept in an agitated state to keep materials uniformly suspended in the water.

C. Shall be designed to provide equal quantities of required materials over a particular spraying area.

PART 3 EXECUTION

3.01 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.

3.02 APPLICATION

A. Application of Topsoil
1. Topsoil shall be applied to the prepared subgrade specified in Section 02210, Site Grading.
2. Topsoil shall be spread to a compacted depth of:
a. Four (4) inches for cross country areas.
b. Areas to have topsoil applied to them shall be scarified or otherwise roughened, just prior to the application.

B. Seedbed Preparation
1. Grade areas to be seeded to a smooth uniform grade.
2. Roll, scarify, rake and level as necessary to obtain true, even surfaces
3. Meet existing grades.
4. All seeded areas shall slope to drain.
5. All finish grades shall meet approval before grass seed is sown.

C. Application Rates of Limestone, Aluminum Sulfate, Fertilizer and Seed
1. Limestone or Aluminum Sulfate shall be applied and thoroughly incorporated in the layer of loam or topsoil to adjust the acidity of the material.
2. The rate of application of the limestone will be determined by the pH value.
3. Fertilizer shall be applied at the rate of 20 pounds per 1000 square feet.
4. The seed mixture shall be sown at the rate of 5 pounds per 1000 square feet.

D. Fertilizing and Liming

1. Fertilizing and liming shall be done when the soil is in a moist condition and at least 24 hours before the sowing of the seed.
2. The fertilizer and lime shall be applied to the soil by means of a mechanical spreader or other approved method capable of maintaining a uniform rate of application.
3. Thoroughly harrowed, raked or otherwise mixed with the soil to a depth of not less than 2 inches.
4. The fertilizer and lime shall not be applied together.

E. Time of Seeding

1. The recommended seeding periods are from April 1 to June 1, and from August 15 to October 1.
2. The Contractor may choose to seed at other times but regardless of the time of seeding he shall be responsible for a full growth of grass.
3. When directed he shall re-fertilize and reseed areas on the project which do not develop a satisfactory growth of grass.
4. Re-fertilizing and reseeding shall be incidental to the original seeding item requirements.

3.03 SEEDING METHODS

A. Fertilizer, limestone, and mulch material, if required, and seed of the type specified may be placed by one of the following methods, provided an even distribution is obtained.

B. Dry Method

1. Power Equipment: Mechanical seeders, seed drills, landscape seeders, cultipacker seeders, fertilizer spreaders, or other approved mechanical seeding equipment or attachments may be used when seed, limestone, and fertilizer are to be applied in dry form.
2. Manual Equipment - On areas which are inaccessible to power equipment, permission may be given to use hand-operated mechanical equipment when the materials applied are in dry form. The use of hand shovels to spread the materials shall not be allowed.
3. When the dry method is used, limestone and fertilizer shall not be mixed together prior to their application, but shall be worked into the soil together to a depth of at least 2 inches.
4. At least 24 hours shall elapse between the time fertilizer is incorporated into the topsoil and seed is spread.
5. Areas covered with park seed shall be raked, and, rolled with a roller weighing not more than 100 pounds per foot of roller width to firm the soil but not to pack it. The rolling shall be done the same day as the seeding unless otherwise permitted.
6. Areas seeded in the spring after April 15 shall be covered with a 1 inch loose layer of clean wheat or oat straw. The straw shall be kept wet until a catch of grass is established. Loose straw shall be removed from the site.
7. Grass on slopes or banks may be established by another method subject to approval. Special care shall be exercised to prevent erosion or washouts.

C. Hydraulic Method

1. The application of grass seed, fertilizer, limestone, and a suitable mulch, if approved, may be accomplished through the use of an approved spraying machine.

2. The materials shall be mixed with water in the machine and kept in an agitated state in order for the materials to be uniformly suspended in the water.
3. The spraying equipment shall be so designed that when the solution is sprayed over an area, the resulting deposits of limestone, fertilizer, and grass seed shall be equal to the required rates.
4. Prior to the start of work, the Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the hydroseeder.
5. The hydraulic seeding and fertilizing machine shall be completely flushed and cleaned each day before seeding is started.
6. If the results of the spray operations are unsatisfactory, the Contractor shall be required to abandon this method and apply the materials in accordance with the dry method.
7. When the hydraulic method is used, compaction or rolling shall be required.

D. Side Slopes Application
1. Roadway side slopes shall be seeded utilizing a hydraulic (hydro-seed) application process, to place seed and fertilizer simultaneously.
2. A color agent shall also be within the hydraulic mix.
3. Care shall be taken during the application to prevent coverage of poles, trees, signs, and etc.

3.04 MAINTENANCE

A. The Contractor shall be responsible for the proper care of the seeded areas during the period when the grass is becoming established.
1. This period shall extend for two months after a successful uniform stand of grass is produced.
2. The Contractor shall reseed all areas as necessary to obtain a uniform stand of grass, free from bare spots.
3. Any seeded areas which fail to show a uniform stand of grass shall be reseeded until all areas are covered
4. Any and all additional seeding shall be at the Contractor's expense.
5. If necessary, barricades of brush or other materials and suitable signs shall be placed to protect the seeded areas.
6. Any washout which occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

3.05 GUARANTEE PERIOD

A. All seeded areas shall be guaranteed by the Contractor for not less than one (1) full year from the date of substantial completion.

END OF SECTION

SECTION 02950

TREE PROTECTION AND RESTORATION

PART 1 GENERAL

1.01 DESCRIPTION

A. The work under this Section consists of protecting, restoring and replacing trees and shrubs affected by the work to be performed under this Contract.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary Conditions, and Sections in Division 1 of these Specifications.
   1. Section 02210 Site Grading
   2. Section 02930 Loam and Seed

1.03 WARRANTY

A. All plants, shrubs, trees and related work required under this Contract must be planted during the recommended time planting period and must satisfactorily grow and survive for a period of one year after acceptance.

B. All plants shall be free of dead or dying branches and branch tips and have foliage of normal density, size and color.

C. Replace all dead trees and shrubs and all these not in vigorous, thriving condition during the entire guarantee period:
   1. Without cost to Owner.
   2. As soon as weather conditions permit.
   3. Within a specified planting period.

D. Replacement plants under this guarantee shall be guaranteed for one full growing season from date of installation.

E. Replacements shall closely match adjacent specimens of the species.
   1. All replacements shall be of the same kind and size.
   2. Replacements shall be furnished and planted and specified herein.

1.04 DELIVERY, STORAGE AND HANDLING

A. Do not deliver more plant materials than can be planted in one day.

B. Deliver plants with legible identification labels.
   1. Label trees, evergreens, bundles or containers of like shrubs, or ground cover plants.
   2. State correct plant name and size.

3. Use durable waterproof labels with water resistant ink which will remain legible for at least 60 days.

C. Protect during delivery to prevent damage to root ball or desiccation of leaves and wind burn.
   1. Plant balls shall be firmly bound, unbroken, reasonably moist to indicate watering prior to delivery and during storage.
   2. Tree trunks shall be free from fresh scars and damage in handling.
   3. No plant material from cold storage will be accepted.

D. Do not drop plants.

E. Do not pick up container plants by stems or trunks.

F. All plants and materials are subject to inspection for approval on delivery to site.
   1. Any approval shall not impair the right of the Engineer to reject plant or material damaged due to Contractor's handling, storage or planting methods.
   2. Notify Engineer of plant and material delivery schedule at least 48 hours in advance so that it may be inspected upon arrival at the job site.
   3. Remove unacceptable plants and materials immediately from the job site at no cost to the Owner.

G. Protect roots of plant material from drying or other possible injury.

H. Store plants in shade and protect from weather.
   1. Maintain and protect plant material not to be planted within four hours.

J. On delivery, set all balled and burlapped plants which cannot be planted immediately on ground and protect with soil, wet peat moss or other acceptable material.
   1. Water as required by weather conditions.

1.05 MAINTENANCE

A. Planting maintenance shall begin immediately after planting and continue until the end of the guarantee period.

B. Reset settled plants to proper grade and position, restore planting saucers and remove dead material.

C. Replace impaired, dead or missing plants promptly during specified planting season.

D. Keep planting saucers and beds free of weeds, grass and other undesired vegetation growth.

E. Tighten and adjust guys as necessary.

F. Water, weed, fertilize, cultivate, remulch, prune, spray, maintain and protect all plants to maintain a vigorous growing condition.

G. Remove soil ridges from around watering basins prior to end of maintenance period.

H. Following the completion of the maintenance period, the Contractor shall remove all wire, hoses, cables, guys and stakes from all trees which have been judged acceptable under guarantee provision.
1. Unless designated otherwise by the Owner, all such materials used for temporary support of trees shall become the property of the Contractor and shall be removed from the site.

PART 2 PRODUCTS

2.01 TREES AND SHRUBS

A. Well-formed and shaped, true to type, and free from disease, injurious pests and defects such as knots, sun-scald, windburn, injuries, abrasion or disfigurement.
1. Plants shall be in accordance with the ASNS Standards of the American Association of Nurserymen.

B. True to botanical and common name and variety:
1. American Joint Committee on Horticultural Nomenclature, Standardized Plant Names.

C. Nursery grown except native pine, and approved collected stock:
1. ANSI Z60.1 (latest edition).
2. Grown within hardiness Zones 1 through 5, as established by the Arnold Arboretum, Jamaica Plain, Massachusetts, will be accepted.
a. The Contractor's supplier must certify in writing that the stock has actually been grown under Zone 5 or hardier conditions.
b. Plants not so certified will not be accepted.
3. Root balled and burlapped plants:
a. The root system of each plant shall be well provided with fibrous roots.
b. All parts shall be moist and show active green cambium when cut.
c. They shall be sound, healthy, and vigorous, well-branched and densely foliated when in leaf.
d. The plants shall be free of disease, insect pests, eggs or larvae.
e. Not root-bound or with root system hardened-off.
f. Burlap shall be untreated eight ounce burlap. Plastic or other not-biodegradable wrappings will not be accepted.
g. No plant will be accepted when the ball of earth its roots has been badly cracked or broken preparatory to or during the process of planting.
h. The plants and balls shall remain intact during all operations.
i. All plants that cannot be planted at once must be heeled in by setting in the ground and covering the balls with soil and watering.
4. Use only ground cover plants well-established in removable containers, integral containers, or formed homogeneous soil sections.
5. Do not prune prior to delivery.
6. Size and form of trees:
a. Height of trees shall be not less than the minimum size designated.
b. Caliper measurement for deciduous trees six inches above ground level up to and including four and twelve inches above ground level for larger sizes.

c. Evergreen trees shall be to the specified height with spread in proportion to height as designated by the ASNS Standards.
d. Evergreen trees shall be well branched to the ground.
e. Each tree shall have a single trunk growing from a single un-mutilated crown of roots.
f. No part of the trunk of any tree shall be conspicuously crooked as compared with normal trees of the same variety.
g. The trunks of all trees shall be free from sun scald, frost cracks, or wounds resulting from abrasions, fire or other causes.

7. Size and form of shrubbery:
   a. Shrubbery shall meet the requirements for spread or height stated in the plant list.
   b. Measurement for height shall be taken from the ground level to the average height of the shrub and not to the longest branch.
   c. Single stemmed or thin plants will not be accepted.
   d. The shrubs shall be well branched to the ground.
   e. The shrubs shall be in a moist, vigorous condition, free from dead wood, bruises or other root or branch injuries.

2.02 PLANTING SOIL MIX

A. Planting soil mix shall be approved loam which has been pH adjusted according to particular planting applications and improved through the addition of organic matter as directed below. Planting loam shall conform to the following pH levels:
   1. For ericaceous plants and broad-leaved evergreens requiring an acid soil, planting loam shall have a true pH of 4.5 to 5.5. If it has not, it shall be amended by the Contractor at his own expense to the proper pH range by mixing with sulfur as specified herein.
   2. Planting loam for general planting of nonacid-loving plants shall have a true pH value of 6.0 to 6.5. If it has not, it shall be amended by the Contractor at his own expense to the proper pH range by mixing with dolomitic limestone as specified herein.
   3. The amount of either sulfur or limestone required to adjust the planting loam to the proper pH range (above) shall be approved by the Landscape Architect on the basis of soil tests as specified herein.

B. Planting soil mix shall consist of pH adjusted loam which has been thoroughly premixed with organic material in the proportions of one (1) part peat moss with five (5) parts of approved loam.

2.03 FERTILIZER

A. Non-acid loving:
   1. N: 10%
   2. $P_2 0_5$: 6%
   3. $K_2 0$: 4%

B. Acid Loving:
   1. N: 7%
   2. $P_2 0_5$: 7%

3. K_20: 7%

2.04 MULCH

A. Bark Mulch:
   1. Shredded or ground, fir, hemlock or pine, average 1 inch to 2 inches.
   2. Uniform color, aged a minimum of 6 months and a maximum of two years.
   3. Free from weed seeds, saw dust, splinters, stringy material and chunks of wood.

B. Wood Cellulose Fiber Mulch:
   1. Mulch to cover hydroseeded areas shall be fiber processed from whole wood chips manufactured specifically for standard hydraulic mulching equipment.
      a. Fiber shall not be produced from recycled material such as sawdust, paper, or cardboard.
   2. Moisture content shall not exceed 10%, plus or minus 3% as defined by the pulp and paper industry standards.
      a. Fiber shall have a water holding capacity of not less than 900 grams water per 100 grams fiber.
   3. The mulch shall be of such character that the fiber will be dispersed into a uniform slurry when mixed with water.
      a. It shall be nontoxic to plant life or animal life.
   4. The mulch shall contain a non-petroleum based organic tackifier and a green dye to allow for easy visual metering during application but shall be non-injurious to plant growth.

2.05 GUYS AND STAKES

A. Stakes for tree support:
   1. Construction grade lumber
   2. Minimum nominal size: 2" x 2" or 2-1/2" in diameter x 9' long and pointed at 1 end, stained dark brown.

B. Guying wire shall be minimum two strands of twisted new pliable annealed galvanized soft steel wire of No. ten gauge size.
   1. Hose for guying wire: New two ply reinforced rubber garden hose not less than one-half inch inside diameter. Color shall be black.
   2. Turnbuckles and eyebolts; Galvanized steel of size and gauge to provide tensile strength equal to that of the cable. Turnbuckle opening shall be a minimum of three inches.

C. Drive anchors and guy wire assembly shall be as manufactured by 'Duckbill' tree anchoring system manufactured by Foresight Industries, Inc., Cheyenne, Wyoming, or 'Ground Gripper' anchors as manufactured by A.B. Chance Co., Centralia, MO, or equal. Sizes used shall be in accordance with the manufacturer's specifications and recommendations.

D. Safety flagging for diagonal guy wires shall consist of twelve inch (12") lengths of wooden one by threes, (1x3) nominal dimension, painted with two coats of white enamel paint and fastened to guy wires with screw eyes, galvanized staples or other suitable hardware.

2.06 ANTI-DESICCANT

A. Acceptable emulsion shall be permeable to transpiration and shall be tested in accordance with ASTM E96.
   1. Anti-desiccant shall be "Wilt-Pruf" or approved equal.

PART 3 EXECUTION

3.01 TREE PROTECTION

A. Priority shall be given to protect the trees 12 inches in diameter and larger.
   1. The removal of trees shall be allowed only when they impede construction.

B. Tie back branches or trees designated for protection.
   1. Do not scar bark or break branches.
   2. Remove twine immediately upon completion of operations in the vicinity.

C. Snow fencing shall be provided, without nails, around designated trees to prevent scarring of the trees from construction equipment.
   1. Snow fencing shall be wire-bound wood roll 4 feet high.
   2. It shall be staked into the ground at 10 feet o.c. maximum, with 7-foot steel posts driven into the ground, or other approved fencing, placed at or beyond the drip-line of the branches and shall indicate the limit of all construction activity.

D Edge of excavation shall be a minimum of eight feet from the trunk of a tree that is to be protected.
   1. Trees in proximity to excavation shall be pruned prior to construction to compensate for anticipated root loss and stress.
   2. Pruning shall be done in accordance with Paragraph 3.02 of this specification.

E. The Contractor shall use a saw to cut roots greater than one inch, but less than three inches in diameter.
   1. Roots larger than three inches in diameter shall not be cut and may require hand digging to prevent damage.

F. No equipment or stockpiles shall be permitted within the drip-line of trees to be protected to avoid compaction of feeder roots (concentrated within the top six to eight inches of soil).
   1. Flag limits of vehicle traffic and stockpiles to minimize excess disturbance.

G. Traffic over roots by heavy construction vehicles shall be minimized.

H. Engineer shall observe protective measures prior to Contractor commencing any other construction operations in the vicinity.

I. Whenever tree roots will be exposed during construction for longer than three days, they shall be covered with a three-inch layer of mulch and kept moist.

3.02 TREE RESTORATION

A. Pruning: The Engineer shall determine, with the assistance of a certified arborist as necessary, whether sufficient structural root mass remains after construction root cutting to assure the survival of the tree.
   1. If not, the tree shall be removed at no additional cost to the Owner.
   2. Trees whose roots were pruned during construction, but shall remain, shall have their tree crowns pruned to balance root loss.

B. Wound Repair: When wounds are inflicted on any tree within or outside of construction or permanent easements, the loose bark shall be removed by cutting the bark back to healthy tissue with a sharp knife, tracing the outline of the wound.
   1. Wound tracing shall be supervised by a certified arborist, as determined by the Engineer.

C. Watering: Additional watering during periods of subnormal rainfall shall be applied at a rate equivalent to one inch per week.
   1. Water shall be non-toxic and free of harmful substances.

D. Replacement: In the event that trees to be protected cannot be saved as intended by the measures outlined in Part 3 of this specification, the tree shall be cleared.
   1. One tree shall be replaced for every 2-inch caliper of damaged or destroyed tree, at no additional cost to the Owner.
   2. A tree of similar species, 2-1/2 to 3-inch caliper shall be provided and planted as specified below.

3.03 TREE REPLACEMENT

A. In the event that trees to be protected cannot be saved as intended by the measures outlined in this specification, the tree shall be cleared.
   1. One tree for every 2 inches of caliper of damaged tree shall be replaced at no additional cost to the Owner.
   2. The tree shall be of similar species and planted at a location determined by the Engineer.

B. Planting Periods
   1. Deciduous Trees and Shrubs:
      a. March 21 through May 1
      b. October 1 through December 1
   2. Evergreen Trees and Shrubs:
      a. April 15 through June 1
      b. August 15 through October 15

C. Plant Pits
   1. Tree pits shall be at least two feet greater in diameter than the spread of the root ball and at least six inches deeper.
   2. All pits shall be sharp and circular in outline and shall have vertical sides.
      a. Excavated materials of a subsoil classification or containing extraneous matter shall be removed from the site by the Contractor on a daily basis.
   3. Test drainage of plant pits shall by filling with water.

a. If water does not drain out within six hours, dig trough impervious layers to a depth where drainage is adequate and backfill with sandy gravel material to proper pit depth.

D. Plants shall be placed at the proper depth, plumb and turned as directed in the pits.
   a. The pits shall be backfilled to within eight inches of finished grade and then soaked in water and allowed to settle.
   b. Backfilling shall consist of planting soil thoroughly mixed with fertilizer.

E. Plant when weather and soil conditions are suitable and in accordance with local practice.

F. The depth of planting pits shall be adjusted to provide a minimum of six (6) inches of compacted planting soil backfill under the balls or roots of all plants.

G. Remove top one-third of burlap, rope, wires, etc. from sides and tops of balls; do not pull burlap out from under.
   a. Synthetic man-made wrapping material, such as polypropylene or other similar materials, shall be completely removed.

H. Backfill remainder of plant pits with planting soil and firmly tamp around plant ball.

I. Place weed control barrier over planting pits and beds.

J. Mulch material shall be placed over entire saucer areas of trees to a depth of two inches after settlement, not later than one week after planting.
   a. No mulch shall be applied prior to the first watering of plant materials.
   b. Provide temporary raised earthen saucers surrounding tree.

K. Watering shall be done by flooding plants twice within the first twenty-four hours of the time of planting.

L. Wrapping shall be completed promptly after planting.
   1. The trunks of trees shall be spirally wrapped to the height of the second branches or as directed.
   2. Wrapping shall be taped securely in place.

M. Guys shall be placed around the trunk at a point higher than the lowest branches of the trees in such a manner that branches will not be subject to undue strain.
   1. Wires shall not come into direct contact with the bark of the tree in any place, but shall be covered with pieces of black rubber garden hose at points of contact.
   2. Guys shall be kept tight at all times.
   3. Bright orange flagging tape shall be tied to guys at chest height in areas subject to pedestrian traffic.

N. Pruning shall be done as specified in Paragraph 3.02 (A), but only under the direction of the Engineer.
   1. Any pruning done without his direction shall be cause for replacement of the plant.
   2. All newly planted trees and shrubs shall be pruned in accordance with National Park Service "Shade Tree Pruning", Tree Preservation Bulletin No. 4 and American Association of Nurserymen Standards to preserve the natural character of the plant.

O. Apply anti-desiccant to all plants in accordance with manufacturer's recommendations.

P. The Contractor shall make good to the satisfaction of the Owner any damage to lawn areas, plants, walks, walls or any other property.

Q. After completion of the work, the Contractor shall remove all debris materials, rubbish, etc. from the site and legally dispose of them.
   1. The premises shall be left clean, presentable and satisfactory.

END OF SECTION

INDEX

DIVISION 3 CONCRETE

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SCOPE

A. The work of this section includes all labor, materials, tools and equipment necessary for the construction, preparation, cleaning and later removal of all concrete formwork necessary for the proper completion of the Work.

1.02 SUBMITTALS

A. Shop drawings, brochures and samples shall be submitted for all items to be furnished in accordance with the provisions of Section 01300.

B. Submittals required under this section include, but are not limited to the following:
   1. Brochures and technical data:
      a. Form ties
      b. Form sealers and coatings, each type
   2. Samples
      a. Form ties

1.03 PRODUCT HANDLING

A. All materials and equipment shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability or appearance.

1.04 TECHNICAL REQUIREMENTS

A. The design of concrete formwork is the Contractor's responsibility. The design and construction of forms shall conform to the American Concrete Institute's "Recommended Practice for Concrete Formwork" (ACI 347) as applicable except as modified by this specification.

PART 2 PRODUCTS

2.01 MATERIALS

A. Forms shall conform to the shape, lines and dimensions of the parts and members of concrete work as shown on the Drawings. Forms shall be substantial and sufficiently tight to prevent leakage of mortar or liquid. Furnish panels in largest practicable sizes to minimize number of joints.

B. Except as otherwise specified, forms shall be constructed of plywood conforming to U.S. Product Standard PS 1-74 Interior and Exterior Plyform as required.

C. Forms may be of metal or other approved materials. Steel forms or forms made of plastic faced plywood may be used if designed to equal in strength and deflection that specified for plywood except as otherwise specified herein.

D. Form releasing agent shall be a non-grain raising and non-staining type that will not leave residual matter on surface of concrete or adversely affect proper bonding of subsequent application of other material applied to concrete surface. For water filtration facilities, form releasing agent shall be listed in the most recent version of the National Sanitation Foundation (NSF) product listing, of a type which will not contaminate potable water. This will include the entire facility.

E. Form Ties:
1. Provide factory-fabricated, adjustable length, removable or snapoff metal form ties, designed to prevent form deflection and to prevent spalling concrete surfaces upon removal.
2. Provide ties so that portion remaining within concrete after removal of exterior parts is at least 1 inch from the outer concrete surface. Provide form ties which will not leave a hole larger than one inch in diameter in the concrete surface.
3. Provide tie cones at each end.
4. Ties for liquid containment structures shall have a neoprene waterstop, factory applied at the center of the tie.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. General:
1. Forms shall be straight and true, mortar tight and have sufficient strength to safely support construction loads without sagging or bowing.
2. Forms shall be braced, tied together and supported to maintain position and shape, and be of adequate strength to support, without deflection or distortion, the pressure and weight of the concrete, together with the movement of men and equipment.
3. Support spacings for the various thickness shall be such as to limit deflection, flexural strength and shear strength to 1/270 of the span for structural concrete. Bending stress and rolling shear stress shall be limited to 1930 and 80 psi respectively for Class I Plyform and 1330 and 72 psi respectively for Class II Plyform.

B. Tolerances: Tolerances shall be as given in Section 203.1 of ACI 347, "Recommended Practice for Concrete Formwork".

C. Form Alignment: Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the hardened concrete surface to obtain accurate alignment of the surface, prevent leakage of mortar and to prevent formation of fins, ridges or other noticeable defects.

D. Chamfered Edges:
   1. All exposed edges of concrete shall have beveled strips to provide chamfers; sizes to conform to details on the drawings. If no size is specified on drawings, a 3/4 inch chamfer shall be used, unless otherwise directed by the Engineer.
   2. Where masonry walls and partitions abut columns and beams, chamfer strip shall be omitted.
   3. Grinding of chamfered corners will not be allowed.

E. Form Panel Joints:
   1. Joints between form panels shall be tightly butted to prevent leakage of grout or fines and shall be strengthened with back-up framing to maintain contact faces of adjacent panels in the same plane.
   2. Form gaskets or form tape shall be used at joinings or juncture of form panels to prevent leakage of fluids, grout or fines from concrete. Form gaskets or form tape shall be placed at the contact edge of the joint, but shall not project into the interior of the form. Where necessary, any projection shall be cut off prior to placement of the concrete. Form gaskets shall also be used between hardened concrete and form panels to prevent leakage of grout or fines from new concrete pours.
   3. Form tape shall not be used in areas where concrete is to receive a brush sandblast finish.

F. Openings:
   1. The Contractor shall form for and leave all openings in the concrete work where required for the installation of his own work and/or for the work of others. He shall carefully examine all drawings for the need of such openings and in failing to provide openings as shown on the drawings, he shall cut them at his own expense.
   2. Except as otherwise noted or specified, all such openings shall be filled with concrete after the work to be installed therein has been completed.

G. Cleanouts and Access Panels:
   1. Temporary openings shall be provided, where required, to facilitate cleaning and inspection prior to placing concrete. This is particularly required at the bottom of wall forms.
   2. Shavings, chips and all refuse shall be removed and the forms shall be broom cleaned before any concrete is placed. Cleanout openings will not be permitted in exposed concrete without the Engineer's approval.

H. Form Releasing Agents:
   1. New plyform may be used as furnished if inspection shows it to be satisfactorily oiled by the manufacturer. For reuse, forms for exposed surfaces of concrete shall be coated with a commercial form release agent or non-staining mineral oil which shall be applied before reinforcing steel is placed. After coating with a form releasing agent, surplus oil or coating on form surfaces and any oil on the reinforcing steel or other surfaces requiring a bond with the concrete shall be removed.
   2. Forms for unexposed surfaces may be thoroughly wetted in lieu of oiling immediately before the placing of concrete, except that in freezing weather, oil shall be used.