



**Capital Projects & Purchasing Department
113 Mable T. Willis Blvd.
Walterboro, SC 29488
843.539.1968**

Addendum #2

This addendum is dated 6-4-2015

RFP: CPST-02

**Water & Wastewater Improvements at Lowcountry Regional
Airport Industrial Park**

MANDATORY PRE-BID CONFERENCE:

Wednesday, June 10, 2015 @ 10:00am

Located at 113 Mable T. Willis Blvd. Walterboro, SC 29488

BIDS DUE: Thursday, June 18, 2015 @ 12:00pm

MAIL RFP RESPONSE TO:

Capital Projects & Purchasing Department
Attn: Kaye B Syfrett
113 Mable T. Willis Blvd.
Walterboro, SC 29488

HAND DELIVER RFP RESPONSE TO:

Capital Projects & Purchasing Department
Attn: Kaye B Syfrett
113 Mable T. Willis Blvd.
Walterboro, SC 29488

**TECHNICAL SPECIFICATIONS
FOR
WATER AND WASTEWATER IMPROVEMENTS
TO THE PROJECT DENT SITE
AT THE LOWCOUNTRY REGIONAL AIRPORT
WALTERBORO, COLLETON COUNTY,
SOUTH CAROLINA**



Prepared For:
Colleton County
113 Mable T. Willis Blvd.
Walterboro, South Carolina 29488



Prepared By:
Alliance Consulting Engineers, Inc.
23 Plantation Park Drive, Suite 204
Bluffton, South Carolina 29910

Project No. 14168-0015

GENERAL AND CIVIL ASPECTS

SECTION 00 01 10

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**WATER AND WASTEWATER IMPROVEMENTS TO THE PROJECT DENT SITE
AT THE LOWCOUNTRY REGIONAL AIRPORT IN COLLETON COUNTY, SOUTH CAROLINA**

**PROJECT NO. 14168-0015
MAY 2015**

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SECTION 02 00 00
EXISTING UTILITIES AND
STRUCTURES

PART 1: GENERAL

1.01 SCOPE OF WORK

- A. Certain information regarding the reputed presence, size, character, and location of existing Underground Facilities such as pipes, drains, sewers, electrical lines, telephone lines, cable TV lines, gas lines, and water lines has been shown on the Contract Drawings and/or provided in the contract documents. This information with respect to Underground Facilities is provided by the Owner in accordance with conditions described in the General Conditions and for informational purposes only. The Subcontractor is responsible to determine actual location of all utilities in proximity to the work for the purposes of the preparation of their bid and during construction.

1.02 NOTIFICATION OF UTILITIES

- A. Call Palmetto Utility Protection Service at 1-888-721-7877 or 811 at least 72 hours prior to beginning land disturbing activities.
- B. Notify the applicable State Agency with jurisdiction over underground facilities and/or all utility companies that construction work under this Contract will pass through containing their underground facilities. Notify these parties in advance to support the construction work (minimum 72 hours). All excavation in the vicinity of existing underground utilities shall be performed in accordance with applicable regulations.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Furnish all materials for temporary support, adequate protection, and maintenance of all underground and surface utility structures, supports, drains, sewer, and other obstructions encountered in the progress of the work.

PART 3: EXECUTION

3.01 OBSTRUCTIONS BY OTHER UTILITY STRUCTURES

- A. Support, relocate, remove, or reconstruct existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or drains. The obstruction shall be permanently supported, relocated, removed or reconstructed where they obstruct the grade or alignment of the pipe. Subcontractor must do so in cooperation with the owners of such utility

structures. Before proceeding, the Subcontractor must reach an agreement with the Alliance Consulting Engineers, Inc. on the method to work around the obstruction.

- B. No deviation shall be made from the required line or depth without the consent of the Alliance Consulting Engineers, Inc.

3.02 REPAIRS

- A. Repair or replace any damage to existing structures, work, materials, or equipment incurred by Subcontractor's operations. All repairs shall be the Subcontractor's responsibility and at the Subcontractor's expense with no additional cost to the Owner.
- B. Repair all damage to streets, roads, curbs sidewalks, highways, shoulders, ditches, embankments, culverts, bridges, trees, shrubs or other public or private property caused by transporting equipment, materials or personnel to or from the work site. Make satisfactory and acceptable arrangements with the persons or agencies having jurisdiction over the damaged property concerning repair or replacement. All repairs shall be the Subcontractor's responsibility and at the Subcontractor's expense with no additional cost to the Owner.
- C. Brace and support existing pipes or conduits crossing the trench, or otherwise exposed to prevent trench settlement from disrupting the line or grade of the pipe or conduit. Before proceeding, the Subcontractor must reach an agreement with Alliance Consulting Engineers, Inc. on the method of bracing and support. Repair or replace all utility services broken or damaged at once to avoid inconvenience to customers. Storm sewers shall not be interrupted overnight. Use temporary arrangements, as approved by Alliance Consulting Engineers, Inc., until any damaged items can be permanently repaired. Maintain all items damaged or destroyed by construction and subsequently repaired. All repairs shall be the Subcontractor's responsibility and at the Subcontractor's expense with no additional cost to the Owner.
- D. Standard detail shall be provided by Alliance Consulting Engineers, Inc. which provides requirements for repair or replacement of sanitary or storm drains removed or damaged during removal of the existing wastewater line, installation of the new wastewater line and all associated structures and appurtenances. All repairs shall be the Subcontractor's responsibility and at the Subcontractor's expense with no additional cost to the Owner.

3.03 RELOCATION

- A. Relocate existing utilities or structures, where necessary, and restore it to a condition equal to or better than that of the original facility. Obtain approval of the owner of the utility or structure prior to relocating and/or restoring the facility.

3.04 SEPARATION OF WATER MAINS AND SANITARY SEWERS

A. General

Consider the following factors when determining adequate separation:

1. Materials and type of joints and restraints for water and sanitary sewer pipes
2. Soil conditions and backfill materials
3. Service and branch connections into the water main and sanitary sewer line
4. Compensating variations in horizontal and vertical separations
5. Space for repair and alterations of water and sanitary sewer pipes
6. Off-setting of pipes around manholes

B. Parallel Installation

Lay water mains at least 10 feet horizontally from any existing or proposed sanitary sewer. Measure the distance from edge to edge. In cases where it is not practical to maintain a 10-foot separation, South Carolina Department of Health and Environmental Control (SCDHEC) may allow deviation on a case-by-case basis, if supported by data from Alliance Consulting Engineers, Inc. Such deviation may allow installation of the water main closer to a sanitary sewer, provided that the water main is laid in a separate trench or on an undisturbed earth shelf located on one side of the sanitary sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sanitary sewer.

C. Crossings

Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of eighteen (18) inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

D. Exception

Notify Alliance Consulting Engineers, Inc. when it is impossible to obtain the proper horizontal and vertical separation as stipulated above. If directed by Alliance Consulting Engineers, Inc., both the water main and sanitary sewer line shall be constructed of, mechanical joint ductile iron or welded joint protected steel pipe. Other types of restrained joints of equal or greater integrity may be used at the discretion of Alliance Consulting Engineers, Inc. after consultation with the applicable State Agency. Where water mains must cross under a sanitary sewer, additional protection shall be provided by:

1. A vertical separation of at least 18 inches between the bottom of the sanitary sewer and the top of the water line.
2. Adequate structural support for the sanitary sewer to prevent excessive deflection of the joints and the settling on and breaking of the water line.
3. Centering the section of water pipe at the point of the crossing so that the joints shall be equidistant and as far as possible from the sanitary sewer line.
4. Consult the applicable State Agency, through Alliance Consulting Engineers, Inc., to discuss the use of double casing or concrete encasement of sanitary sewer and/or water lines as possible alternatives when the above conditions cannot be met.
5. Any additional requirements that may be set forth by the applicable State agency where construction is taking place in regards to water mains crossing under sanitary sewer mains.

3.05 SEPARATION OF WATER MAINS AND STORM SEWERS

- A. Where water mains and storm sewers would run parallel, lay water mains at least 10 feet horizontally from the existing or proposed storm sewer (measured from edge to edge). Where storm sewers and water mains would cross, place water mains at least 12 inches from the storm sewer (measured from edge to edge). In cases where it is not practical to maintain the specified separation, Alliance Consulting Engineers, Inc. may allow deviation on a case by case basis or as clearly called out in the plans. If Alliance Consulting Engineers, Inc. deems that such deviation will be allowed, install the water main as directed by Alliance Consulting Engineers, Inc. in such a way that does not compromise more stringent and desired separation from sanitary sewers per subsection 3.04.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 SCOPE OF WORK

Provide concrete for structures such as water pump stations, wastewater lift station, storage tanks, underground junction boxes, thrust blocking, manhole bases, pipe encasement, curbs, sidewalks and pavement in accordance with this Specification Section. This section is not applicable to flowable fill.

1.02 SUBMITTALS

Subcontractor shall submit a certification from the concrete producer, as well as supporting data, stating that the cement concrete conforms to the compressive strength needed for the proposed project.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Portland Cement shall be Type I or Type III and conform to "Specification for Portland Cement" ASTM C150.
- B. Air-Entraining Agent from approved manufacturer shall be added in accordance with manufacturer's directions to the normal Portland cement to entrain 4½ percent air ± 1 percent with all other ingredients and strength as specified. Air-entraining admixtures shall conform to "Specifications for Air-Entraining Admixtures for Concrete" ASTM C260.
- C. Concrete Aggregates shall conform to "Specifications for Concrete Aggregates" ASTM C33. Coarse aggregates shall be a maximum of 1½-inches in size in footings and plain concrete. Pea gravel shall be used for sections 3-inches or less in thickness.
- D. Water used in mixing concrete shall be clean and free from injurious amounts of oils, acids, alkalis, organic materials, or other deleterious substances. In effect, the water used shall be potable water.
- E. Reinforcing Bars shall be billet steel grade (60,000 psi minimum yield) conforming to the requirements of ASTM A615, Grade 60. Reinforcing bars shall be new stock, free from rust, scale, or other coatings that tend to destroy or reduce bonding.
- F. Welded Wire Mesh shall conform to "Specifications for Welded Steel Wire Fabric for Concrete Reinforcements" ASTM A185.

- G. Premolded Expansion Joint Material shall be provided where shown on the Construction Drawings or directed by Alliance Consulting Engineers, Inc... This non-extruding compressible joint material shall conform to the requirements of "Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction", ASTM D1751.

2.02 CONCRETE MIXES

Ready-mixed concrete shall conform to "Specifications for Ready-Mixed Concrete", ASTM C94.

- A. All concrete mixes shall produce a dense durable concrete. The minimum 28-day compressive strength of the concrete shall be:
 - 1. 3,000 psi - thrust blocking, sidewalks, curbs and pipe encasement.
 - 2. 4,000 psi - manhole bases, manhole channels, road pavement, walls and slabs for pump stations, meter vaults, foundations for water storage tanks, and the like.
- B. Water/cement ratio for the concrete shall not exceed a maximum as shown in Table 4.4 of the ACI Standard 318 latest edition, Building Code Requirements For Reinforced Concrete, when strength data from field experience or trial mixtures are not available. A workable concrete with minimum slump of 3-inches and a maximum slump of 5-inches shall be produced without exceeding the water/ cement ratio.

PART 3: EXECUTION

3.01 FORMWORK

- A. Build all forms mortar tight and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. Construct and maintain forms so as to prevent warping and the opening of joints.
- B. The forms shall be substantial and unyielding. Design the forms so that the finished concrete conforms to the proper dimensions and contours. Design the forms to take into account the effect of the vibration of concrete during placement.

3.02 PLACING REINFORCING STEEL

- A. Place all steel reinforcement accurately in the positions shown on the Construction Drawings. Secure the steel reinforcement firmly in place during the placing and setting of concrete. When placed in the work, it shall be free from dirt, detrimental rust, loose scale, paint, oil or other foreign material. When spacing between crossing bars is greater than one foot, tie all bars at all intersections. When spacing is less than one foot in each direction, tie alternate intersections of bars.

- B. Maintain distances from the forms by means of stays, blocks, ties, hangers or other approved supports. Continuous high chairs will not be permitted. Furnish all reinforcement in full lengths as indicated on the Construction Drawings. Splicing of bars will not be permitted without the approval of Alliance Consulting Engineers, Inc., except where shown on the Drawings. Stagger splices as far apart as possible. Unless otherwise shown on the Construction Drawings, bars shall be lapped 36 diameters to make the splice.
- C. Lap welded wire mesh at least 1½ meshes plus end extension of wires but not less than 12-inches in structural slabs. Lap welded wire mesh at least ½ mesh plus end extension of wires but not less than 6-inches in slabs on the ground.

3.03 CONVEYING AND PLACING CONCRETE

- A. Concrete placement is not permitted when weather conditions prevent proper placement and consolidation unless approved by Alliance Consulting Engineers, Inc.
- B. When concrete is mixed and/or delivered by a truck mixer, the concrete shall be delivered to the project site for ultimate discharge within 90 minutes.
- C. Convey concrete from the mixer to the forms as rapidly as practical by approved methods which will prevent segregation and loss of ingredients.
- D. Clean formwork of dirt and construction debris, drain water, and remove snow and ice. After the forms have been inspected, deposit the concrete in approximately horizontal layers to avoid flowing along the forms. Place all concrete in the dry free from standing water. Deposit all concrete continuously or in layers of a thickness such that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the sections. Place the concrete to create a monolithic structure the component parts of which are securely bonded together. Compact the concrete during placement by suitable means. Work the concrete around the reinforcement and embedded fixtures and into corners and angles of forms, taking care to avoid overworking which may result in segregation.
- E. Do not drop concrete into forms from a height greater than 5 feet. Use a spout to deposit concrete from a greater height; or, provide openings in the forms limit the height of drop. Obtain the approval of Alliance Consulting Engineers, Inc. before using any other method of placing concrete from a height greater than 5 feet.
- F. Direct concrete through chutes to prevent it from striking reinforcement or sides of the form above the level of placement. Avoid segregation and coating of the surfaces with paste which may dry before concrete reaches its level.

- G. Submit a concrete mix design to Alliance Consulting Engineers, Inc. for approval prior to placing any concrete by pumping.

3.04 THRUST BLOCKING

- A. See the thrust blocking details. Notify Alliance Consulting Engineers, Inc. whenever field conditions are noted which are more restrictive than the thrust block design data included on details.
- B. Construct blocking against the vertical face of undisturbed earth or sheeting left in place. Prevent the concrete from enclosing more than half the circumference of the pipe unless it is a straddle block. Keep the concrete away from joints or bolts in the piping.
- C. If thrust blocks are employed, place thrust blocking for hydrants to allow the hydrant to drain.

3.05 PLACING CONCRETE IN COLD WEATHER

- A. Follow the provisions of ACI 306R-10, ACI 308 and Paragraph 8-5 of USACE, Standard Practice For Concrete For Civil Works Structures, when the ambient temperature is less than 40°F at time of placement or expected to be less than 40°F during the curing period.
- B. Control concrete setting time with the use of accelerating admixtures as required to facilitate placing and finishing operations. Do not use calcium chloride in excess of 2% by weight in the concrete free of steel reinforcement. Where steel reinforcement is employed and concrete with calcium chloride is permitted, Contractor must use galvanized or coated steel satisfactory to Alliance Consulting Engineers, Inc...
- C. Exposed subgrade, formwork and reinforcing shall be warmer than 33°F prior to placement of concrete.
- D. The temperature of the concrete during placing shall be between 55°F and 75°F. Maintain the temperature of the concrete between 55°F and 75°F for a minimum of 5 days by providing insulating blankets, heated enclosures, or other methods of thermal protection. Provide a means of maintaining atmospheric moisture when dry heat is used. Provide proper curing for a minimum of days or as approved by Alliance Consulting Engineers, Inc...
- E. In case of low air temperatures (below 40°F), submit a plan to comply with this section. Alliance Consulting Engineers, Inc. may, at their discretion, raise the minimum limiting temperatures for water, aggregates and mixed concrete when temperatures drop below 40°F.
- F. Protect all earth-supported concrete from damage due to frost heave.

END OF SECTION

SECTION 03 48 10

PRECAST CONCRETE MANHOLES

PART 1: GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete manholes for sanitary sewers and water lines or as indicated on the Construction Drawings.
- B. Precast concrete sanitary sewer manholes with fiberglass liner or sewer gas resistance epoxy coating where corrosion resistant manholes are specifically required to prevent early deterioration of the manhole.
- C. Pile-supported concrete foundation used for unstable subgrade treatment for manhole base.

1.02 SUBMITTALS

- A. Conform to requirements of Section - Submittals.
- B. Submit manufacturer's data and details of following items for approval:
 - 1. Shop drawings of manhole sections, base units and construction details, including reinforcement, jointing methods, materials and dimensions.
 - 2. Summary of criteria used in manhole design including, as minimum, material properties, loadings, load combinations, and dimensions assumed. Include certification from manufacturer that precast manhole design is in full accordance with ASTM C 478 and design criteria as established in Paragraph 2.01E of this Specification.
 - 3. Frames, grates, rings, and covers
 - 4. Materials to be used in fabricating drop connections
 - 5. Materials to be used for pipe connections at manhole walls
 - 6. Materials to be used for stubs and stub plugs, if required.
 - 7. Materials and procedures for corrosion-resistant liner and coatings, if required.
 - 8. Plugs to be used for sanitary sewer hydrostatic testing
 - 9. Manufacturer's data for pre-mix (bag) concrete, if used for channel inverts and benches.

PART 2: PRODUCTS

2.01 PRECAST CONCRETE MANHOLES

- A. Provide manhole sections, base sections, and related components conforming to ASTM C 478. Provide base riser section with integral floors, unless shown otherwise. Provide adjustment rings which are standard components of manufacturer of manhole sections. Mark date of manufacture and name or trademark of manufacturer on inside of barrel.
- B. Construct barrels for precast manholes from standard reinforced concrete manhole sections of diameter indicated on the Construction Drawings. Use various lengths of manhole sections in combination to provide correct height with fewest joints.
- C. Provide tops to support AASHTO HS-20 vehicle loading, and receive cast iron frame covers, as indicated on the Construction Drawings.
- D. For manholes larger than 48-inch diameter, provide precast base sections with flat slab top precast sections used to transition to 48-inch diameter manhole access riser sections. Transition can be concentric or eccentric unless otherwise requested by Alliance Consulting Engineers, Inc.. Locate transition to provide minimum of 7-foot head clearance from base to underside of transition unless otherwise approved by Alliance Consulting Engineers, Inc..
- E. Design Loading Criteria: Manhole walls, transition slabs, cone tops, and manhole base slab shall be designed by manufacturer, to requirements of ASTM C 478 for depth as shown on the Construction Drawings and to resist the following loads.
 - 1. AASHTO HS-20 vehicle loading applied to manhole cover and transmitted down to transition and base slabs
 - 2. Unit soil weight of 120 lbs/ft³ located above portions of manhole, including base slab projections
 - 3. Lateral soil pressure based on saturated soil conditions producing an at-rest equivalent fluid pressure of 100 lbs/ft³
 - 4. Internal liquid pressure based on unit weight of 63 lbs/ft³
 - 5. Dead load of manhole sections fully supported by transition and base slabs
- F. Provide joints between sections with o-ring gaskets conforming to ASTM C443.
- G. When base is cast monolithic with portion of vertical section, extend reinforcing in vertical section into base.
- H. Precast Concrete Base: Suitable cutouts or holes to receive pipe and connections. Lowest edge of holes or cutouts: For water line manhole, no less than 6-inches above inside surface of floor of base.

2.02 CONCRETE

- A. Conform to requirements of Section 03 30 00 - Cast-In-Place Concrete.
- B. Channel Inverts: Use concrete for inverts not integrally formed with manhole base, with minimum compressive strength of 4000 psi.
- C. Concrete Foundation: Provide concrete with minimum compressive strength of 4000 psi for concrete foundation slab under manhole base section as indicated on the Construction Drawings.

2.03 REINFORCING BARS

- A. Conform to the requirements of Section 03 30 00 – Cast-In-Place Concrete.

2.04 FRAMES AND COVERS

- A. Use castings for frames, grates, rings and covers conforming to ASTM A48, Class 35B.
- B. Use clean castings capable of withstanding application of AASHTO M306-40,000 pound proof loading without detrimental permanent deformation.
- C. Fabricate castings to conform to shapes and dimensions as shown on the Contract Drawings, and cast with the wording or logo “SEWER” for sanitary sewer and “WATER” for water system frames and covers. Standard dimensions for manhole frames and covers shall be either 24 or 30-inches in diameter as indicated on the Contract Drawings.
- D. Castings shall be smooth and clean, and free from blowholes and other surface imperfections. Use clean and symmetrical cast holes in covers, free of plugs.
- E. Provide watertight manhole frames and covers when the top of the frame and cover is below the 50 - year flood elevation or when subjected to ponding. Watertight manhole frames and covers shall be provided with minimum of four bolts and gasket designed to seal cover to frame. Supply approved watertight manhole covers and frames.

2.05 DROP CONNECTIONS AND STUBS

- A. All manhole drop connections shall be outside drop. Outside drops shall be provided when the invert elevation into the manhole is 24-inches higher than the manhole invert.
 - 1. Pipe material used for outside drops shall be same pipe material as sewer main, or;
 - 2. Ductile iron pipe as indicated on the Contract Drawings.

2.06 PIPE CONNECTIONS TO MANHOLE

A. Sanitary Sewers.

1. Provide resilient connectors conforming to requirements of ASTM C923. Use the following materials for metallic mechanical devices as defined in ASTM C923:
 - a. External clamps: Type 304 stainless steel
 - 1) Internal, expandable clamps on standard manholes: Type 304 stainless steel, 11 gauge minimum.
 - 2) Internal, expandable clamps on corrosion - resistant manholes:
 - b. Type 316 stainless steel, 11 gauge minimum
 - c. Type 304 stainless steel, 11 gauge minimum, coated with minimum 16 mil fusion - bonded epoxy conforming to AWWA C213
2. Where rigid joints between pipe and cast-in-place manhole base are specified, provide polyethylene - isoprene water - stop meeting physical property requirements of ASTM C923.

B. Water Lines

1. Where smooth exterior pipes, i.e., steel, ductile iron, or PVC pipes are connected to manhole base or barrel, seal space between pipe and manhole wall with assembly consisting of rubber gasket or links mechanically compressed to form a watertight barrier.
2. When connecting concrete or cement mortar coated steel pipes, or as option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of a stainless steel power sleeve, stainless steel take - up clamp and a rubber gasket. Take - up clamp: Minimum of $\frac{9}{16}$ -inch wide.

2.07 SEALANT MATERIALS

- A. Provide sealing materials between precast concrete adjustment ring and manhole cover frame in accordance with ASTM C443.

2.08 CORROSION RESISTANT MANHOLE MATERIALS

- A. Where corrosion - resistant manholes are required, such as a manhole receiving a force main or manholes located within a 1,000 feet down-stream of a force discharge, provide a fiberglass liner or sewer gas resistant epoxy coating for precast cylindrical manhole section, base sections, and cone sections. Liners relying on mechanically fastened batten strips as primary means of anchorage are unacceptable. All manholes with a corrosion resistant interior coating shall be provided with an exterior bituminous coating in locations where ground water table can reach above the base of the manhole.

2.09 BACKFILL MATERIALS

- A. Conform to requirements of Section 31 23 33- Excavation Backfill and Compaction for Utilities.

2.10 NON-SHRINK GROUT

- A. Provide prepackaged, inorganic, flowable, non - gas-liberating, non - metallic, cement - based grout requiring only addition of water.
- B. Meet requirements of ASTM C1107 and have a minimum 28-day compressive strength of 7000 psi.

2.11 VENT PIPES

- A. Provide an external vent pipe for manholes for every third manhole when three or more consecutive water tight frame and covers are installed.
- B. Vent opening to be located a minimum of 1 foot above 100 year flood plain.
- C. Buried Vent Pipes: Provide appropriate size PVC or DIP as indicated on the Drawings.
- D. Vent Outlet Assembly: Provide vent outlet assembly as shown on the Construction Drawings.

2.12 PROHIBITED MATERIALS

- A. Do not use brick masonry for construction of sanitary sewer manholes, including adjustment of manholes to grade. Use only specified materials listed herein.

2.13 MANHOLE LADDER FOR WATERLINE MANHOLES

- A. Manhole Ladder: Fiberglass with 300-lb rating at appropriate length; conform to requirements of OSHA.
 - 1. Use components, including rungs, made of fiberglass, fabricated with nylon or aluminum rivets and/or epoxy. Apply non-skid coating to ladder rungs. Mount ladder using manufacturer's recommended hardware.
 - 2. Fiberglass: Premium type polyester resin, reinforced with fiberglass; constructed to provide complete wetting of glass by resin; resistant to rot, fungi, bacterial growth and adverse effects of acids, alkalis and residential and industrial waste; yellow in color.
- B. Provide approved petroleum-based tape encapsulating bolts in access manhole.

PART 3: EXECUTION

3.01 EXAMINATION

- A. Verify that lines and grades are correct.
- B. Obtain an adequate foundation for all manhole structures by removing and replacing unsuitable material with well - graded granular material, by tightening with coarse rock, or by such other means as provided for foundation preparation of the connected sewers, or as directed by Alliance Consulting Engineers, Inc..
- C. Dewater sufficiently to maintain the ground water level at or below the bottom of the manhole foundation prior to an during the placement of the foundation.
- D. Do not build manholes in ditches, swales, or drainage paths unless approved by Alliance Consulting Engineers, Inc..

3.02 PLACEMENT

- A. Install precast manholes to conform to locations and dimensions as shown on the Contract Drawings.
- B. Place sanitary manholes at points of change in alignment, grade, size, pipe intersections, and end of sewer unless otherwise directed by Alliance Consulting Engineers, Inc..

3.03 MANHOLE BASE SECTIONS AND FOUNDATIONS

- A. Place precast base on 6-inch thick (minimum) foundation of crushed stone, or concrete foundation slab.
- B. Unstable Subgrade Treatment: Notify Alliance Consulting Engineers, Inc. immediately when unsatisfactory material is encountered in the manhole subgrade. With Alliance Consulting Engineers, Inc. approval, up to 12-inches of additional undercut may be permitted to achieve suitable foundation. If the additional undercut does not result in a satisfactory foundation, the Contractor shall obtain a bedding design prepared by a Geotechnical Engineer licensed in the State of South Carolina.

3.04 PRECAST MANHOLE SECTIONS

- A. Install sections, joints, and gaskets in accordance with manufacturer's printed recommendations.
- B. Install precast adjustment rings above tops of cones or flat-top sections as required to adjust finished elevation and to support manhole frame.
- C. Seal any lifting holes with non-shrink grout.
- D. Where fiberglass liners are required, seal joints between sections in accordance with manufacturer's recommendations.
- E. Precast concrete grade rings shall be permitted to achieve the required grade. Grade rings shall not be permitted to more than 12-inches.

- F. External joint wrap all riser joints to ensure seal. No grout is permitted on the interior of manhole riser joints prior to testing.
- G. Concrete base must be dry prior to setting any sections above it.

3.05 PIPE CONNECTIONS AT MANHOLES

- A. Install approved resilient connectors at each pipe entering and exiting manholes in accordance with manufacturer's instructions.
 - 1. Where smooth exterior pipes, i.e. steel, ductile iron or PVC pipes are connected to manhole base or barrel, space between pipe and manhole wall shall be sealed with an assembly consisting of rubber gaskets or links mechanically compressed to form watertight barrier.
 - 2. When connecting concrete or cement mortar coated steel pipes, or as an option for connecting smooth exterior pipes to manhole base or barrel, space between pipe and manhole wall may be sealed with an assembly consisting of stainless steel power sleeve, stainless steel take-up clamp and rubber gasket. Take-up clamp: Minimum of 9/16-inch wide.
- B. Ensure no concrete, fill, or other rigid material is allowed to enter space between pipe and edge of wall opening at and around resilient connector on either interior or exterior of manhole. If necessary, fill space with compressible material to ensure full flexibility provided by resilient connector.
- C. Where new manhole is constructed on existing sewer, rigid joint pipe may be used. Install waterstop gasket around existing pipe at center of cast – in - place wall. Join ends of split waterstop material at pipe springline using an adhesive recommended and supplied by waterstop manufacturer.
- D. Test connection for watertight seal before backfilling, or at direction of Alliance Consulting Engineers, Inc..

3.06 INVERTS FOR SANITARY SEWERS

- A. Construct invert channels to provide smooth flow transition waterway with no disruption of flow at pipe-manhole connections. Conform to following criteria:
 - 1. Slope of invert bench: 1-inch per foot minimum; 1-¹/₂-inches per foot maximum
 - 2. Depth of bench to invert:
 - a. Pipes smaller than 15-inches: one-half of largest pipe diameter
 - b. Pipes 15 to 24-inches: three-fourths of largest pipe diameter
 - c. Pipes larger than 24-inches: equal to largest pipe diameter
 - 3. Invert slope through manhole: 0.17 foot (2-inches) drop across manhole with smooth transition of invert through manhole, unless otherwise indicated on Drawing.

Form invert channels with concrete if not integral with manhole base section. For direction changes of mains, construct channels tangent to mains with maximum possible radius of curvature. Provide curves for side inlets and smooth invert fillets for flow transition between pipe inverts.

3.07 DROP CONNECTIONS FOR SANITARY SEWERS

- A. Install drop connection when sewer line enters manhole higher than 24-inches above invert of manhole
- B. Backfill drop assembly shall be 3000 psi concrete to form solid encasement for all drop connections. Extend concrete encasement minimum of 4-inches outside bells, all per the Construction Drawings.

3.08 STUBS FOR FUTURE CONNECTIONS

- A. In manholes, where future connections are indicated on the Construction Drawings, install resilient connectors and pipe stubs with approved watertight plugs.

3.09 MANHOLE FRAME AND ADJUSTMENT RINGS

- A. Combine precast concrete or HDPE adjustment rings so elevation of installed casting cover matches pavement surface. Seal between concrete adjustment ring and precast top section with non-shrink grout; do not use mortar between adjustment rings. Apply latex-based bonding agent to precast concrete surfaces joined with non-shrink grout. Set cast iron frame on adjustment ring in bed of approved sealant material. Install sealant bed consisting of two beads of sealant, each bead having minimum dimensions of 1/2-inch and 1/2-inch wide.
- B. Wrap manhole frame and adjustment rings with external sealing material, minimum 3-inches beyond joint between ring and frame and adjustment rings and precast section.
- C. For manholes in unpaved areas, set top of frame flush with existing grade upto a maximum of 12-inches above existing grade, unless otherwise noted. In unpaved areas, encase manhole frame in mortar or non-shrink grout placed flush with face of manhole ring and top edge of frame. Provide rounded corner around perimeter.

3.10 BACKFILL

- A. Place and compact backfill materials in area of excavation surrounding manholes in accordance with requirements of Section 31 23 33 - Excavation Backfill and Compaction for Utilities.
- B. Where rigid joints are used for connecting existing sewers to manhole, backfill existing sewer up to springline of pipe with flowable fill.
- C. In unpaved areas, provide positive drainage away from all manhole frames to natural grade. Provide restoration of disturbed areas in accordance with Section 32 92 00 – Lawn Restoration.

3.11 DOGHOUSE MANHOLE

- A. Existing sewer pipe to remain until satisfactory completion of manhole testing.
- B. Crown of existing pipe shall be flush with concrete shelf that is formed within the manhole.
- C. Doghouse manholes, if required, shall be constructed as per the Construction Drawings.

3.12 FIELD QUALITY CONTROL

- A. Conduct testing of manholes in accordance with requirements of Section 33 01 30.13 - Acceptance Testing for Sanitary Sewers.

3.13 PROTECTION

- A. Protect manholes from damage until Work has been accepted. Repair damage to manholes at no additional cost to the Owner.

END OF SECTION

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.01 DESCRIPTION

- A. Work included: Remove all organic vegetative mater as required to complete the construction as indicated on the construction plans.
- B. Related work:
 - 1. Documents affecting work of this Section include, but are not necessarily limited to, Standard General Conditions, Supplementary Conditions and Sections in Division 1 of these Specifications.
 - 2. Section 01 71 23 - Field Engineering.
 - 3. Section 31 10 00 - Site Preparation.
 - 4. Section 31 25 00 - Erosion and Sedimentation Control.
 - 5. Section 32 92 00 – Turf and Grasses.

1.02 QUALITY ASSURANCE

- A. Use required number of workmen that are properly trained and have experience in the crafts and who are completely familiar with the specified requirements herein and the methods for proper performance of the work specified in this section.
- B. Use the proper equipment that is adequate in size, capacity and numbers to accomplish the work within the timeframe of the Project schedule.
- C. Comply with requirements of governmental agencies having jurisdiction within the Project area.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 AREA INCLUDED

- A. All areas where new construction is taking place, or as illustrated on the plans.

3.02 PROCEDURES

- A. Clearing and grubbing: The entire area within the limits described above shall be cleared and grubbed at a minimum depth of 6-inches.
- B. Areas that are to be selectively cleared shall consist of removing vegetation, brush, stumps, etc., from the area. Special care shall be taken to avoid damage to trees that are left. Grubbing will not be required in areas designated for selective clearing.
- C. Removal of trees and shrubs: All trees being taken down must be removed avoiding damage to trees and existing features that are to remain. All parts of the trees being

removed are to be completely taken from the site and properly disposed of. Any shrubs or small trees that are undesirable may be selectively removed as directed.

- D. Stumps and roots: All stumps and roots larger than 2-inches in diameter shall be completely removed by grubbing except in areas of building site, parking areas and drives; they must be cut off no less than 18-inches below any subgrade. The area of operation then shall be cleared of resulting debris and matted roots, weeds and other organic matter shall be hauled away from the site. Generally, all material that cannot be compacted to 90-percent maximum density in lawn areas and 95-percent of maximum density elsewhere must be removed.
- E. Protection of trees: Trees that are to remain in place will need to be protected in areas where earthwork cut or fill is eighteen inches or less and in existing parking areas. Contractor must obtain approval from Engineer prior to removal of significant trees covered by local tree ordinances. Existing trees that are remaining in place during and after construction must be protected by constructing barricades around each tree.
- F. Erosion and Sediment Control: Construct and maintain erosion and sediment control devices as illustrated on the construction plans and in accordance with Section 31 25 00 of these specifications.

3.03 MEASUREMENT AND PAYMENT

- A. Measurement for Clearing and Grubbing shall be based on the area in acres as shown on the plans and/or as shown in the bid form. Payment shall be made to the nearest 0.10 acre.

END OF SECTION

SECTION 31 23 16.13

TRENCHING FOR SITE UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for underground utilities.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, Standard General Conditions, Sections in Division 1 of these Specifications.
- B. Section 01 71 23 - Field Engineering.
- C. Section 31 22 00 – Grading.
- D. Section 31 23 16 - Excavation.
- E. Section 31 23 23.13 – Backfill and Compaction.

1.03 DEFINITIONS

- A. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54 kg (10-lb) Rammer and a 457 mm (18 in.) Drop; American Association of State Highway and Transportation Officials; 2010 (2009).
- B. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2006.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012.
- D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method; 2007.
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN m/m³)); 2012.
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method; 2008.
- G. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2011.
- H. ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth); 2005.
- I. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth); 2005.

- J. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils; 2010.
- K. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2010

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Samples: 10 lb. sample of each type of fill; submit in air-tight containers to testing laboratory.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used.
- E. Compaction Density Test Reports.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where indicated.
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.
- C. Verify that survey bench marks and intended elevations for the Work are as indicated.
- D. Protect plants, lawns, rock outcroppings, and other features to remain.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

1.07 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.

1.08 JOB CONDITIONS

- A. Existing utilities:

1. Approximate location of certain underground lines and structures are shown on the plans for information only, other underground lines or structures are not shown.
2. Locate these and other possible unknown utility lines using electronic pipe finder, or other approved means.
3. Locate, excavate and expose all existing underground lines in advance of trenching operations.
4. The Contractor will be held responsible for the workmanlike repair of any damage done to any of these utilities in the execution of his work under this Section.
5. The Contractor shall familiarize himself with the existing conditions and be prepared to adequately care for and safeguard himself and the Owner from damage.

B. Notification of intent to excavate:

1. South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978) requires persons to ascertain the location of underground public utility property prior to excavation or demolition in certain situations. The Act also requires such persons to give timely notice of intent to excavate or demolish prior to commencing such operations. Failure to comply could subject the violator to a civil penalty of up to one thousand dollars (\$1,000) for each violation of the Act.
 - a. Notification of intent to excavate may be given by calling this toll free number: 811.

C. Protecting trees, shrubbery and lawns:

1. Trees and shrubbery in developed areas and along the trench line shall not be disturbed unless absolutely necessary, and subject to the approval of the Engineer.
 - a. Any such trees and shrubbery necessary to be removed shall be heeled in and replanted.
2. Where trenches cross private property through established lawns, sod shall be cut, removed, stacked and maintained in suitable condition until replacement is approved by the Engineer.
 - a. Topsoil underlying lawn areas shall be removed and kept separate from general excavated materials.

D. Clearing:

1. Perform all clearing necessary for installation of the complete work.
2. Clearing shall consist of removing all trees, stumps, roots, brush and debris in the rights-of-way obtained for the Work.
3. All timber of merchantable size shall remain the property of the Owner and shall be trimmed and cut in such lengths as directed and stacked along the edge of the right-of-way.

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4. All other material, including trimmings from above, shall be completely disposed of in a satisfactory manner.
- E. Removing and resetting fences:
1. Where existing fences must be removed to permit construction of utilities:
 - a. Remove such fences and, as the Work progresses, reset the fences in their original location and condition.
 - b. Provide temporary fencing or other safeguards as required to prevent stock and cattle from wandering to other lands.
- F. Restoration of disturbed areas:
1. Restore all areas disturbed by, during or as a result of construction activities to their existing or better condition.
 2. Do not interpret this as requiring replacement of trees and undergrowth in undeveloped sections of the rights-of-way.
- G. Minimizing silting and bank erosion during construction:
1. During construction, protective measures shall be taken and maintained to minimize silting and bank erosion of creeks and rivers adjacent to the work being performed during construction.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. General Fill: Subsoil excavated on-site.
1. Graded.
 2. Free of lumps larger than three (3) inches, rocks larger than two (2) inches, and debris.
 3. Conforming to ASTM D 2487 Group Symbol CL.
- B. Granular Fill - Fill Type No. 57: Coarse aggregate, conforming to State of South Carolina Highway Department standard.
- C. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
1. Graded in accordance with ASTM D 2487 Group Symbol GW.
 2. Graded in accordance with ASTM C 136, within the following limits:
 - a. 2 inch sieve: 100 percent passing.
 - b. 1 inch sieve: 95 percent passing.
 - c. 3/4 inch sieve: 95 to 100 percent passing.

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- d. 5/8 inch sieve: 75 to 100 percent passing.
 - e. 3/8 inch sieve: 55 to 85 percent passing.
 - f. No. 4 sieve: 35 to 60 percent passing.
 - g. No. 16 sieve: 15 to 35 percent passing.
 - h. No. 40: 10 to 25 percent passing.
 - i. No. 200: 5 to 10 percent passing.
- D. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, and organic matter.
- 1. Grade in accordance with ASTM D 2487 Group Symbol GM.
 - 2. Graded in accordance with ASTM C 136, within the following limits:
 - a. Minimum Size: 1/4 inch.
 - b. Maximum Size: 5/8 inch.
- E. Sand: Natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter.
- 1. Grade in accordance with ASTM D 2487 Group Symbol SW.
 - 2. Graded in accordance with ASTM C 136; within the following limits:
 - a. No. 4 sieve: 100 percent passing.
 - b. No. 14 sieve: 10 to 100 percent passing.
 - c. No. 50 sieve: 5 to 90 percent passing.
 - d. No. 100 sieve: 4 to 30 percent passing.
 - e. No. 200 sieve: 0 percent passing.
- F. Topsoil: Topsoil excavated on-site.
- 1. Select.
 - 2. Graded.
 - 3. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
 - 4. Acidity range (pH) of 5.5 to 7.5.
 - 5. Containing a minimum of 4 percent and a maximum of 25 percent inorganic matter.
 - 6. Conforming to ASTM D2487 Group Symbol OH.

2.02 EXCAVATED MATERIALS

- A. Perform all excavation of every description and of whatever substances encountered to depths indicated or specified.
- B. Pile material suitable for backfilling in an orderly manner at safe distance from banks or trenches to avoid overloading and to prevent slides or cave-ins.
- C. Remove and deposit unsuitable or excess materials as directed by the Engineer.

2.03 BACKFILL MATERIALS

- A. Provide from materials excavated for installation of utility.
 - 1. Select soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2-inches in greatest dimension for backfill up to 12-inches above top of utility being covered.
 - 2. Do not permit rocks larger than 2-inches in greatest dimension in top 6-inches of backfill.

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.
- B. Should the quantity of suitable on-site material be insufficient to complete the work, provide suitable borrow material as approved by the Engineer at no additional expense to the Owner.
- C. Provide select materials from on-site if acceptable material as approved by the Engineer is available on-site. Otherwise, provide approved select material from an off-site source.

2.05 SOURCE QUALITY CONTROL

- A. Where fill materials are specified by reference to a specific standard, test and analyze samples for compliance before delivery to site.
- B. If tests indicate materials do not meet specified requirements, change material and retest.
- C. Provide materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.
- B. Locate, identify, and protect utilities that remain and protect from damage.

- C. Notify utility company to remove and relocate utilities.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Protect plants, lawns, rock outcroppings, and other features to remain.

3.03 PROTECTION OF EXISTING UTILITIES AND ADJACENT STRUCTURES

- A. Existing utilities:
 - 1. Unless shown to be removed, protect active utility lines shown on the drawings or otherwise made known to the Contractor prior to trenching. 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 service is interrupted as a result of work under this Section, immediately restore service by repairing the damaged utility at no additional cost to the Owner.
 - 4. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
 - 5. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.
 - 6. Locations within streets or highways:
 - a. Comply with Kershaw County and the South Carolina Department of Transportation's (SCDOT) "Encroachment Permit" issued for the Work, and Kershaw County and the South Carolina Department of Transportation's (SCDOT) "A Policy for Accommodating Utilities on Highway Rights-of-Way".
 - b. Take all precautions and comply with all requirements as may be necessary to protect the improvements, including barricades for protection of traffic.
 - c. Keep a minimum of one lane open to traffic at all times where utility crosses street or highway.
 - 7. Protection of persons and property:
 - a. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
 - b. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
 - c. 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.

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8. Dewatering:
 - a. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.
 - b. Keep trenches and site construction area free from water.
9. 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.
10. Maintain access to adjacent areas at all times.

3.04 TRENCHING

- A. Notify Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd. measured by volume.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- J. Remove excess excavated material from site.
- K. Trench Excavation:
 1. Remove all materials of whatever substance encountered.
- L. Where trenching occurs in existing lawns, remove turf in sections and keep damp. Replace turf upon completion of the backfilling.
- M. Open cut:
 1. Excavate for utilities by open cut.
 2. If conditions at the site prevent such open cut, and if approved by the Engineer, tunneling may be used.
 3. Short sections of a trench may be tunneled if, in the opinion of the Engineer, the conductor can be installed safely and backfill can be compacted properly into such tunnel.

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4. Remove boulders and other interfering objects, and backfill voids left by such removals, at no additional cost to the Owner.
 5. Remove wet or otherwise unstable soil incapable of properly supporting the utility, as determined by the Engineer, to depth required and backfill to proper grade with stone bedding material, at no additional cost to the Owner.
 6. Excavating for appurtenances:
 - a. Excavate for manholes and similar structures to a distance sufficient to leave at least 12-inches clear between outer surfaces and the embankment or shoring that may be used to hold and protect the banks.
 - b. Overdepth excavation beyond such appurtenances that has not been directed will be considered unauthorized. Fill with sand, gravel, or lean concrete as directed by the Engineer, and at no additional cost to the Owner.
- N. Trench to the minimum width necessary for proper installation of the utility, with sides as nearly vertical as possible. Accurately grade the bottom to provide uniform bearing for the utility.
1. Dig to a true grade and to provide a smooth continuous support along the entire length of the pipe line.
 2. Excavate to a width not less than 12" greater than the outside diameter of the pipe.
 3. Trench depth shall provide a minimum of 3.5' of cover over the pipe as measured along the pipe centerline.
 4. Where the pipeline crosses creeks, drainage ditches or land subject to flooding, the depth of cover shall be 4' minimum.
 5. Where the pipeline crosses existing gas mains or other utilities, a minimum of 24" of separation under the existing utility shall be maintained. Additional depth of excavation as required to maintain separation shall be completed at no additional cost to the Owner.
 6. At any creek, draw, gully, embankment or other place where rough terrain exists, the trench shall be graded to avoid the use of bends or deflections greater than 2-1/2° per joint unless otherwise approved by the Engineer.
 - a. Where changes in direction occur requiring greater than 2-1/2° deflection, field bending of the pipe is to be used with minimum bending radius being no less than 10 times the pipe diameter.
- O. Provide sheeting and shoring necessary for protection of the Work and for the safety of personnel.
1. Remove in units when level of backfilling has reached the elevation necessary to protect the utility work and adjacent property.

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2. Sheeting at the bottom of trenches over 10-feet deep for sewers 15-inches and larger in size, shall remain in place and be cut off no less than 2-inches above top of pipe, at no additional cost to the Owner.
 3. When, in the opinion of the Engineer, other sheeting cannot be safely removed, it shall be left in place and the Contractor will be paid for such sheeting at the prices bid.
 - a. Cut such sheeting off at least 2-feet below finished surface.
 - b. No lumber for sheeting or shoring exceeding that size customarily used will be paid for unless the use of larger sizes has been ordered, in writing, by the Engineer.
- P. Depressions:
1. Dig bell holes and depressions for joints after the trench has been graded. Provide uniform bearing for the pipe on prepared bottom of the trench.
 2. Except where rock is encountered, do not excavate below the depth indicated or specified.
 3. Where rock is encountered, excavate rock to a minimum overdepth of 4-inches below the trench depth indicated or specified, and to provide 6-inches clearance in any horizontal direction from all parts of the utility and appurtenances.
- Q. Comply with pertinent OSHA regulations in regards to the excavation of utilities.

3.05 PREPARATION FOR UTILITY PLACEMENT

- A. Cut out soft areas of subgrade not capable of compaction in place; backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

3.06 BACKFILLING

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Backfill trenches and excavations immediately after the pipes are laid, unless other protection is directed or indicated.
- C. Select and deposit backfill materials with special reference to the future safety of the pipes.
- D. Reopen trenches which have been improperly backfilled, to a depth as required for proper compaction. Refill and compact as specified or otherwise correct to the approval of the Engineer.
- E. Surplus material shall be disposed of as directed by the Engineer.
- F. Original surface shall be restored to the approval of the Engineer.

- G. Fill up to subgrade elevations unless otherwise indicated.
- H. Lower portion of trench:
 - 1. Deposit approved backfill and bedding material in layers of 6-inches maximum thickness, and compact with suitable tampers to the density of the adjacent soil until there is a cover of not less than 36-inches over sewers and 12-inches over other utility lines.
 - 2. Take special care in backfilling and bedding operations not to damage pipe and pipe coatings.
- I. Remainder of trench:
 - 1. Except for special materials for pavements, backfill the remainder of the trench with material free from stones larger than 6-inches or 1/2 the layered thickness, whichever is smaller, in any dimension.
 - 2. Deposit backfill material in layers not exceeding the thickness specified, and compact each layer to the minimum density directed by the soil engineer.
- J. Undeveloped areas:
 - 1. Backfill in wooded, swampy or undeveloped areas shall be as specified hereinbefore, except that tamping of the backfill above a level 2-feet over the top of the pipe will not be required.
 - 2. Mound excavated material neatly over the ditch to provide for future settlements.
- K. Employ a placement method that does not disturb or damage other work.
- L. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- M. Maintain optimum moisture content of fill materials to attain required compaction density.
- N. Granular Fill: Place and compact materials in equal continuous layers not exceeding 6 inches compacted depth.
- O. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
- P. Slope grade away from building minimum 2 inches in 10 ft., unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- Q. Correct areas that are over-excavated.
 - 1. Thrust bearing surfaces: Fill with concrete.
 - 2. Other areas: Use general fill, flush to required elevation, compacted to minimum 95 percent of maximum dry density.
- R. Compaction Density Unless Otherwise Specified or Indicated:
 - 1. Under paving, slabs-on-grade, and similar construction: 100 percent of maximum dry density.

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2. At other locations: 95 percent of maximum dry density.
- S. Reshape and re-compact fills subjected to vehicular traffic.

3.07 BEDDING AND FILL AT SPECIFIC LOCATIONS

- A. Use general fill unless otherwise specified or indicated.
- B. Utility Piping:
1. Bedding: Use general fill.
 2. Cover with general fill.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8 inch lifts to 95 percent of maximum dry density.
- C. At Pipe Culverts:
1. Bedding: Use general fill.
 2. Cover with general fill.
 3. Fill up to subgrade elevation.
 4. Compact in maximum 8 inch lifts to 95-percent of maximum dry density.

3.08 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.09 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D3017, or ASTM D6938.
- C. Perform compaction density testing on compacted fill in accordance with ASTM D1556, ASTM D2167, ASTM D2922, or ASTM D3017.
- D. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("standard Proctor"), ASTM D1557 ("modified Proctor"), or AASHTO T 180.
- E. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- F. Frequency of Tests:
1. At least one (1) field density test for every fifty (50) linear feet of trench within each lift.

3.10 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials; leave area in a clean and neat condition; grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition; grade to prevent standing surface water.

END OF SECTION

SECTION 31 23 23

UTILITY BACKFILL MATERIALS

PART 1: GENERAL

1.01 SECTION INCLUDES

- A. Material Classifications
- B. Utility Backfill Materials:
 - 1. Concrete sand
 - 2. Gem sand
 - 3. Pea gravel
 - 4. Crushed stone
 - 5. Crushed concrete
 - 6. Bank run sand
 - 7. Select backfill
 - 8. Random backfill
- C. Material Handling and Quality Control Requirements.

1.02 DEFINITIONS

- A. Unsuitable Material:
 - 1. Materials classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.
 - 3. Materials containing large clods, aggregates, or stones greater than 4 inches in any dimension; debris, vegetation, or waste; or any other deleterious materials.
 - 4. Materials contaminated with hydrocarbons or other chemical contaminants.
- B. Suitable Material:
 - 1. Materials meeting specification requirements.
 - 2. Unsuitable materials meeting specification requirements for suitable soils after treatment with lime or cement.
- C. Foundation Backfill Materials: Natural soil or manufactured aggregate meeting Class I requirements and geotextile filter fabrics as required, to control drainage

and material separation. Foundation backfill material is placed and compacted as backfill where needed to provide stable support for structure foundation base. Foundation backfill materials may include concrete fill and seal slabs.

- D. Foundation Base: Crushed stone aggregate with filter fabric (if required by the project). Substitutions may be approved by Alliance Consulting Engineers, Inc. on a case by case basis.
- E. Backfill Material: Classified soil material meeting specified quality requirements for designated application as embedment or trench zone backfill.
- F. Embedment Material: Material as specified herein and as shown on construction details; unless otherwise approved in advance by Alliance Consulting Engineers, Inc. Bedding materials shall be placed under controlled conditions within embedment zone extending vertically upward from top of foundation to an elevation 12 inches above top of pipe, and including pipe bedding, haunching and initial backfill.
- G. Trench Zone Backfill: Classified soil material meeting specified quality requirements and placed under controlled conditions in trench zone from top of embedment zone to base course in paved areas or to surface grading material in unpaved areas.
- H. Foundation: Either suitable soil of trench bottom or material placed as backfill of over excavation for removal and replacement of unsuitable or otherwise unstable soils.
- I. Source: Source selected by Contractor for supply of embedment or trench zone backfill material. Selected source may be project excavation, off-site borrow pits, commercial borrow pits, or sand and aggregate production or manufacturing plants.
- J. Refer to Excavation Backfill and Compaction Section for other definitions regarding utility installation by trench construction.

1.03 SUBMITTALS

- A. Conform to requirements of Section - Submittal Procedures.
- B. Submit description of source, material classification and product description, production method, and application of backfill materials.
- C. Submit test results for samples of off-site backfill materials. Comply with Paragraph 2.03, Material Testing.
- D. Before stockpiling materials, submit copy of approval from landowner for stockpiling backfill material on private property.

- E. Provide delivery ticket which includes source location for each delivery of material that is obtained from off site sources or is being paid as specific bid item.

1.04 TESTS

- A. Perform tests of sources for backfill material in accordance with Paragraph 2.03B.
- B. Verification tests of backfill materials may be performed by Alliance Consulting Engineers, Inc. in accordance with Paragraph 3.03.

PART 2: PRODUCTS

2.01 MATERIAL CLASSIFICATIONS

- A. Classify materials for backfill for purpose of quality control in accordance with Unified Soil Classification Symbols as defined in ASTM D2487. Material use and application is defined in utility installation specifications and Drawings either by class, as described in Paragraph 2.01 B, or by product descriptions, as given in Paragraph 2.02.
- B. Class Designations Based on Laboratory Testing:
 - 1. Class I: Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW):
 - a. Plasticity index: non-plastic.
 - b. Gradation: D60/D10 - greater than 4 percent; amount passing No. 200 sieve - less than or equal to 5 percent.
 - 2. Class II: Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM):
 - a. Plasticity index: non-plastic to 4.
 - b. Gradations:
 - (1) Gradation (GP, SP): amount passing No. 200 sieve - less than 5 percent.
 - (2) Gradation (GM, SM): amount passing No. 200 sieve - between 12 percent and 50 percent.
 - (3) Borderline gradations with dual classifications (e.g., SP-SM): amount passing No. 200 sieve - between 5 percent and 12 percent.
 - 3. Class III: Clayey gravels and sands, poorly graded mixtures of gravel, sand, silt, and clay (GC, SC, and dual classifications, e.g., SP-SC):
 - a. Plasticity index: greater than 7.
 - b. Gradation: amount passing No. 200 sieve - between 12 percent and 50 percent.
 - 4. Class IVA: Lean clays (CL).
 - a. Plasticity Indexes:
 - (1) Plasticity index: greater than 7, and above A line.

- (2) Borderline plasticity with dual classifications (CL-ML): PI between 4 and 7.
 - b. Liquid limit: less than 50.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
- 5. Class IVB: Fat clays (CH)
 - a. Plasticity index: above A line.
 - b. Liquid limit: 50 or greater.
 - c. Gradation: amount passing No. 200 sieve - greater than 50 percent.
 - d. Inorganic.
- 6. Use soils with dual class designation according to ASTM D2487, and which are not defined above, according to more restrictive class.

2.02 PRODUCT DESCRIPTIONS

- A. Soils classified as silt (ML), silty clay (CL-ML with PI of 4 to 7), elastic silt (MH), organic clay and organic silt (OL, OH), and organic matter (PT) are not acceptable as backfill materials. These soils may be used for site grading and restoration in unimproved areas as approved by Alliance Consulting Engineers, Inc. Soils in Class IV B, fat clay (CH) may be used as backfill materials where allowed, provided applicable Specification requirements specifically within Excavation Backfill and Compaction Section are satisfied.
- B. Provide backfill material that is free of stones greater than 6 inches, free of roots, waste, debris, trash, organic material, unstable material, non-soil matter, hydrocarbon or other contamination, conforming to following limits for deleterious materials:
 - 1. Clay lumps: Less than 0.5 percent for Class I, and less than 2.0 percent for Class II, when tested in accordance with ASTM C142.
 - 2. Lightweight pieces: Less than 5 percent when tested in accordance with ASTM C123.
 - 3. Organic impurities: No color darker than standard color when tested in accordance with ASTM C40.
- C. Manufactured materials, such as crushed concrete, may be substituted for natural soil or rock products where indicated in product specification, and approved by Alliance Consulting Engineers, Inc., provided that physical property criteria are determined to be satisfactory by testing.
- D. Bank Run Sand: Durable bank run sand classified as SP, SW, or SM by Unified Soil Classification System (ASTM D2487) meeting following requirements:
 - 1. Less than 15 percent passing number 200 sieve when tested in accordance with ASTM D1140. Amount of clay lumps or balls may not exceed 2 percent.
 - 2. Material passing number 40 sieve shall meet the following requirements when tested in accordance with ASTM D4318: Plasticity index: not exceeding 7.

- E. Concrete Sand: Natural sand, manufactured sand, or combination of natural and manufactured sand conforming to requirements of ASTM C33 and graded within following limits when tested in accordance with ASTM C136:

<u>Sieve</u>	<u>Percent Passing</u>
3/8"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

- F. Gem Sand: Sand conforming to requirements of ASTM C33 for course aggregates specified for number 8 size and graded within the following limits when tested in accordance with ASTM C136:

<u>Sieve</u>	<u>Percent Passing</u>
3/8"	95 to 100
No. 4	60 to 80
No. 8	15 to 40

- G. Pea Gravel: Durable particles composed of small, smooth, rounded stones or pebbles and graded within the following limits when tested in accordance with ASTM C136:

<u>Sieve</u>	<u>Percent Passing</u>
1/2"	100
3/8"	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

- H. Crushed Aggregates: Crushed aggregates consist of durable particles obtained from an approved source and meeting the following requirements:

1. Materials of one product delivered for same construction activity from single source, unless otherwise approved by Alliance Consulting Engineers, Inc.
2. Non-plastic fines.

3. Angeles abrasion test wear not exceeding 45 percent when tested in accordance with ASTM C131.
4. Crushed aggregate shall have minimum of 90 percent of particles retained on No. 4 sieve with 2 or more crushed faces.
5. Crushed stone: Produced from oversize plant processed stone or gravel, sized by crushing to predominantly angular particles from naturally occurring single source. Uncrushed gravel is not acceptable materials for embedment where crushed stone is shown on applicable utility embedment drawing details.
6. Crushed Concrete: Crushed concrete is an acceptable substitute for crushed stone as utility backfill. Gradation and quality control test requirements are same as crushed stone. Provide crushed concrete produced from normal weight concrete of uniform quality; containing particles of aggregate and cement material, free from other substances such as asphalt, reinforcing steel fragments, soil, waste gypsum (calcium sulfate), or debris.
7. Gradations, as follows:

Percent Passing by Weight for Pipe
Embedment by Ranges of Nominal Pipes Sizes

<u>Sieve</u>	<u>Pipe >15"</u>	<u>Pipe 15" - 8"</u>	<u>Pipe < 8"</u>
1"	95 - 100	100	-
3/4"	60 - 90	90 - 100	100
1/2"	25 - 60	-	90 - 100
3/8"	-	20 - 55	40 - 70
No.4	0- 5	0-10	0-15
No. 8	-	0- 5	0- 5

- I. Select Backfill: Class III clayey gravel or sand or Class IV lean clay with plasticity index between 7 and 20 or clayey soils treated with lime to meet plasticity criteria.
- J. Random Backfill: Any suitable soil or mixture of soils within Classes I, II, III and IV; or fat clay (CH) where allowed, provided applicable Specification requirements specifically within Excavation Backfill and Compaction Section are satisfied.

2.03 MATERIAL TESTING

- A. Source Qualification. Perform testing to confirm test results provided by suppliers for selection of material sources and products not from the project site. Test samples of processed materials from current production representing material to be delivered. Use tests to verify that materials meet Specification requirements. Repeat qualification test procedures each time source

characteristics change or there is planned change in source location or supplier. Include the following qualification tests, as applicable:

1. Gradation: Report complete sieve analyses regardless of specified control sieves from largest particle through No. 200 sieve.
 2. Plasticity of material passing No. 40 sieve
 3. Los Angeles abrasion wear of material retained on No. 4 sieve
 4. Clay lumps
 5. Lightweight pieces
 6. Organic impurities
- B. Production Testing: At Alliance Consulting Engineers, Inc.'s discretion, Contractor shall provide reports to Alliance Consulting Engineers, Inc. from an independent testing laboratory that backfill materials to be placed in Work meet applicable specification requirements.
- C. Assist Alliance Consulting Engineers, Inc. in obtaining material samples for verification testing at source or at production plant.

PART 3: EXECUTION

3.01 SOURCES

- A. Use of existing material in trench excavations is acceptable, provided applicable Specification requirements listed within Excavation Backfill and Compaction Section are satisfied.
- B. Identify off-site sources for backfill materials at least 14 days ahead of intended use so that Alliance Consulting Engineers, Inc. may obtain samples for verification testing.
- C. Materials may be subjected to inspection or additional verification testing after delivery. Materials which do not meet requirements of Specifications will be rejected. Do not use material which, after approval, has become unsuitable for use due to segregation, mixing with other materials, or by contamination. Once material is approved by Alliance Consulting Engineers, Inc., expense for sampling and testing required to change to different material will be at the expense of the Contractor.
- D. Bank run sand, select backfill, and random backfill, if available in project excavation, may be obtained by selective excavation and acceptance testing. Obtain additional quantities of these materials and other materials required to complete work from off-site sources.
- E. Alliance Consulting Engineers, Inc. does not represent or guarantee that any soil found in excavation work will be suitable and acceptable as backfill material.

3.02 MATERIAL HANDLING

- A. When backfill material is obtained from either commercial or non-commercial borrow pit, open pit to expose vertical faces of various strata for identification and selection of approved material to be used. Excavate selected material by vertical cuts extending through exposed strata to achieve uniformity in product.
- B. Establish temporary stockpile locations for practical material handling and control in advance of final placement. Obtain approval from landowner for storage of backfill material on adjacent private property.
- C. When stockpiling backfill material near project site, use appropriate covers to eliminate blowing of materials into adjacent areas and prevent runoff containing sediments from entering drainage system.
- D. Place stockpiles in layers to avoid segregation of processed materials. Load material by making successive vertical cuts through entire depth of stockpile.

3.03 FIELD QUALITY CONTROL

- A. Quality Control
 - 1. Alliance Consulting Engineers, Inc. may sample and test backfill at:
 - a. Sources including borrow pits, production plants and Contractor's designated off-site stockpiles.
 - b. On-site stockpiles
 - c. Materials placed in Work
 - 2. Alliance Consulting Engineers, Inc. may re-sample material at any stage of work or location if changes in characteristics are apparent.
- B. Production Verification Testing: If requested, an independent testing laboratory will provide verification testing on backfill materials, as directed by Alliance Consulting Engineers, Inc. Samples may be taken at source or at production plant, as applicable.

END OF SECTION

SECTION 31 23 33

EXCAVATION BACKFILL AND COMPACTION FOR UTILITIES

PART 1: GENERAL

1.01 SECTION INCLUDES

- A. Trench excavation, backfill, and compaction shall include, but not necessarily be limited to, the excavation, backfill, and compaction of trenches for water mains, and sanitary sewers, shown on the Construction Drawings, and in accordance with the Alliance Consulting Engineers, Inc. Standard Specifications and Details.

1.02 DEFINITIONS

- A. Pipe Foundation: Suitable and stable native soils that are exposed at trench subgrade after excavation to depth of bottom of bedding as shown on the Construction Drawings, or foundation backfill material placed and compacted in over-excavations.
- B. Embedment Material/Pipe Bedding: Portion of trench backfill that extends vertically from top of foundation up to level line at bottom of pipe, and horizontally from one trench sidewall to opposite sidewall.
- C. Haunching: Material placed on either side of pipe from top of bedding up to springline of pipe and horizontally from one trench sidewall to opposite sidewall.
- D. Initial Backfill: Portion of trench backfill that extends vertically from springline of pipe (top of haunching) up to level line 12-inches above top of pipe, and horizontally from one trench sidewall to opposite sidewall.
- E. Pipe Embedment Zone: Portion of trench backfill that consists of bedding, haunching and initial backfill.
- F. Trench Zone: Portion of trench backfill that extends vertically from top of pipe embedment up to pavement subgrade or up to final grade when not beneath pavement.
- G. Unsuitable Material: Unsuitable soil materials are the following:
 - 1. Materials that are classified as ML, CL-ML, MH, PT, OH, and OL according to ASTM D2487.
 - 2. Materials that cannot be compacted to required density due to gradation, plasticity, or moisture content.

3. Materials that contain large clods, aggregates, stones greater than 4-inches in any dimension, debris, vegetation, waste or any other deleterious materials.
 4. Materials that are contaminated with hydrocarbons or other chemical contaminants.
- H. **Suitable Material:** Suitable soil materials are those meeting specification requirements. Materials mixed with lime, fly ash, or cement that can be compacted to required density and meeting requirements for suitable materials may be considered suitable materials, unless otherwise indicated.
- I. **Backfill:** Suitable material meeting specified quality requirements placed and compacted under controlled conditions.
- J. **Ground Water Control Systems:** Installations external to trench, such as well points, eductors, or deep wells. Ground water control includes dewatering to lower ground water, intercepting seepage which would otherwise emerge from side or bottom of trench excavation, and depressurization to prevent failure or heaving of excavation bottom.
- K. **Surface Water Control:** Diversion and drainage of surface water runoff and rain water away from trench excavation. Rain water and surface water accidentally entering trench shall be controlled and removed as part of excavation drainage.
- L. **Excavation Drainage:** Removal of surface and seepage water in trench by sump pumping and using drainage layer, as defined in ASTM D2321, placed on foundation beneath pipe bedding or thickened bedding layer of Class I material.
- M. **Trench Conditions** are defined with regard to stability of trench bottom and trench walls of pipe embedment zone. Maintain trench conditions that provide for effective placement and compaction of embedment material directly on or against undisturbed soils or foundation backfill, except where structural trench support is necessary.
1. **Dry Stable Trench:** Stable and substantially dry trench conditions exist in pipe embedment zone as result of typically dry soils or achieved by ground water control (dewatering or depressurization) for trenches extending below ground water level.
 2. **Stable Trench with Seepage:** Stable trench in which ground water seepage is controlled by excavation drainage.
 - a. **Stable Trench with Seepage in Clayey Soils:** Excavation drainage is provided in lieu of or to supplement ground water control systems to control seepage and provide stable trench subgrade in predominately clayey soils prior to bedding placement.
 - b. **Stable Wet Trench in Sandy Soils:** Excavation drainage is provided in embedment zone in combination with ground water control in predominately sandy or silty soils.
 3. **Unstable Trench:** Unstable trench conditions exist in pipe embedment zone if ground water inflow or high water content causes soil disturbances, such as sloughing, sliding, boiling, heaving or loss of density.

- N. Sub-trench: Sub-trench is special case of benched excavation. Sub-trench excavation below trench shields or shoring installations may be used to allow placement and compaction of foundation or embedment materials directly against undisturbed soils. Depth of sub-trench depends upon trench stability and safety as determined by the Contractor.
- O. Trench Dam: Placement of low permeability material in pipe embedment zone or foundation to prohibit ground water flow along trench.
- P. Over-excavation and Backfill: Excavation of subgrade soils with unsatisfactory bearing capacity or composed of otherwise unsuitable materials below top of foundation as shown on the Contract Drawings, and backfilled with foundation backfill material.
- Q. Foundation Backfill Materials: Natural soil or manufactured aggregate of controlled gradation, and geotextile filter fabrics as required, to control drainage and material separation. Foundation backfill material is placed and compacted as backfill to provide stable support for bedding. Foundation backfill materials may include concrete seal slabs.
- R. Trench Safety Systems: Includes both protective systems and shoring systems.
- S. Trench Shield (Trench Box): Portable worker safety structure moved along trench as work proceeds, used as protective system and designed to withstand forces imposed on it by cave in, thereby protecting persons within trench. Trench shields may be stacked if so designed or placed in series depending on depth and length of excavation to be protected.
- T. Shoring System: Structure that supports sides of an excavation to maintain stable soil conditions and prevent cave-ins, or to prevent movement of ground affecting adjacent installations or improvements.
- U. Special Shoring: Shoring system meeting special shoring as specified in Paragraph 1.06, Special Shoring Design Requirements, for locations identified on Drawings.

1.03 SCHEDULING

- A. Schedule work so that pipe embedment can be completed on same day that acceptable foundation has been achieved for each section of pipe installation, manhole, or other structures.
- B. The Contractor shall not excavate more trench in any day than can be completed (facility installed and trench backfilled) in the same day, unless by written permission of Alliance Consulting Engineers, Inc... Alliance Consulting Engineers, Inc. shall be empowered at any time to require the backfilling of open trenches over completed pipe lines if, in their judgment, such action is necessary.

1.04 SUBMITTALS

- A. Conform to requirements of Section 01 33 00 - Submittal Procedures.

- B. Submit planned typical method of excavation, backfill placement and compaction including:
 - 1. Trench widths
 - 2. Procedures for foundation and pipe zone bedding placement, and trench backfill compaction.
 - 3. Procedures for assuring compaction against undisturbed soil when pre-manufactured trench safety systems are proposed.
- C. Submit backfill material sources and product quality information in accordance with requirements of Section – Utility Backfill Materials.
- D. Submit trench excavation safety program. Identify by name who will be OSHA competent person for excavations. If special shoring system is to be used, include designs for special shoring meeting requirements defined in Paragraph 1.06, Special Shoring Design Requirements contained herein.
- E. Submit record of location of utilities as installed, referenced to survey control points. Include locations of utilities encountered or rerouted. Give stations (if applicable), horizontal dimensions, elevations, inverts, and gradients.

1.05 TESTS

- A. Geotechnical testing and analysis of backfill materials for soil classification and compaction testing during construction shall be provided by the Contractor, at the Contractor's expense, and performed by an independent, State-certified, testing company approved by Alliance Consulting Engineers, Inc.. The results of all failing tests shall be communicated to Alliance Consulting Engineers, Inc. immediately. Written results of all tests performed, shall be presented to Alliance Consulting Engineers, Inc. in a timely manner. When test results indicate that the density is less than the percent specified, contractor shall excavate and re-compact the areas that have failed at no expense to Alliance Consulting Engineers, Inc. or the Owner.
- B. Perform backfill material source qualification testing in accordance with requirements of Section – Utility Backfill Materials.
- C. The Contractor will arrange for all in-place moisture/density testing on the project.
- D. Frequency :

Compaction testing shall be performed on random lifts a minimum of every 300 LF unpaved areas and 100 LF in paved areas unless otherwise approved by Alliance Consulting Engineers, Inc.. Alliance Consulting Engineers, Inc. reserves the right to require re-tests if the initial compaction test fails.

 - 1. If ground water is present, at the discretion of Alliance Consulting Engineers, Inc., compaction testing shall be increased to every 100 LF in unpaved areas.
 - 2. A minimum of one (1) compaction test per lift shall be performed for all backfill operations with less linear footage than specified in 1.05 D.

3. The testing agency shall determine at the time of testing the location of each compaction test within the specified testing length.
4. As an alternative to the compaction testing frequency specified, the Contractor shall have the option to demonstrate acceptable compaction at the start of the project.
 - a. At the start of the trenching operation, the Contractor shall demonstrate to Alliance Consulting Engineers, Inc. representative through the results reported by the accepted testing agency that the compaction density specified can be attained by the compaction equipment and methods the Contractor intends to use.
 - b. Once the method and equipment has been approved, no substitutions will be permitted without Alliance Consulting Engineers, Inc.'s approval.
 - c. Additional demonstration of the suitability of the compaction equipment and methods will be required whenever there is a significant change in material characteristics or change in compaction equipment or method.
 - d. Should testing determine that the required density is not being met, or the material is outside the specified moisture range, the Contractor shall, without additional compensation, reexcavate, rework, and/or recompact the particular layer or section until the required density and/or moisture is attained.

E. Compaction

1. The Contractor shall, in unimproved areas outside the public rights-of-way, compact each trench backfill layer in such a manner as to obtain a dense backfill free of voids and not susceptible to undue settlement or depression. Trench backfill extending to not less than 1-foot in depth above the top of pipe shall be compacted to at least 90% of maximum density at a moisture content within 5% of the optimum in accordance with ASTM D1556.
2. Trench backfill within all rights-of-way of improved or paved areas shall be compacted to at least 95% of maximum density at a moisture content within 5%, or local requirements which ever is more stringent, of the optimum moisture in accordance with ASTM D1556. The final 1-foot of trench backfill to pavement subgrade shall be compacted to at least 95% of maximum density at a moisture content within 5% of the optimum in accordance with ASTM D1556.

1.06 SPECIAL SHORING DESIGN REQUIREMENTS

- A. Have special shoring designed or selected by Contractor's Professional Engineer registered in the State of South Carolina to provide support for sides of excavations, including soils and hydrostatic ground water pressures as applicable, and to prevent ground movements affecting adjacent installations or improvements such as structures, pavements and utilities. Special shoring may be a premanufactured system selected by Contractor's Professional Engineer to meet project site requirements based on manufacturer's standard design.

- B. The requirement for special shoring shall be determined by Alliance Consulting Engineers, Inc. for all excavations within 10-feet of a City owned asset.

PART 2: PRODUCTS

2.01 EQUIPMENT

- A. Perform excavation with hydraulic excavator or other equipment suitable for achieving requirements of this Section.
- B. Heavy compaction equipment shall not be used until adequate cover is attained. in order to prevent damage to pipes, conduits, or ducts.
- C. Use trench shields or other protective systems or shoring systems, including special shoring systems as referenced in Paragraph 1.06, which are designed and operated in accordance with all Local, State, and Federal (including OSHA) standards and regulations.

2.02 MATERIAL CLASSIFICATIONS

- A. Embedment and Trench Zone Backfill Materials: Conform to classifications and product descriptions of Section – Utility Backfill Materials.
- B. Concrete Encasement: Concrete used for encasement or caps shall have a minimum compressive strength of 3,000 psi.
- C. Concrete Backfill: Also known as flowable fill. Flowable fill must be “excavatable” as defined by the National Ready Mixed Association as having a compressive strength not exceeding 150 psi.
- D. Concrete for Trench Dams: Concrete backfill or 3 sack premixed (bag) concrete.

PART 3: EXECUTION

3.01 STANDARD PRACTICE

- A. Install flexible pipe, including "semi-rigid" pipe, to conform to standard practice described in ASTM D2321, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.
- B. Install rigid pipe to conform to standard practice described in ASTM C12, and as described in this Section. Where an apparent conflict occurs between standard practice and requirements of this Section, this Section governs.

3.02 PREPARATION

- A. Maintain barricades and warning lights for streets and intersections affected by Work, and that are considered hazardous to traffic movements as specified in the approved traffic control plan for the project.
- B. It is the Contractor's responsibility to obtain all required permits for excavation to include a Traffic Control Plan approved by the South Carolina Department of Transportation (SCDOT) and/or the City of Walterboro.
- C. Perform work to conform to applicable safety standards and regulations, as outlined in current OSHA, State and local regulations.
- D. Immediately notify agency or company owning any existing utility line which is damaged, broken, or disturbed. Obtain approval from Alliance Consulting Engineers, Inc. and agency for any repairs or relocations, either temporary or permanent.
- E. Remove existing pavements and structures, including sidewalks and driveways, to conform to local (local, SCDOT, DPW, etc.) requirements.
- F. Install and operate necessary dewatering and surface-water control measures. Provide stable trench to allow installation in accordance with Specifications.
- G. Maintain permanent benchmarks, monuments, and other reference points. Unless otherwise directed in writing, at the expense of the Contractor a Licensed Surveyor shall replace those which are damaged or destroyed in accordance with the requirements of Alliance Consulting Engineers, Inc. and local or State requirements.

3.03 CRITICAL LOCATION INVESTIGATION

- A. Horizontal and vertical location of various underground lines shown on the Construction Drawings, including but not limited to water lines, gas lines, storm sewers, sanitary sewers, telecommunication lines, electric lines or power ducts, pipelines, concrete and debris, are based on best information available but are only approximate locations.
- B. The Contractor is responsible for coordinating all utility locates within the Limits of Disturbance per the standard procedures for the project location (One call system, DPW, Utility Company Coordination, etc.)
- C. The Contractor is responsible for verifying the location of existing utilities in a manner that complies with all local, State and Federal regulations. Use extreme caution and care when uncovering these lines.

- D. Notify Alliance Consulting Engineers, Inc. in writing immediately upon identification of obstruction.
- E. Notify involved utility companies of date and time that investigation excavation will occur and request that their respective utility lines be marked in field. Comply with utility or pipeline company requirements that their representative be present during excavation. Provide Alliance Consulting Engineers, Inc. written 72 hours notice prior to field excavation or related work.

3.04 PROTECTION

- A. Protect trees, shrubs, lawns, existing structures, and other permanent objects outside of grading limits and within grading limits as designated on the Contract Drawings.
- B. Protect and support above-grade and below-grade utilities which are to remain.
- C. Restore damaged permanent facilities to a condition equal to or better than pre-construction conditions unless replacement or abandonment of facilities is indicated on the Construction Drawings.
- D. Take measures to minimize erosion of trenches. Do not allow water to pond in trenches. Where slides, washouts, settlements, or areas with loss of density or pavement failures or potholes occur, repair, recompact, and pave those areas at no additional cost to Alliance Consulting Engineers, Inc. or the Owner.
- E. Protection of Property and Structures: The Contractor shall be responsible for all damage and assume all expense for direct or indirect injury caused by his work, to above ground facilities or below ground facilities shown on the Construction Drawings. The Contractor shall, at his own expense, sustain in place and protect from direct or indirect injury all existing facilities in the vicinity of the excavation, whether above or below the ground, or that may appear in the trench. The Contractor shall be responsible for the implementation of protective measures associated with the presence or proximity of pipes, poles, tracks, walls, buildings, property markers, and other structures and property of every kind and description in or over his trenches or in the vicinity of his work whether above or below the surface of the ground.

3.05 EXCAVATION

- A. Except as otherwise specified or shown on the Construction Drawings, install underground utilities in open cut trenches with vertical sides.
- B. Perform excavation work so that pipe, conduit, and ducts can be installed to depths and alignments shown on the Construction Drawings. Avoid disturbing surrounding ground and existing facilities and improvements.

- C. Trenches shall be wide enough to allow for compaction equipment.
- D. Use sufficient trench width or benches above embedment zone for installation of well point headers or manifolds and pumps where depth of trench makes it uneconomical or impractical to pump from surface elevation. Provide sufficient space between shoring cross braces to permit equipment operations and handling of forms, pipe, embedment and backfill, and other materials.
- E. Upon discovery of unknown utilities, badly deteriorated utilities not designated for removal, or concealed conditions notify Alliance Consulting Engineers, Inc. immediately
- F. Trench Support:
 - 1. The Contractor shall support the sides and ends of all excavations wherever necessary with braces, sheeting, shoring or stringers, trench boxes, or other acceptable excavation support systems. All timbering shall be installed by persons skilled in such work and shall be so arranged that it may be withdrawn as backfilling proceeds, without injury to the utility or structure constructed or to any roadbed or adjacent structure or property.
 - 2. All work shall be performed in accordance with the latest OSHA requirements.
 - 3. All timbering in excavations, trench boxes, or excavation support systems shall be withdrawn as the backfilling is being done, except where and to such extent as Alliance Consulting Engineers, Inc. shall order in writing that said timbering or excavation support system be left in place or where Alliance Consulting Engineers, Inc. permits the trench support to be left in place at the Contractor's expense and upon his request. The Contractor shall cut off any sheeting left in place 2 feet below finished grade and shall remove the material cut off without compensation therefore.
 - 4. The support of the trench shall be the sole responsibility of the Contractor.
 - 5. Removal or Moving of trench shoring shall be performed so that pipe, and backfill materials, after placement and compaction, are not damaged nor disturbed, nor degree of compaction reduced. Re-compact after shoring is moved if soil is disturbed.
 - 6. The Contractor shall coordinate and provide safe access at all times to all inspecting and testing activities for Alliance Consulting Engineers, Inc. and Alliance Consulting Engineers, Inc.-authorized representatives.

3.06 HANDLING EXCAVATED MATERIALS

- A. Use only excavated materials, which are suitable as defined in this Section and conforming to Section – Utility Backfill Materials. Place material suitable for backfilling in stockpiles per the most current OSHA standards.
- B. When required, provide additional backfill material conforming to requirements of Section – Utility Backfill Materials.

- C. Stockpile locations shall be pre-approved by Alliance Consulting Engineers, Inc. and the local governing authority.
- D. All excavated material not used as backfill the same day as excavated shall be removed from the site and/or stockpiled in an area pre-approved by Alliance Consulting Engineers, Inc. or DPW.

3.07 TRENCH FOUNDATION

- A. The Contractor shall, before any pipe or appurtenance is installed, fill all unauthorized depressions or irregularities in the bottom of the trench or tunnel with firmly compacted embankment or other approved material.
- B. It shall be the Contractor's responsibility to adequately control water that may be present in the excavation. He shall provide for the disposal of water removed from excavations in such a manner not to cause damage to public or private property or to any portion of the Work completed or in progress or cause any impediment to the use of any area by the public. Nor shall the Contractor discharge any flushing or ground water or any material of any nature into existing sanitary sewer system during construction of the facilities. All water shall be discharged through an approved sediment control device.
- C. Notify Alliance Consulting Engineers, Inc. immediately when unsatisfactory material is encountered on trench bottom. With Alliance Consulting Engineers, Inc. approval, up to 12 -inches of additional undercut may be permitted to achieve suitable trench bottom. If the additional undercut does not result in a satisfactory trench bottom, the Contractor shall obtain a bedding design prepared by a Geotechnical Engineer licensed in the State of South Carolina
- D. Perform over excavation, if directed by Alliance Consulting Engineers, Inc., in accordance with Paragraph 3.07.C above. Removal of material may be required. Even though Contractor has not determined material to be unsuitable.
- E. Trench dams shall be installed as determined by Alliance Consulting Engineers, Inc. when ground water is encountered.

3.08 PIPE EMBEDMENT, PLACEMENT, AND COMPACTION

- A. Embedment material as shown on the Construction Plans shall be used for the pipe embedment zone (bedding, haunching, and initial backfill).
- B. Remove loose, sloughing, caving, or otherwise unsuitable soil from bottoms and sidewalls of trenches immediately prior to placement of embedment materials.
- C. Place embedment including bedding, haunching, and initial backfill as shown on Construction Drawings.
- D. For pipe installation, manually spread embedment materials around pipe to provide uniform bearing and side support when compacted. Protect flexible pipe from damage during placing of pipe zone bedding material. Perform placement

and compaction directly against undisturbed soils in trench sidewalls, or against sheeting which is to remain in place.

- E. Do not place trench shields or shoring within height of embedment zone unless means to maintain density of compacted embedment material are used. If moveable supports are used in embedment zone, lift supports incrementally to allow placement and compaction of material against undisturbed soil.
- F. Place geotextile to prevent particle migration from in-situ soil into open-graded (Class I) embedment materials or drainage layers.
- G. Do not damage coatings or wrappings of pipes during backfilling and compacting operations. When embedding coated or wrapped pipes, do not use crushed stone or other sharp, angular aggregates.
- H. Place haunching material around pipe and compact per the pipe manufacture's recommendation to provide uniform bearing and side support. The haunching shall be installed in a manner that prevents the pipe from moving.
- I. Place electrical conduit, if used, directly on foundation without bedding.
- J. The method of compaction of the embedment zone material shall comply with the pipe manufacture's recommendation. Water tamping is not allowed.

3.09 TRENCH ZONE BACKFILL PLACEMENT AND COMPACTION

- A. Place backfill for pipe or conduits and restore surface as soon as practicable. Leave only minimum length of trench open as necessary for construction.
- B. For water and sewer lines under existing pavement, use an aggregate base backfill up to the pavement base or sub grade. Aggregate base shall meet the specifications of and be installed per the SCDOT regulations.
- C. Unless otherwise shown on the Construction Drawings, for trench excavations not under pavement, random backfill of suitable material may be used in trench zone.
 - 1. Clay Soils may be used as trench zone backfill outside paved areas.
 - 2. Place in maximum 8-inch thick lift.
 - 3. Compact per Paragraph 1.05 of this specification section.
 - 4. Moisture content as necessary to achieve density.
- D. For electric conduits, remove form work used for construction of conduits before placing trench zone backfill.

3.10 MANHOLES, JUNCTION BOXES AND OTHER PIPELINE STRUCTURES

- A. Manholes, junction boxes and other pipeline structures shall have bedding consisting of a minimum of 1' compacted ¾" to 1" clean stone. The compacted ¾" to 1" stone shall be installed horizontally out from the base to the limits of the excavation (minimum 1'), and extend up to a minimum of 1' above the pipe or base, which ever is greater (does not include the upper connection of a drop inlet). The stone shall be installed to a uniform depth around the entire perimeter of the structure. The remainder of the backfill shall be installed per section 3.09 Trench Zone Backfill Placement and Compaction to include paved and unpaved area requirements.

3.11 DISPOSAL OF EXCESS MATERIAL

- A. Dispose of excess materials in accordance with requirements of the contract documents, State and local requirements.

END OF SECTION

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work included: Provide protection of the environment during the construction of this project to reduce soil erosion and siltation to the lowest reasonably achievable level.

1.2 GENERAL

- A. Exercise every reasonable precaution, throughout the life of the project, to prevent the eroding of soil and the silting of rivers, streams, lakes, reservoirs, other water impoundments, ground or roadway surfaces, or other property. Erosion control practices to be used for this project are shown on the drawings and are to conform to South Carolina Department of Health and Environmental Control regulations.

PART 2 PRODUCTS

2.1 CRUSHED STONE

- A. Provide #57 crushed stone for project entrance and exit.
- B. Provide #57 crushed stone for temporary sediment barriers around inlets and for temporary stone check dams.

2.2 GRASSING

- A. Comply with Section 32 92 00 – Lawn Restoration.

2.3 SILT FENCE

- A. Posts:
 - 1. Posts shall be self-fastener angle steel, 5' in length.
- B. Woven wire shall conform to the requirements of ASTM A 116, Class I zinc coating for wire. Each woven square shall measure 5.33" X 12". The top and bottom wires shall be 10 gauge. All other wires shall be 12-1/2 gauge.
- C. Filter fabric shall be synthetic fabric as manufactured by Celanese Fibers Co., DuPont, Industrial Netting or approved equal.

2.4 EROSION CONTROL BLANKET

- A. Use erosion control blanket S150 if North American Green, or similar products by profile products, or approved equal.

2.5 RIP-RAP – N/A

2.6 FILTER FABRIC (Temporary Stone Check Dam)

- A. Use Stabilenka Filter Fabric (T-140N), Mirafi (140N) or approved equal.

PART 3 EXECUTION

3.1 GENERAL

- A. Construct and maintain all erosion control measures until the substantial completion of the project.

3.2 TEMPORARY CONSTRUCTION ENTRANCE/EXIT

- A. Construct a gravel area or pad at points where vehicles enter and exit construction site.
- B. Clear the entrance and exit area of all vegetation, roots, and other objectionable material and properly grade and place gravel to the grade and dimensions shown on the plans.
- C. Construct drainage channels to carry water to a sediment trap or other suitable outlet.
- D. Use geotextile fabrics to improve stability of the foundation in locations subject to seepage or high water table.
- E. Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site by periodic top dressing with two inches of stone.
- F. After each rainfall, inspect any structure used to trap sediment and clean it out as necessary.
- G. Immediately remove objectionable materials spilled, washed, or tracked onto public roadways.

3.3 TEMPORARY GRASSING

- A. Provide a temporary cover for erosion control on disturbed areas that will remain stabilized for a period of more than thirty (30) days in accordance with Section 32 92 00 – Lawn Restoration.
- B. This practice applies to cleared areas, diversions, dams, temporary sediment basins, temporary road banks, and topsoil stockpiles where vegetation is needed for less than one (1) year.
- C. Provide grassing on slope 5% or greater within fourteen (14) days of disturbance. Comply with Section 32 92 00 – Lawn Restoration.

3.4 SILT FENCE

- A. Provide silt fence barrier where shown on the plans and on utility construction parallel to the disturbed trench where perpendicular sheet flow runoff occurs on disturbed areas with slopes greater than 4%.
- B. Place at the extreme limits of the area to be disturbed as shown on the plans.

- C. Construct temporary sediment barriers of filter fabric, buried at the bottom, stretched and supported by posts and install below small disturbed areas as indicated on the drawings to retain sediment by reducing the flow velocity to allow sediment deposition.
- D. Provide spacing between posts 5'-0" on center, minimum.
- E. Remove sediment deposits prior to reaching one-third height of the fence.
- F. Monitor site frequently and place additional silt fencing should evidence indicate that erosion is about to occur at locations other than those shown on plan.

3.5 INLET PROTECTION

- A. Construct temporary sediment barriers around storm drain curb inlets as indicated on the drawings.
- B. Inspect structure after each rainfall and repair as required.
- C. Remove sediment when trap reaches one-half capacity.
- D. Remove structure when protected areas have been stabilized.

3.6 EROSION CONTROL BLANKET

- A. Provide on areas as shown on the plans or on all embankments with slopes equal to or steeper than 2-1/2:1.

3.7 TEMPORARY STONE CHECK DAMS

- A. Utilize temporary stone check dams as indicated on the plans or directed by Engineer.
- B. Provide temporary stone check dams constructed of both rip-rap and #57 stone, as illustrated on the plans.

3.8 MAINTENANCE

- A. Place all erosion control devices or measures prior to any land disturbing activity within the drainage area they are located.
- B. Periodically check erosion control devices and clean or otherwise remove silt build-up as necessary to maintain them in proper working order.

3.9 REMOVAL

- A. Remove temporary structures after protected areas have been stabilized.

3.10 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 31 37 00

RIPRAP

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Furnishing all labor, materials, and equipment and performing all operations in conjunction with placing protective coatings of broken stone in accordance with these specifications and in conformity with the lines, grades and thicknesses shown on the plans or established by the Engineer.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work of this Section include, but are not necessarily limited to, Standard General Conditions, and Sections in Division 1 of these Specifications.
- B. Section 31 25 00 - Erosion and Sediment Control.
- D. Section 31 23 23.13 – Backfill and Compaction.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with State of South Carolina Department of Transportation Highways standard.
- B. 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.
- C. Maintain one copy of each document on site.

1.04 SUBMITTALS

- A. Comply with pertinent provisions of Section 01 30 00.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Riprap: Granite type; broken stone; solid and nonfriable; 6 inch minimum size, 12 inch maximum size.
- B. Aggregate: Granular fill as specified in Section 31 23 23.13.
- C. Filter Fabric
 - 1. Comply with Section 31 25 00.

PART 3 EXECUTION

3.01 RIP-RAP PLACEMENT

- A. Place riprap at culvert pipe ends, embankment slopes, around pipe support piers, or as indicated.

- B. Where thickness is not shown on the plans, it shall be 12-inches.
- C. The slope upon which this rip-rap is to be placed shall conform with the cross section shown on the plans or as directed by the Engineer.
- D. Properly compact depressions that may be filled in trimming and shaping the slope.
- E. Install filter fabric, lapping sides 12-inches.
- F. Begin placing in a trench at least 2-feet below the toe of the slope.
- G. Firmly imbed against the slope and the adjoining piece with the sides in contact and with broken joints.
- H. Fill the spaces between the larger pieces with spalls of suitable size, thoroughly ram into place.
- I. The finished surface shall present an even, tight surface true to line, grade and section.

3.02 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 31 50 00

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes temporary excavation support and protection systems.

- B. Related Sections:

- 1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities and support facilities.

1.3 PERFORMANCE REQUIREMENTS

- A. Design, furnish, install, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting soil and hydrostatic pressure and superimposed and construction loads.

Contractor shall adequately support all utilities encountered within the excavation trench and shall be responsible for any damage to the utilities as a result of excavating for the project.

- 1. Delegated Design: Design excavation support and protection system, including comprehensive engineering analysis by a licensed professional engineer in South Carolina, using performance requirements and design criteria indicated.
 - 2. Prevent surface water from entering excavations by grading, dikes, dewatering or other means.
 - 3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
 - 4. Monitor vibrations, settlements, and movements.

1.4 SUBMITTALS

- A. Shop Drawings: For excavation support and protection system.

- B. Delegated-Design Submittal: For excavation support and protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a professional engineer licensed in South Carolina responsible for their preparation.

- C. Coordinate first paragraph below with qualification requirements in Division 01 Section "Quality Requirements." Qualification Data: For qualified professional engineer.

- D. Other Informational Submittals:

1. Photographs: Show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by the absence of, the installation of, or the performance of, excavation support and protection systems. Submit before Work begins.
2. Record Drawings: Identifying and locating capped utilities and other subsurface structural, electrical, or mechanical conditions.
 - a. Note locations and capping depth of wells and well points.

1.5 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to excavation support and protection system including, but not limited to, the following:
 - a. Existing utilities and subsurface conditions.
 - b. Proposed excavations.
 - c. Proposed equipment.
 - d. Monitoring of excavation support and protection system.
 - e. Working area location and stability.
 - f. Coordination with waterproofing.
 - g. Abandonment or removal of excavation support and protection system.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

B. Survey Work: Engage a qualified land surveyor to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

1. During installation of excavation support and protection systems, regularly resurvey benchmarks, maintaining an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Engineer if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A36, ASTM A690, or ASTM A992.
- C. Steel Sheet Piling: ASTM A328, ASTM A572, or ASTM A690; with continuous interlocks.
 1. Corners: Site-fabricated mechanical interlock.
- D. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

- E. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- F. Tiebacks: Steel bars, ASTM A722.
- G. Tiebacks: Steel strand, ASTM A416.

PART 3 EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
 - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces are not impeded.
- D. Monitor excavation support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.
- E. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.

3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Accurately place the piling, using templates and guide frames

unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

- A. Tiebacks: Drill, install, grout, and tension tiebacks. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
1. Test loading shall be observed by a qualified professional engineer responsible for design of excavation support and protection system.
 2. Maintain tiebacks in place until permanent construction is able to withstand lateral soil and hydrostatic pressures.

3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Engineer.
 2. Install internal bracing, if required, to prevent spreading or distortion of braced frames.
 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.6 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlaying construction and abandon remainder.
 2. Fill voids immediately with approved backfill compacted to density specified in Division 31 Section "Excavation Backfill and Compaction for Utilities."
 3. Repair or replace, as approved by Engineer, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

3.7 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 32 12 16

REMOVING AND REPLACING PAVEMENTS

PART 1 GENERAL

1.01 DESCRIPTION:

A. Section Includes:

1. Removal and replacement of existing pavements for installation of utility lines, as specified herein, and as needed for a complete and proper installation.

B. Related work:

1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, and Sections in Division 00 and 01 of these specifications.
2. Section 31 23 23 – Utility Backfill Material
3. Section 31 23 33 – Excavation Backfill and Compaction for Utilities

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 for proper performance of the work of this Section.

1.03 SUBMITTALS:

- ###### A. Comply with pertinent provisions of Section 01 30 00 – Administrative Requirements.

1.04 PRODUCT HANDLING:

- ###### A. Comply with pertinent provisions of Section 01 60 00 – Product Requirements.

1.05 WARRANTY:

- ###### A. All remove and replace pavement work within the South Carolina Department of Transportation (SCDOT) rights-of-way shall be warranted for two years beginning on the date of acceptance by the SCDOT.

PART 2 PRODUCTS

2.01 ASPHALTIC CONCRETE:

- ###### A. Use Types 1 complying with South Carolina Department of Transportation Standard Specifications, Section 403.

2.02 AGGREGATE BASE COURSE WITH PRIME:

- A. Comply with applicable portions of South Carolina Department of Transportation Standard Specifications, Section 306.

PART 3 EXECUTION

3.01 GENERAL:

- A. Saw cut and remove to neat lines and dispose of as directed.
- B. Replace the removed pavement with bases and pavements similar to type removed, unless otherwise indicated.

3.02 CUTTING:

- A. Concrete pavement or base:
 - 1. Cut on straight and true lines, to a minimum depth of 2-inches, using powered concrete saw.
 - 2. Shear off remaining depth with pneumatic tools.
- B. Concrete sidewalks shall be removed back to the nearest joint on each side of the crossing.
- C. Concrete Curb and Gutter shall be removed back to the nearest joint on each side of the crossing.
- D. Asphaltic concrete pavements: Cut to straight and true lines with powered concrete saw.

3.03 REPLACEMENT:

- A. Concrete pavements:
 - 1. Use 4000 psi concrete.
 - 2. Replace to 6-inches below existing slab and undercut each edge 6-inches to form shelf.
 - 3. Finish surface to match that of the existing surface.
- B. Concrete sidewalks:
 - 1. Replace with 3000 psi concrete.
 - 2. Depth shall be equal to existing section removed, but not less than 4-inches.
 - 3. Finish surface to match that of the existing sidewalk.
- C. Flexible pavements (Ditch Line) - Secondary and Primary Roads:

1. Compact subgrade thoroughly.
2. Undercut each edge 6-inch to form a shelf.
3. Place 8-inches 3000 psi concrete leaving surface rough and depressed 2-inches or Controlled density fill or that allowed by the South Carolina Department of Transportation.
4. Top with 2-inches (200 lbs.) of asphaltic concrete.

D. Flexible pavements (Ditch Line) - Driveways:

1. Compact subgrade thoroughly.
2. Place 8-inches deep aggregate base course with prime.
3. Top with 2-inches of asphaltic concrete.

E. Flexible pavements (Resurfacing):

1. In some instances where utilities are installed within existing pavements, resurfacing of the entire width of the original pavement will be required.
2. Replace pavement in ditch line as specified above.
3. Prime and resurface with 2-inches of asphaltic concrete.
4. Taper resurfacing to existing pavement evenly for a distance of 50 feet beyond repaired area.

3.04 MEASUREMENT AND PAYMENT:

- A. No separate measurement or direct payment will be made for the work under this Section and all cost for the same shall be included in the lump sum or unit price for the item to which it pertains.

END OF SECTION

SECTION 32 92 00

LAWN RESTORATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Seeding and Fertilization
- B. Provide grassing for the area specified herein, or as indicated, for a complete and proper installation.
- C. Water and sanitary sewer easements, including highway and street shoulders: All areas disturbed by the construction process.

1.02 RELATED REQUIREMENTS

- A. Documents affecting work in this section include, but are not necessarily limited to, General Conditions, and Sections in Division 1 of these Specifications.
- B. Section 31 23 23 – Utility Backfill Materials
- C. Section 31 25 00 – Erosion and Sediment Control

1.03 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnsongrass, Poison Ivy, Nut Sedge, Nimble Will, Blindweed, Bentgrass, Wild Garlic, Perennial Sorrel, and Brome Grass.

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.
- B. Seed: Conform to all State laws and to all requirements and regulations of the South Carolina Department of Agriculture.
 - 1. Deliver to site each variety of seed individually packaged and tagged to show name, net weight, origin, and lot number.
- C. Fertilizer: Conform to State fertilizer law.

1.05 SUBMITTALS

- A. See Section 01 30 00 – Administrative Requirements, for submittal procedures.
- B. Comply with pertinent provisions of Section 01 30 00
- C. Product Data: Within 15 calendar days after the Contractor has received the Owner's Notice to Proceed, submit:
 - 1. Complete materials list of items proposed to be provided under this Section.

2. Material Safety Data Sheets for all materials to be used.
3. Installation/Application Instructions for all relevant materials (i.e. erosion blankets, hydraulic mulches)

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- C. Comply with pertinent provisions of Section 01 60 00 – Produce Requirements
- D. At time of delivery, furnish the Engineer invoices of all materials received in order that application rates may be determined.
- E. Immediately remove from the site materials that do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

PART 2 PRODUCTS

2.01 GRASS SEED

- A. Provide grass seed that is:
 1. Free from noxious weed seeds
 2. Current year crop seed
 3. Treated with appropriate fungicide at time of mixing
 4. Delivered to the site in sealed containers with dealer's guaranteed analysis
- B. Water: Clean, fresh and free of substances that could inhibit vigorous growth of grass.
- C. Stakes: Softwood lumber, chisel pointed
- D. String: inorganic fiber
- E. Lime and pH Adjustment
 1. For Dry Seeding operations provide agricultural grade, standard ground limestone conforming to the current "Rules, Regulations and Standards of the Fertilizer Board of Control" issued at Clemson University.
 2. For Hydraulic Seeding operations, provide NeutraLime® Dry by Profile Products to raise pH or Aqua-pHix® by Profile Products to lower pH at rate determined by soil analysis or at manufacturer's recommended rate.
 3. Bag tags or delivery slip for bulk loads shall indicate brand or trade name, calcium carbonate equivalent, and other pertinent data to identify the lime.
- F. Wood Fiber Mulch

1. Provide 100% thermally processed wood fiber or blended 70/30 wood/cellulose fiber manufactured specifically for discharging uniformly on the ground surface when dispersed by a hydro-seeding machine.
2. Material shall contain thermally processed wood fibers so as to contain no germination or growth inhibiting factors and to achieve phyto-sanitization.
3. Material shall contain basic green dye to facilitate visual metering.

G. Flexterra HP-FGM

1. Provide Flexterra HP-FGM® as manufactured by Profile Products.
2. Material shall contain thermally refined wood fibers and crimped synthetic fibers so as to contain no germination or growth inhibiting factors.
3. Materials shall contain non-toxic green dye to facilitate metering.
4. Material shall be 100% Bio-degradable.

H. Straw Mulch/Dry Applied Mulching Pellets

1. Provide straw or hay material.
 - a. Straw to be stalks of wheat, rye, barley or oats.
 - b. Hay to be timothy, peavine, alfalfa, or coastal Bermuda
2. Material to be reasonably dry and reasonably free from mature seed bearing stalks, roots, or bulblets or Johnson Grass, Nutgrass, Wild Onion or any other Noxious weeds detailed in part 1.04 of this Section.
3. Seed Aide Aero® manufactured by Profile Products at a rate of 3,000 LBS/ACRE can be used as a weed free alternative to straw mulch.

I. Erosion Control Blanket

1. Provide on areas as shown on the plans
2. Provide Erosion Control Blanket S-2®, from Western Excelsior, or approved equal.

2.02 TESTS

- A. Provide analysis of topsoil fill under provisions of Section 01 40 00 – Quality Requirements.
- B. Analyze to ascertain the percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter, and pH value.
- C. Submit minimum 10 oz. (280 g) sample of topsoil proposed. Forward sample to approved testing laboratory in sealed containers to prevent contamination.
- D. Testing is not required if recent test are available for imported topsoil. Submit these test results to the testing laboratory for approval. Indicate, by test results, information necessary to determine suitability.
- E. If pH is not in the range of 6.0 to 7.0, adjust accordingly with Lime.

- F. Organic matter must be 2.0% or greater. If organic matter percentage is less than 2%, contractor shall apply JumpStart® and/or BioPrime® by Profile Products to modify soil organic matter. JumpStart and BioPrime to be applied at rate determined by soil analysis or at manufacturer's recommended rate

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

- A. Seed these areas immediately upon completion of grading or construction and cleanup operations.
 - 1. Slopes greater than 4:1
 - 2. Utility right-of-ways or any other disturbed area adjacent to wetlands.
- B. Bring all areas to proper line, grade and cross section indicated on the plans.
- C. Repair erosion damage prior to commencing seeding operations.
- D. Loosen seed bed to a minimum depth of 3" and track in slope so as the direction of the track marks is perpendicular to the direction of the slope.
- E. Remove all roots, clods, stones larger than 1" in any dimension, and other debris.

3.03 FERTILIZATION

- A. Apply fertilizer in accordance with manufacturer's instructions, and the Soil Analyses as detailed in part 2.03 of this Section.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Mix thoroughly into upper 2 inches (50 mm) of topsoil.
- D. If seeding using a hydro-seeder apply fertilizer in slurry with mulch, seed, and lime.
- E. Spread uniformly over areas to be seeded at:
 - 1. Rate of 11 LBS/1000 sq. ft. when using 19-19-19.
 - 2. Rate of 20 LBS/1000 sq. ft. when using 10-10-10.
 - 3. Use approved mechanical spreaders for dry seeding application.
- F. Second Application of Fertilizer
 - 1. When plants are established and showing satisfactory growth, apply Nitrogen at the rate of 1 lb. per 1000 sq. ft.
 - 2. Apply using dry seeding application unless otherwise directed by Engineer.
 - 3. Do not apply to stands of temporary grasses.

3.04 SEEDING

A. Mixtures of different types of seed for the various schedules shall be weighted and mixed in proper proportions in the presence of the Engineer.

B. Permanent Seeding Mix – Slopes 4:1 or Greater

1. Schedule No. 1 – Planting Dates April 1 – September 15:

a) Slopemaster® Spring/Summer Mix by Pennington Seed, Inc.

- 25% Hulled Sahara Bermuda Grass
- 25% Unhulled Sahara Bermuda Grass
- 25% Pensacola Bahia Grass
- 10% Durana White Clover
- 10% Brown Top Millet
- 5% Weeping Love Grass

b) Rate 75 LBS/ACRE or 1.75 LBS/1000 sq. ft.

c) Seed to be coated with MYCO Advantage by Pennington Seed, Inc.

d) Contact: Pennington Seed, Inc., 1236 Eden Street, Columbia, SC 29201
– Jay Sprague – 803-608-5963

2. Schedule No. 2 – Planting Dates September 15 – March 31:

a) Slopemaster Fall/Winter Mix by Pennington Seed, Inc.

- 25% Unhulled Sericea Lespedeza
- 20% Unhulled Sahara Bermuda Grass
- 20% Greystone Tall Fescue
- 10% Pensacola Bahia Grass
- 10% Durana White Clover
- 10% Rye Grain
- 5% Weeping Love Grass

b) Rate 100 LBS/ACRE or 2.25 LBS/1000 sq. ft.

c) Seed to be coated with MYCO Advantage by Pennington Seed, Inc.

d) Contact: Pennington Seed, Inc., 1236 Eden Street, Columbia, SC 29201
– Jay Sprague – 803-608-5963

C. Permanent Seeding Mix – Slopes 4:1 or Less

1. Schedule No. 1 – Planting Dates April 1 – September 15:

a) Hulled Sahara® Bermuda Grass

b) Rate 75 LBS/ACRE or 1.75 LBS/1000 sq. ft.

2. Schedule No. 2 – Planting Dates September 15 – March 31:

- a) Unhulled Sahara Bermuda Grass
- b) Rate 100 LBS/ACRE or 2.25 LBS/1000 sq. ft.

D. Temporary Seeding Mix – All Disturbed Areas

- 1. 1. Schedule No. 1 – Planting Dates April 1 – September 15:
 - a) Brown Top Millet
 - Rate 45 LBS/ACRE or 1 LBS/1000 sq. ft.
- 2. 2. Schedule No. 2 – Planting Dates September 15 – March 31:
 - b) Rye Grain
 - Rate 80 LBS/ACRE or 2 LBS/1000 sq. ft.

E. Do not seed areas in excess of that which can be mulched on same day.

F. Do not sow during rain, when the ground is too dry, or during windy periods.

G. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches (3 mm). Maintain clear of shrubs and trees.

H. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches (100 mm) of soil.

I. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches (100 mm by 100mm).

3.05 SOWING METHODS

A. General:

- 1. Perform seeding during the periods and at the rates specified in the seeding schedules.
- 2. Do not conduct seeding work when ground is frozen or excessively wet.
- 3. Produce satisfactory stand of grass regardless of period of the year the Work is performed.

B. Seeding, slopes less than four horizontal to one vertical:

- 1. Seeding of slopes of 4:1 or less will be done in one of the following two ways:
- 2. Dry Seeding:
 - a) Sow seed not more than 24 hours after application of fertilizer and lime.
 - b) Use mechanical seed drills on accessible areas, rotary hand seeders, power sprayers, etc. may be used on steep slopes or areas not accessible to seed drills.
 - c) Cover seed and lightly compact with culti-packer if seed drill does not.
 - d) Within 24 hours following compaction of seeded areas, uniformly apply straw mulch, as defined in Section 2.01, at a rate of 4000 LBS/ACRE or 90 LBS/1000 sq. ft.

- 3. Hydraulic Seeding:

- a) Apply seed, fertilizer, lime, and wood fiber mulch using hydraulic equipment.
- b) Equipment to have built-in agitation system with capacity to agitate, suspend and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed, lime, and water.
- c) Minimum capacity of slurry tank: 1000 gallons.
- d) Apply 100% wood or 70/30 wood/cellulose blend fiber mulch, defined in Section 2.01, at a rate of 2500 LBS/ACRE or 60 LBS/1000 sq. ft.
- e) Regulate slurry mixture so that amounts and rates of application will result in uniform application of all materials at not less than the specified amounts.
- f) Apply slurry in two directions so as to avoid “shadowing.”
- g) Use color of fiber mulch as guide, spraying the prepared seed bed until a uniform visible coat is obtained.

C. Seeding, slopes greater than four horizontal to one vertical:

- 1. Seeding of slopes of 4:1 or greater will be done in one of the following two ways:
 - a. Dry Seeding:
 - i. Sow seed not more than 24 hours after application of fertilizer and lime.
 - ii. Use mechanical seed drills on accessible areas, rotary hand seeders, power sprayers, etc. may be used on steep slopes or areas not accessible to seed drills.
 - iii. Cover seed and lightly compact with culti-packer if seed drill does not.
 - iv. Within 24 hours following compaction of seeded areas, uniformly lay double netted excelsior blanket, as defined in Section 2.01, over seeded areas. Excelsior blanket installation and staple pattern shall conform strictly to manufacturer’s instructions.
 - b. Hydraulic Seeding:
 - i. Apply seed, fertilizer, lime, and Flexterra HP-FGM mulch using hydraulic equipment.
 - ii. Equipment to have built-in agitation system with capacity to agitate, suspend and homogeneously mix a slurry of the specified amount of fiber, fertilizer, seed, lime, and water.
 - iii. Minimum capacity of slurry tank: 1000 gallons.
 - iv. Apply Flexterra HP FGM, as defined in Section 2.01, at a rate of 3000 LBS/ACRE or 68 LBS/1000 sq. ft.
 - v. Regulate slurry mixture so that amounts and rates of application will result in uniform application of all materials at not less than the specified amounts.
 - vi. Apply slurry in two directions so as to avoid “shadowing.”

- vii. Use color of fiber mulch as guide, spraying the prepared seed bed until a uniform visible coat is obtained.

3.06 MAINTENANCE

- A. Water to prevent grass and soil from drying out.
- B. Roll surface to remove minor depressions or irregularities.
- C. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- D. Areas not showing satisfactory evidence of germination within six weeks of the seeding or which show bare spots shall be immediately reseeded, fertilized and/or mulched.
- E. Protect seeded areas with warning signs during maintenance period.
- F. Maintain all seeded areas in satisfactory condition until final acceptance of Work.
- G. Repair any eroded areas.
- H. Mow as necessary to maintain healthy growth rate until final acceptance of the Work.

3.07 ACCEPTANCE

- A. Permanently seeded areas will be accepted when the stand of grass reaches 70% coverage.
- B. No acceptance will be made of temporary seeded areas.

3.08 MEASUREMENT AND PAYMENT

- A. No separate measurement or direct payment will be made for the work under this Section and all costs for same shall be included in the price bid for the item to which it pertains.

END OF SECTION

SECTION 33 01 30.13

ACCEPTANCE TESTING FOR SANITARY SEWERS

PART 1: GENERAL

1.01 PERFORMANCE REQUIREMENTS

- A. Gravity flow sanitary sewers are required to have straight alignment and uniform grade between manholes.
- B. Flexible pipe, including "semi-rigid" pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling and compacting of line segment but prior to final acceptance using standard mandrel to verify that installed pipe is within specified deflection tolerances.
- C. All new sanitary sewers shall be Mandrel Tested. If the Mandrel Test is failed, the pipe shall also be televised in accordance with the requirements outlined in this Specification.
- D. Maximum allowable leakage for Infiltration or Exfiltration
 - 1. The total exfiltration, as determined by hydrostatic head test, shall not exceed 200 gallons per inch diameter per mile of pipe per 24 hours at minimum test head of 2 feet above crown of pipe at upstream manhole or 2 feet above groundwater elevation, whichever is greater.
 - 2. When pipes are installed more than 2 feet below groundwater level, use infiltration test in lieu of exfiltration test. Total infiltration shall not exceed 200 gallons per inch diameter per mile of pipe per 24 hours. Groundwater elevation must be at least 2 feet above crown of pipe at upstream manhole.
 - 3. Refer to Table 1 at the end of this section, for water test allowable leakage in sewers. Perform leakage testing to verify that leakage criteria are met.
- E. Perform air testing in accordance with requirements of this Specification and SCDHEC or local environmental agency requirements.
 - 1. Refer to Table 2 at the end of this section, for time allowed for pressure loss from 3.5 psig to 2.5 psig;
 - 2. Refer to Table 3 at the end of this section, for minimum testing times for low pressure air test; and
 - 3. Refer to Table 4 at the end of this section, for vacuum test time table.

1.02 SUBMITTALS

- A. Conform to requirements of Section - Submittals.
- B. Test Plan: Test plan shall be submitted to Alliance Consulting Engineers, Inc. for review two weeks prior to testing. Test plan shall include testing procedures,

methods, equipment, and tentative schedule. Contractor shall obtain advance written approval for deviations from the Contract Drawings and Specifications.

- C. Test Reports: Submit test reports for each test on each segment of sanitary sewer.

1.03 GRAVITY SANITARY SEWER QUALITY ASSURANCE

- A. Repair, correct, and retest manholes or sections of pipe which fail to meet specified requirements when tested.
- B. Provide testing reports as directed by Alliance Consulting Engineers, Inc..

1.04 SEQUENCING AND SCHEDULING

- A. Contractor shall perform testing as work progresses. Schedule testing so that no more than 1000 linear feet of installed sewer remains untested at one time.
- B. Coordinate testing schedules with Alliance Consulting Engineers, Inc.. Perform testing under observation of Alliance Consulting Engineers, Inc..

PART 2: PRODUCTS

2.01 DEFLECTION MANDREL

- A. Mandrel Sizing. Rigid mandrel shall have OD equal to 95 percent of inside ID of pipe. ID of pipe, for purpose of determining OD of mandrel, shall be average OD minus two minimum wall thicknesses for OD controlled pipe and average ID for ID controlled pipe, dimensions shall be per appropriate standard. Statistical or other "tolerance packages" shall not be considered in mandrel sizing.
- B. Mandrel Design. Rigid mandrel shall be constructed of metal or rigid plastic material that can withstand 200 psi without being deformed. Mandrel shall have nine or more "runners" or "legs" as long as total number of legs is odd number. Barrel section of mandrel shall have length of at least 75 percent of ID of pipe. Rigid mandrel shall not have adjustable or collapsible legs which would allow reduction in mandrel diameter during testing. Provide and use proving ring for modifying each size mandrel.
- C. Proving Ring. Furnish "proving ring" with each mandrel. Fabricate ring of 1/2-inch-thick, 3-inch-wide bar steel to diameter 0.02 inches larger than approved mandrel diameter.
- D. Mandrel Dimensions (5 percent allowance). Average ID and minimum mandrel diameter are specified in Table 5, Pipe vs. Mandrel Diameter, at end of this Section. Mandrels for higher strength, thicker wall pipe or other pipe not listed in table may be used when approved by Alliance Consulting Engineers, Inc..

2.02 EXFILTRATION TEST

- A. Test Equipment:
 - 1. Pipe plugs.
 - 2. Pipe risers where manhole cone is less than 2 feet above highest point in pipe or service lead.

2.03 INFILTRATION TEST

- A. Test Equipment:
 - 1. Calibrated 90 degree V-notch weir.
 - 2. Pipe plugs.

2.04 LOW PRESSURE AIR TEST

- A. Minimum Requirement for Equipment:
 - 1. Control panel
 - 2. Low-pressure air supply connected to control panel.
 - 3. Pneumatic plugs: Acceptable size for diameter of pipe to be tested; capable of withstanding internal test pressure without leaking or requiring external bracing.
 - 4. Air hoses from control panel to:
 - 1. Air supply.
 - 2. Pneumatic plugs.
 - 3. Sealed line for pressuring.
 - 4. Sealed line for monitoring internal pressure.
- B. Testing Pneumatic Plugs: Place pneumatic plug in each end of length of pipe on ground. Pressurize plugs to 25 psig; then pressurize sealed pipe to 5 psig. Plugs are acceptable when they remain in place against test pressure without external aids.

2.05 GROUND WATER DETERMINATION

- A. Equipment: Pipe probe or small diameter casing for ground water elevation determination.

2.06 SMOKE TESTING

- A. Equipment:
 - 1. Pneumatic plugs.
 - 2. Smoke generator.
 - 3. Blowers producing 2500 scfm minimum.

PART 3: EXECUTION

3.01 PREPARATION

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure meters, pipe probe, calibrated weirs, or any other device necessary for proper testing and inspection.

- B. Determine selection of test methods and pressures for gravity sanitary sewers based on ground water elevation. Determine ground water elevation using equipment and procedures conforming to Control of Ground Water and Surface Water.

3.02 MANDREL TESTING FOR GRAVITY SANITARY SEWERS

- A. Perform deflection testing on flexible and semi-rigid pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D3034. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of line segment.
- B. Pull approved mandrel by hand through sewer sections. Replace any section of sewer not passing mandrel. Mandrel testing is not required for stubs.
- C. Retest repaired or replaced sewer sections.

3.03 LEAKAGE TESTING FOR GRAVITY SANITARY SEWERS

- A. Test Options:
 - 1. Test gravity sanitary sewer pipes for leakage by either exfiltration or infiltration methods, as appropriate, or with low pressure air testing.
 - 2. Test new or rehabilitated sanitary sewer manholes with water or low pressure air. Manholes tested with low pressure air shall undergo physical inspection prior to testing.
 - 3. Perform leakage testing after backfilling of line segment, and prior to tie-in of service connections.
 - 4. If no installed piezometer is within 500 feet of sewer segment, provide temporary piezometer for this purpose.
- B. Compensating for Ground Water Pressure:
 - 1. Where ground water exists, install pipe nipple at same time sewer line is placed. Use 1/2-inch capped pipe nipple approximately 10-inches long. Make installation through manhole wall on top of sewer line where line enters manhole.
 - 2. Immediately before performing line acceptance test, remove cap, clear pipe nipple with air pressure, and connect clear plastic tube to nipple. Support tube vertically and allow water to rise in tube. After water stops rising, measure height in feet of water over invert of pipe. Divide this height by 2.3 ft/psi to determine ground water pressure to be used in line testing.
- C. Exfiltration test:
 - 1. Determine ground water elevation.
 - 2. Plug sewer in downstream manhole.
 - 3. Plug incoming pipes in upstream manhole.
 - 4. Install riser pipe in outgoing pipe of upstream manhole when highest point in service lead (house service) is less than 2 feet below bottom of manhole cone.

5. Fill sewer pipe and manhole or pipe riser, when used, with water to point 2-1/2 feet above highest point in sewer pipe, house lead, or ground water table, whichever is highest.
 6. Allow water to stabilize for one to two hours. Take water level reading to determine drop of water surface, in inches, over one-hour period, and calculate water loss (1 inch of water in 4 feet diameter manhole equals 8.22 gallons) or measure quantity of water required to keep water at same level. Loss shall not exceed that calculated from allowable leakage according to Table 1 at the end of this Section.
- D. Infiltration test: Ground water elevation must be not less than 2 feet above highest point of sewer pipe or service lead (house service).
1. Determine ground water elevation.
 2. Plug incoming pipes in upstream manhole.
 3. Insert calibrated 90 degree V-notch weir in pipe on downstream manhole.
 4. Allow water to rise and flow over weir until it stabilizes.
 5. Take five readings of accumulated volume over period of 2 hours and use average for infiltration. Average must not exceed that calculated for 2 hours from allowable leakage according to Table 1 at the end of this Section.
- E. Low Air Pressure Test: When using this test conform to ASTM C 828, ASTM C 924, or ASTM F1417, as applicable, with holding time not less than that listed in Table 2 below.
1. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.
 2. Lines 36-inch average inside diameter and larger shall be tested at each joint. Minimum time allowable for pressure to drop from 3.5 pounds per square inch gauge to 2.5 pounds per square inch during joint test shall be 10 seconds, regardless of pipe size.
 3. For pipe sections less than 36-inch average inside diameter:
 - a. Determine ground water level.
 - b. Plug both ends of pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug concrete pipe.
 - c. After manhole-to-manhole section of sanitary sewer main has been sliplined and prior to any service lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
 - d. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 2 at the end of this Section.
 - e. To determine air loss, measure time interval for pressure to drop to 2.5 psig. Time must exceed that listed in Table 2 at the end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.
- F. Retest: Repair and retest any section of pipe which fails to meet requirements.

3.04 TEST CRITERIA TABLES

- A. Exfiltration and Infiltration Water Tests: Refer to Table 1 at the end of this Section, for water test allowable leakage.
- B. Low Pressure Air Test:
 - 1. Time in Table 2 at the end of this Section, allowed for pressure loss from 3.5 psig to 2.5 psig, is based on the following data and equation.

		$T = 0.0850(D)(K)/(Q)$
where:	T =	Time for pressure to drop 1.0 pounds per square inch gauge in seconds
	K =	0.000419 DL, but not less than 1.0
	D =	Average inside diameter in inches
	L =	Length of line of same pipe size in feet
	Q =	Rate of loss, 0.0015 ft ³ /min./sq.ft. internal surface

- 2. Since K value of less than 1.0 shall not be used, there are minimum testing times for each pipe diameter as given in Table 3 at the end of this Section for minimum testing times for low pressure air test.

Notes:

- 1. When two sizes of pipe are involved, compute time by ratio of lengths involved.
- 2. Lines with 27-inch average inside diameter and larger may be air tested at each joint.
- 3. Lines with average inside diameter greater than 36 inches must be air tested for leakage at each joint.
- 4. If joint test is used, perform visual inspection of joint immediately after testing.
- 5. For joint test, pipe is to be pressurized to 3.5 psi greater than pressure exerted by groundwater above pipe. Once pressure has stabilized, time allowable for pressure to drop from 3.5 pounds psi gauge to 2.5 psi gauge shall be a minimum of 10 seconds.

3.05 LEAKAGE TESTING FOR MANHOLES

- A. After completion of manhole construction, wall sealing, or rehabilitation, but prior to backfilling, test manholes for water tightness using hydrostatic or vacuum testing procedures.
- B. Plug influent and effluent lines, including service lines, with suitably-sized pneumatic or mechanical plugs. Ensure plugs are properly rated for pressures required for test; follow manufacturer's safety and installation recommendations. Place plugs minimum of 6 inches outside of manhole walls. Brace inverts to prevent lines from being dislodged when lines entering manhole have not been backfilled.

- C. Vacuum testing:
1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to recommended maximum inflation pressure; do not over-inflate.
 2. Evacuate manhole with vacuum pump to 10 inches mercury (Hg), disconnect pump, and monitor vacuum for time period specified in Table 4, Vacuum Test Time Table.
 3. If drop in vacuum exceeds 1 inch Hg over specified time period tabulated in Table 4, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.
- D. Perform hydrostatic exfiltration testing as follows:
1. Seal wastewater lines coming into manhole with internal pipe plug. Then fill manhole with water and maintain it full for at least one hour.
 2. The maximum leakage for hydrostatic testing shall be 0.025 gallons per foot diameter per foot of manhole depth per hour.
 3. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

3.06 SMOKE TEST PROCEDURE FOR POINT REPAIRS

- A. Application: Perform smoke test to:
1. Locate points of line failure for point repair.
 2. Determine when point repairs are properly made.
 3. Determine when service connections have been reconnected to rehabilitated sewer.
 4. Check integrity of connections to newly replaced service taps to liners and to existing private service connections.
- B. Limitations: Do not backfill service taps until completion of this test. Test only those taps in single manhole section at one time. Keep number of open excavations to minimum.
- C. Preparation: Prior to smoke testing, give written notices to area residents no fewer than 2 days, nor more than 7 days, prior to proposed testing. Also give notice to local police and fire departments 24 hours prior to actual smoke testing.
- D. Isolate Section: Isolate manhole section to be tested from adjacent manhole sections to keep smoke localized. Temporarily seal annular space at manhole for sliplined sections.
- E. Smoke Introduction:
1. Operate equipment according to manufacturer's recommendation and as approved by Alliance Consulting Engineers, Inc.

2. Conduct test by forcing smoke from smoke generators through sanitary sewer main and service connections. Operate smoke generators for minimum of 5 minutes.
 3. Introduce smoke into upstream and downstream manhole as appropriate. Monitor tap/connection for smoke leaks. Note sources of leaks.
- F. Repair and Retest: Repair and replace taps or connections noted as leaking and then retest. Taps and connections may be left exposed in only one manhole section at time. When repair or replacement, testing or retesting, and backfilling of excavation is not completed within one work day, properly barricade and cover each excavation as approved by Alliance Consulting Engineers, Inc..
- G. Service Connections: On houses where smoke does not issue from plumbing vent stacks to confirm reconnection of sewer service to newly installed liner pipe, perform dye test to confirm reconnection. Introduce dye into service line through plumbing fixture inside structure or sewer cleanout immediately outside structure and flush with water. Observe flow at service reconnection or downstream manhole. Detection of dye confirms reconnection.

TABLE 1
WATER TEST ALLOWABLE LEAKAGE

DIAMETER OF RISER OR STACK IN INCHES	VOLUME PER INCH OF DEPTH		ALLOWANCE LEAKAGE*	
	INCH	GALLONS	PIPE SIZE IN INCHES	GALLONS/MINUTE PER 100FT.
1	0.7854	.0034	6	0.0039
2	3.1416	.0136	8	0.0053
2.5	4.9087	.0212	13	0.0066
3	7.0686	.0306	12	0.0079
4	12.5664	.0306	15	0.0099
5	19.6350	.0544	18	0.0118
6	28.2743	.1224	21	0.0138
8	50.2655	.2176	24	0.0158
			27	0.0177
			30	0.0197
			36	0.0237
			42	0.0276
For other diameters, multiply square of diameters by value of 1" diameter			Equivalent to 50 gallons per inch of inside diameter per mile per 24 hours	

* Allowable leakage rate shall be reduced to 10 gallons per inch of inside diameter per mile per 24 hours, when sewer is identified as located within 25-year flood plain

TABLE 2
ACCEPTANCE TESTING FOR SANITARY SEWERS

TIME ALLOWED FOR PRESSURE LOSS FROM 3.5 PSIG TO 2.5 PSIG														
Pipe Diam. (in)	Min. Time (min /sec)	Length for min. time (ft)	Time for Longer Length (sec)	Specification Time for Length (L) shown (min:sec)										
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft	550 ft	600 ft
6	5:40	398	0.854	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07	7:50	8:33
8	7:33	298	1.519	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40	13:56	15:12
10	9:27	239	2.374	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47	21:46	23:45
12	11:20	199	3.419	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30	31:20	34:11
15	14:10	159	5.342	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31	48:58	53:25
18	17:00	133	7.692	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06	70:31	76:56
21	19:50	114	10.47	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15	95:59	104:42
24	22:40	99	13.67	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58	125:22	136:46
27	25:30	88	17.30	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14	158:40	173:05
30	28:20	80	21.36	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05	195:53	213:41
33	31:10	72	25.85	43:06	64:38	86:11	107:44	129:17	150:50	172:23	193:55	215:28	237:01	258:34

TABLE 3
MINIMUM TESTING TIMES FOR SANITARY SEWERS - LOW PRESSURE AIR TEST

PIPE DIAMETER (inches)	MINIMUM TIME (seconds)	LENGTH FOR MINIMUM TIME (feet)	TIME FOR LONGER LENGTH (seconds)
6	340	398	0.855 (L)
8	454	298	1.520 (L)
10	567	239	2.374 (L)
12	680	199	3.419 (L)
15	850	159	5.342 (L)
18	1020	133	7.693 (L)
21	1190	114	10.471 (L)
24	1360	100	13.676(L)
27	1530	88	17.309 (L)
30	1700	80	21.369 (L)
33	1870	72	25.856 (L)

TABLE 4
MINIMUM TESTING TIMES FOR SANITARY MANHOLES - LOW PRESSURE AIR TEST

DEPTH IN FEET	TIME IN SECONDS BY PIPE DIAMETER		
	48"	60"	72"
4	10	13	16
8	20	26	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
*	5.0	6.5	8.0

***Add T times for each additional 2-foot depth.
(The values listed above have been extrapolated from ASTM C924-85)**

TABLE 5
PIPE VS. MANDREL DIAMETER

<u>Material and Wall Construction</u>	<u>Nominal Size (Inches)</u>	<u>Average I.D (Inches)</u>	<u>Minimum Mandrel Diameter (Inches)</u>
PVC-Solid (SDR 26)6	6	5.764	5.476
	8	7.715	7.329
	10	9.646	9.162
PVC-Solid (SDR 35)12	12	11.737	11.150
	15	14.374	13.655
	18	17.629	16.748
	21	20.783	19.744
	24	23.381	22.120
	27	26.351	25.033
PVC-Truss	8	7.750	7.363
	10	9.750	9.263
	12	11.790	11.201
	15	14.770	14.032
PVC-Profile (ASTM F794)	12	11.740	11.153
	15	14.370	13.652
	18	17.650	16.768
	21	20.750	19.713
	24	23.500	22.325
	27	26.500	25.175
	30	29.500	28.025
	36	35.500	33.725
	42	41.500	39.425
HDPE-Profile	48	47.500	45.125
	18	18.000	17.100
	21	21.000	19.950
	24	24.000	22.800
	27	27.000	25.650
	30	30.000	28.500
	36	36.000	34.200
	42	42.000	39.900
	48	48.000	45.600
	54	54.000	51.300
Fiberglass (Class SN 46)	60	60.000	57.000
	12	12.85	11.822
	18	18.66	17.727
	20	20.68	19.646
	24	24.72	23.484
	30	30.68	29.146
	36	36.74	34.903
	42	42.70	40.565
	48	48.76	46.322
54	54.82	52.079	
60	60.38	57.361	

END OF SECTION

SECTION 33 01 30.51
PUMPING AND BYPASSING

PART 1: GENERAL

1.01 SCOPE

- A. Subcontractor is required to furnish all materials, labor, equipment, power, maintenance, etc. to implement a temporary pumping system for the purpose of diverting the existing flow around the work area for the duration of the project.
- B. The design, installation, and operation of the temporary bypass pumping system shall be the Subcontractor's responsibility. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- C. When directed by Alliance Consulting Engineers, Inc., the Subcontractor shall put the affected sanitary sewer line back into service at the end of each working day.
- D. All unmanned bypass pumping operations shall be fitted with an auto-dialer feature to monitor the operation of the pump and notify the Subcontractor in the event of a pump failure or overflow situation.

1.02 SUBMITTALS

- A. Conform to the requirements of Section 01 30 00 – Administrative Requirements
- B. The following additional items shall be submitted for approval in accordance with Section 01 30 00:
 - 1. Detailed Bypass Pumping Plan – Subcontractor shall submit to Alliance Consulting Engineers, Inc. detailed design plans and descriptions outlining all provisions and precautions to be taken by the Subcontractor regarding the handling of existing wastewater flows. The pumping system must be designed to provide adequate capacity for peak flows.

PART 2: PRODUCTS

2.01 EQUIPMENT

- A. All pumps used shall be fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system. The pumps may be electric or diesel powered. All pumps used must be constructed to allow dry running for long periods of time to account for the cyclical nature of effluent flows.
- B. Subcontractor shall provide the necessary stop/start controls for each pump.
- C. Subcontractor shall include one stand-by pump for each size to be maintained on site. Back-up pumps shall be on-line, isolated from the primary system by a valve.

- D. Discharge and suction piping sizing shall be determined according to flow calculations and system operating calculations.
- E. High Density Polyethylene (HDPE) – Piping shall be homogenous throughout, free of visible cracks, discoloration, pitting, varying wall thickness, holes, foreign material, or other deleterious faults. Pipe shall be assembled and joined on site using couplings, flanges or butt-fusion method to provide leak proof joint. Thread or solvent joints are not acceptable. Pipe fusion shall be carried out by personnel certified as fusion technicians by manufacturer of HDPE pipe and/or fusing equipment. Butt-fusion joints shall be true alignment and uniform roll- back beads resulting from use of proper temperature and pressure.
- F. Flexible Hoses and Associated Couplings and Connectors – Flexible hose and couplings shall be abrasive resistant and suitable for the intended services (i.e., fire hoses are not permitted). They shall be rated for external and internal loads anticipated including test pressure. External load design shall incorporate anticipated traffic loadings, including traffic impact loading where applicable. When subjected to traffic loading, the system shall be composed of traffic ramps and covers maintaining the H-20 loading requirement while in use or as directed by Alliance Consulting Engineers, Inc.
- G. All rigid or hard piping shall be constructed with positive restrained joints.
- H. Under no circumstance will aluminum irrigation type piping or glued PVC pipe be allowed.

2.02 DESIGN REQUIREMENTS

- A. Bypass pumping systems shall have sufficient capacity to pump at the capacity of the pump station with sufficient head to pump to the downstream point of discharge. The Subcontractor shall provide all pipeline plugs, pumps of adequate size to handle peak flow, and temporary discharge piping to ensure that the total flow of the main can be safely diverted around the section to be repaired. Bypass pumping system may be required to be operated 24 hours per day. Subcontractor shall provide all necessary monitoring device to notify the Subcontractor of any pump failure.
- B. The Subcontractor shall have adequate standby equipment available and ready for immediate operation and use in the event of an emergency or breakdown. One standby pump for each pump size utilized shall be installed at the mainline flow bypassing locations, ready for use in the event of primary pump failure.
- C. Bypass pumping system shall be capable of bypassing flow around the work area and of releasing any amount of flow up to the full available flow into the work area as necessary for satisfactory performance of the work.

- D. The Subcontractor shall make all arrangements for bypass pumping during the time when the main is shut down for any reason. The system must overcome any existing force main pressure on discharge.

1.03 PERFORMANCE REQUIREMENTS

- A. It is essential to the operation of the existing sewerage system that there be no interruption in the flow of sewage throughout the duration of the project. To this end, the Subcontractor shall provide, maintain, and operate all temporary facilities such as dams, plugs, pumping equipment (both primary and back-up units as required), conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with work, carry it past the work area, and return it to the existing sewer downstream of the work area.
- B. The design, installation, and operation of the temporary pumping system shall be the Subcontractor's responsibility. The bypass system shall meet the requirements of all local, state, and federal codes and regulations.
- C. Subcontractor shall provide all necessary means to safely convey the sewage past the work area. The Subcontractor will not be permitted to stop or impede the main flows under any circumstances.
- D. The Subcontractor shall maintain sewer flow around the work area in a manner that will not cause surcharging of sewers, damage to sewers, and that will protect public and private property from damage and flooding.
- E. The Subcontractor shall protect water resources, wetlands, and other natural resources.

PART 3: EXECUTION

3.01 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Test – Subcontractor shall perform leakage and pressure tests of the bypass pump discharge piping using clean water prior to actual operation. The Engineer will be given 24 hour notice prior to testing.
- B. Inspection – Subcontractor shall inspect bypass pumping system every two hours to ensure that the system is working properly.
- C. Maintenance Service – Subcontractor shall insure that the temporary pumping system is properly maintained and a responsible operator shall be on hand at all times when pump(s) is operating.
- D. Extra Materials:
 - 1. Spare parts for pumps and piping shall be kept on site as required.

2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.02 PREPARATION

A. Precautions

1. Subcontractor is responsible for locating any existing utilities in the area the Subcontractor selects to locate the bypass pipelines. The Subcontractor shall locate his bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from Alliance Consulting Engineers, Inc. All costs associated with relocating utilities and obtaining approvals shall be the responsibility of the Subcontractor.
2. During all bypass pumping operation, the Subcontractor shall protect the pumping station and main and all local sewer lines from damage inflicted by any equipment. The Subcontractor shall be responsible for any physical damage to the pump station and main and all local sewer lines caused by human or mechanical failure.

3.03 INSTALLATION AND REMOVAL

- A. Subcontractor shall remove manhole sections or make connections to the existing sewer and construct temporary bypass pumping structures only at the access location indicated on the Drawings and as may be required to provide suction conduit.
- B. Plugging or blocking of sewage flows shall incorporate primary and secondary plugging device. When plugging or blocking is no longer needed for performance and acceptance of work, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge, to prevent surcharging, or causing other major disturbances downstream.
- C. When working inside a manhole or force main, the Subcontractor shall exercise caution and comply with OSHA requirements when working in the presence of sewer gases, combustible oxygen-deficient atmospheres, and confined spaces.
- D. The installation of bypass pipelines is prohibited in all saltmarsh/wetland areas. The pipeline must be located off streets sidewalks, and on shoulders of the roads. When the bypass pipeline crosses local streets and private driveways, where roadway ramps cannot be used, the Subcontractor must place the bypass line in trenches and cover with temporary pavement.
- E. Upon completion of the bypass pumping operations, and after the receipt of written permission from the Engineer, the Subcontractor shall remove all piping, restore all property to pre-construction condition, and restore all pavement and roadways. The Subcontractor is responsible for obtaining any approvals for placement of temporary pipelines from local agencies.

END OF SECTION

SECTION 33 05 23.16
JACK AND BORE CROSSINGS

PART 1 GENERAL

1.01 SCOPE

The work covered in this section consists of furnishing all materials, labor, equipment, and other miscellaneous appurtenances necessary for the proper completion of pipeline crossings under roads, railroads, or creeks.

1.02 SUBMITTALS

Complete product data and engineering data, including shop drawings, shall be submitted to the Engineer in accordance with the requirements of Section 01 60 00 of the Contract Documents.

PART 2 PRODUCTS

2.01 MATERIALS:

Shall conform to requirements of South Carolina Department of Transportation (SCDOT) for crossings of State Highways or to the applicable railroad owner for railroad crossings if more stringent than the requirements specified within this section.

A. Carrier Pipe:

Shall be ductile iron pipe, Pressure Class 350, of the size shown on the drawings.

B. Casing Pipe:

Shall be steel pipe conforming to ASTM A-139, Grade B, electric fusion welded pipe having a minimum yield strength of 35,000 psi. The exterior of the casing pipe shall be coated with Kopper "Bitumastic Super Service Black", coal tar epoxy paint or equal. The size and wall thickness of the casing pipe for the indicated carrier pipe shall be as shown below:

Carrier Pipe I.D.-(Nom.) Inches	Casing Pipe I.D.-(Nom.) Inches	Casing Pipe Wall Thickness Inches
4	12	0.200
6	14	0.250
8	16	0.250
10	18	0.250
12	20	0.250
16	24	0.375
18	30	0.375
20	30	0.375
24	36	0.375
30	42	0.375

C. Casing Spacers:

Shall be Model CCS stainless steel casing spacers as manufactured by Cascade Waterworks Mfg. Co. of Yorkville, IL or approved equal.

PART 3 EXECUTION

3.01 GENERAL

Construction method shall conform to requirements of SCDOT for crossings of State Highways or to the applicable railroad owner for railroad crossings if more stringent than the requirements specified within this section.

3.02 JACKING PROCEDURES

- A. The diameter of the excavation shall conform to the outside diameter and circumference of the pipe as closely as practicable. Any voids which develop during the installation operation and which are determined by the Engineer to be detrimental to the roadbed shall be pressure grouted with an approved mix.
- B. The distance that the excavation extends beyond the end of the pipe will depend upon the character of the excavated material, but shall not exceed 2 feet in any case.
- C. The pipe shall be jacked from the low or downstream end. Variation in the final position of the pipe from the line and grade established by the Engineer will be permitted if approved by the Engineer, providing that the final grade of flow line shall be in the direction indicated on the plans. Wood blocking to adjust the grade of the carrier pipe may be required.
- D. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment.
- E. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his expense.
- F. Pressure pipeline carriers shall be adequately blocked with pressure treated wood to prevent movement in the casing pipe.
- G. Casing pipe shall be welded by a certified welder in accordance with AWS and AISC Standards. Welds shall be continuous, watertight and develop a greater strength than the pipe. Welds shall be chipped and wire brushed immediately before applying coal tar coating.
- H. The ends of the casing pipe shall be sealed with brick and mortar to affect a watertight seal.
- I. Bores under Paved Driveways and Surface Obstructions: When driveways and other obstructions are encountered along the proposed waterline, the Contractor shall avoid damaging the area by boring under the driveways or other surface obstruction as called for on the plans.
- J. The type of bore shall be determined by its length and the soil conditions of the bore location. Bore diameter shall not exceed four (4) inches larger than that of the carrier pipe. When bore lengths exceed 25 L.F., a casing pipe shall be carried along with the bore. After the piping has been inserted through the casing, the casing shall be removed from the bore hole. When bore lengths are less than 25 L.F., the casing pipe will not be required to be used unless soil conditions will not permit an uncased bore.

JACK AND BORE CROSSINGS

- K. Casing spacers shall be placed not more than three (3) feet from each end of each joint of piping. Spacers shall be installed in strict accordance with manufacturer's recommendations.

3.03 BORING PROCEDURES

- A. Holes are to be bored mechanically.
- B. The boring may be done using a pilot hole approximately 2" in diameter which shall be bored the entire length of the installation and shall be checked for line and grade on the opposite end of the bore. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.
- C. The use of water or other fluids in connection with boring will be permitted only to the extent necessary to lubricate cuttings. Jetting will not be permitted.

3.04 MEASUREMENT AND PAYMENT

- A. Measurement for Jack and Bore Crossings shall be based on the distance in linear feet as shown on the plans and/or as shown in the bid form. Payment shall be made to the nearest linear foot.

END OF SECTION

SECTION 33 05 27

TRACER WIRE

PART 1: GENERAL

1.01 SCOPE

- A. Install electrically continuous tracer wire with access points as described herein to be used for locating pipe with an electronic pipe locator after installation. Tracer wire shall be installed on all water mains and services, all wastewater lines and sewer mains and services and all wastewater force mains.

1.02 SUBMITTALS

- A. Submit shop drawings and manufacturer's literature to Alliance Consulting Engineers, Inc. for approval in accordance with Specification Section 01 30 00 – Administrative Requirements.

PART 2: PRODUCTS

2.01 TRACER WIRE MATERIAL

- A. Tracer wire shall be twelve (12) gauge minimum solid copper with thermoplastic insulation recommended for direct burial. Wire connectors shall be 3M DBR, or approved equal, and shall be watertight to provide electrical continuity.
- B. Tracer wire color shall be blue for all water construction and green for all wastewater construction.

2.02 TRACER WIRE ACCESS BOXES

For locations where valve boxes are not present, the tracer wire access point shall be composed of one SnakePit Tracer Wire Access Box, or approved equal, installed at each proposed access point.

2.03 TESTING REQUIREMENTS

- A. Contractor shall perform a continuity test on all tracer wire in the presence of Alliance Consulting Engineers, Inc. or Alliance Consulting Engineers, Inc.'s representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire at their own expense.

PART 3: EXECUTION

3.01 INSTALLATION - GENERAL REQUIREMENTS

- A. Tracer wire shall be installed on all water and sewer mains and services. The wire shall be installed in such a manner as to be able to properly tracer all mains without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.
- B. Tracer wire shall be installed in the same trench and inside bored holes and casing with pipe during pipe installation. It shall be laid in the trench above the pipe and 12-inches below grade to ensure that the wire is not damaged during future repair operations. The tracer wire shall be securely bonded together at all wire joints with an approved watertight connector to provide electrical continuity, and it shall be accessible at all tracer wire access points.
- C. Tracer wire access points shall in general be no more than five-hundred feet and at every proposed concrete valve box collar (or manhole where required). Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar. Tracer wire access points shall be within public right-of-way or public utility easements.
- D. At each valve location, (including fire hydrant isolation valves), a loop of wire is to be brought up the outside of the valve box and looped inside the box through a hole drilled 2-inch below the bottom of the lid.
- E. At the point of connection between cast or ductile iron mains with any non-iron main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of 2 inches thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.
- F. Tracer wire shall be laid flat and securely affixed to the pipe at 10 foot intervals. The wire shall be protected from damage during the execution of the Work. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At service saddles, the tracer wire shall not be allowed to be placed between the saddle and the main.
- G. Except for approved spliced-in connections, tracer wire shall be continuous and without splices from each tracer wire access point. Where any approved spliced-in connections occur, 3M DBR water tight connectors, or approved equal, shall be used to provide electrical continuity.
- H. At all main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connections. The end

of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevation as the water main.

- I. For directional drilling, auguring or boring installations, four #12 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or cad welded to the existing iron pipe at both ends.
- J. Spliced connections between the main line tracer wire and branch connection tracer wire shall only be allowed at water main tees, crosses or at iron or copper water services where a portion of the branch connection water main or water service is replaced with non-iron or non-copper material. The branch connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection.
- K. At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced as outlined above.

END OF SECTION

SECTION 33 10 00

WATER DISTRIBUTION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, fittings, valves, hydrants, and accessories for ground buried water distribution piping systems.
- B. Water distribution systems shall be installed in conformance with the construction plans, details, and these specifications.
- C. RELATED ITEMS
 - 1. The following specification sections are related to the work under this section.
 - a. Section 31 23 16 - Excavation
 - b. Section 31 23 23.13 - Backfill and Compaction
 - c. Section 31 23 16.13 – Trenching for Site Utilities
 - d. Section 31 50 00 – Excavation Support and Protection

1.02 REFERENCE STANDARDS

- A. The work under this section shall conform to the most current edition of the following applicable reference standards.
 - 1. ANSI/NSI 60 - Drinking Water Treatment Chemical Health Effects
 - 2. ANSI/NSI 61 - Drinking Water System Components Health Effects
 - 3. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 5. ASTM A285 - Standard Specification for Pressure Vessel Plates, Carbon Steel, Low and Intermediate-Tensile Strength
 - 6. ASTM A536 - Standard Specification for Ductile Iron Castings
 - 7. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
 - 8. ASTM B88 - Seamless Copper Water Tube
 - 9. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
 - 10. ASTM D638 - Tensile Strength Testing for Butt-Fusion PVC Weld
 - 11. ASTM D1599 - Burst Testing of Fused PVC Joints
 - 12. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials or Wire and Cable
 - 13. ASTM D2241 - Standard Specification for PVC Pressure-Rated Pipe

14. ASTM D2737 - Standard Specification for PE Plastic Tubing
15. ASTM D2774 - Standard Practice for Installation of Thermoplastic Pressure Piping
16. ASTM D3035 - Standard Specification for PE Plastic Pipe
17. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
18. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
19. ASTM F1483 - Standard Specification for PVC Pressure Pipe
20. ASTM F1789 - Standard Terminology for F16 Mechanical Fasteners
21. ASTM F2164 - Field Water Testing of PE Pressure Pipe
22. ASTM F2774 - Underground Installation of Thermoplastic Pressure Piping
23. ASTM F2786 - Field Air Testing of PE Plastic Pipe
24. AWWA C104 - Cement-Mortar Lining for Ductile Iron Pipe and Fittings
25. AWWA C110 - Standard for Ductile Iron and Gray-Iron Fittings
26. AWWA C111 - Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
27. AWWA C115 - Standard for Flanged Ductile Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges
28. AWWA C116 - Fusion-Bonded Epoxy Coatings for Ductile Iron Fittings
29. AWWA C151 - Ductile Iron Pipe, Centrifugally Cast
30. AWWA C153 - Ductile Iron Compact Fittings for Water Service
31. AWWA C213 - Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
32. AWWA C502 - Dry-Barrel Fire Hydrants
33. AWWA C504 - Rubber Seated Butterfly Valves
34. AWWA C508 - Swing-Check Valves for Waterworks Service
35. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
36. AWWA C511 - Standard for Reduced Pressure Principle Backflow Prevention Assembly
37. AWWA C512 - Air-Release, Air/Vacuum, and Combination Air Valves for Water Service
38. AWWA C550 - Protective Interior Coatings for Valves and Hydrants
39. AWWA C600 - Installation of Ductile Iron Water Mains and Their Appurtenances
40. AWWA C605 - Installation of PVC Pressure Pipe and Fittings
41. AWWA C651 - Disinfecting Water Mains
42. AWWA C655 - Field De-chlorination
43. AWWA C800 - Underground Service Line Valves and Fittings
44. AWWA C900 - PVC Pipe and Fittings, 4 In. Through 12 In.
45. AWWA C901 - PE Pipe and Tubing, 1/2 In. Through 3 In.
46. AWWA C905 - PVC Pipe and Fittings, 14 In. Through 24 In.

47. AWWA C906 - PE Pipe and Fittings, 4 In. Through 24 In.
48. AWWA C909 - Molecularly Oriented PVC Pipe, 4 In. Though 24 In.
49. NSF 60/61 - National Sanitation Foundation
50. UL 246 - Hydrants for Fire Protection Services

1.03 SUBMITTALS

Submit manufacturer's product data, installation instructions and certification for all materials to be furnished in accordance with Specification Section 01 30 00 – Administrative Requirements. Submit classification and gradation test results for embedment and pipe backfill material.

1.04 QUALITY ASSURANCE

- A. Perform work in accordance with the rules and requirements of the South Carolina Department of Health and Environmental Control (SCDHEC) and South Carolina Department of Transportation (SCDOT).
- B. All materials shall be of new manufacture and be suitable for potable water as certified under NSF 61 standards.
- C. The Contractor shall furnish evidence that the installed water distribution system has been flushed, pressure tested, and disinfected in accordance with AWWA standards. This will include providing a current bacteriological test report at the time of close-out for the project.
- D. PRODUCT HANDLING
 1. Comply with Section 01 60 00 – Product Requirements.
 2. Pipes, fittings, valves, hydrants, cross connection control devices, and accessories shall be handled, unloaded, and stored by the Contractor in accordance with manufacturer requirements.
 3. Plastic pipes, fittings, and gaskets shall be covered during on-site storage to minimize exposure to direct sunlight.
 4. Materials known to have experienced a potential damaging impact blow shall not be installed by the Contractor and shall be promptly removed from the project site.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Furnish and install water distribution pipes, fittings, valves, hydrants, cross connection control devices, and accessories as noted on the construction plans following the specifications included under this section of the work.
- B. All products and materials that contact potable water must meet the requirements of ANSI/NSF Standard 60 or 61 and applicable AWWA specifications.

- C. Materials that support microbiological growth shall not be used for any gaskets, O-rings, lubricants, or other products used in pipe joints or other materials that will contact potable water.
- D. All fasteners shall utilize Type 316 stainless steel conforming to ASTM A593. Anti-seize compound shall be applied to all fastener threads.
- E. All plugs and caps shall be ductile iron conforming to AWWA C110. Plugs and caps shall be epoxy coated conforming to AWWA C116. Restrained joints shall be provided within 20 feet of all plugs and caps and for all yard piping. A two (2) inch tap and stainless steel plug shall be provided on plugs and caps used as flushing connections.
- F. **All material used shall meet the requirements of the "Reduction of Lead in Drinking Water Act of 2011" amendments to the Safe Drinking Water Act (SDWA) Section 1417 which went into effect on January 4, 2014.**

2.02 DUCTILE IRON PIPE AND FITTINGS

- A. Ductile iron pipe shall be push-on joint conforming to AWWA C151 and NSF 61 standards. The pipe wall thickness shall be in accordance with AWWA C150 for a working pressure of 150 psi, the depth of cover shown on the plans, and a type 3 pipe bedding condition. The pipe thickness shall not be less than pressure class 150. The pipe shall be supplied with a standard thickness cement mortar lining conforming to AWWA C104. All exposed metal shall be epoxy coated in accordance with AWWA C116. Pipe joint gaskets shall conform to AWWA C111 with restraining gaskets used as necessary to meet thrust restraint requirements.
- B. Ductile iron fittings for ground buried conditions shall be mechanical joint with restraining glands conforming to AWWA C153. Ductile iron fittings within structures shall be flanged with full face gaskets conforming to AWWA C115. Fittings shall be suitable for a working pressure of 150 psi and not less than Class 52. The fittings shall be supplied with a standard thickness cement mortar lining conforming to AWWA C104. All exposed metal shall be epoxy coated in accordance with AWWA C116. Pipe joint gaskets shall conform to AWWA C111.
- C. All fitting joints shall be restrained with retainer glands equal to Series 1100 Megalugs as manufactured by EBBA Iron Inc., Star Pipe Products, Inc. Stargrip Series 3000, or an approved equal. The restraint system shall be designed to withstand a working pressure of 350 psi plus a surge pressure equal to the working pressure. The body shall be fabricated from steel conforming to ASTM A285 Grade C and epoxy coated conforming to AWWA C213. The restraint shall be for the full circumference of the pipe utilizing machined serrations making contact with the pipe.
- D. Pipe used for directional drilling shall be Class 350 ductile iron pipe (DIP) with pipe manufacturer designed restrained flexible joints and smoothly contoured bells. Joints with bulky glands or flanges that may prevent the smooth flow of the drilling fluid/soil slurry over the joint shall not be acceptable. DIP shall be US Pipe TR FLEX, American Flex-Ring, or approved equal.

2.03 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. PVC pipe shall be push-on joint conforming to AWWA C900 or C905, and NSF 61 standards. The pipe material shall conform to ASTM F1784 with a minimum cell classification 12454 as measured by ASTM D3350. The pipe wall thickness shall be in

accordance with AWWA C900 or C905 for a working pressure of 150 psi, the depth of cover shown on the plans, and a type 3 pipe bedding condition. The pipe thickness for AWWA C900 pipe shall not be less than pressure class 165 psi, DR18. The pipe thickness for AWWA C905 pipe shall not be less than pressure class 235 psi, DR 18. Pipe joints shall conform to ASTM D3139 with gaskets conforming to ASTM F477.

- B. Fittings for ground buried conditions shall be ductile iron mechanical joint with restraining glands conforming to AWWA C153. Fittings within structures shall be ductile iron flanged joint with full face gaskets conforming to AWWA C115. Fittings shall be suitable for a working pressure of 150 psi and not less than Class 52. The fittings shall be supplied with a standard thickness cement mortar interior coating conforming to AWWA C104. All exposed metal shall be epoxy coated in accordance with AWWA C116. Pipe joint gaskets shall conform to AWWA C111.
- C. All fitting joints shall be restrained with retainer glands equal to Series 2000PV Megalugs as manufactured by EBBA Iron Inc., Star Pipe Products, Inc. Stargrip Series 4000, or approved equal. The restraint system shall be designed to withstand a working pressure of 350 psi plus a surge pressure equal to the working pressure. The body shall be fabricated from steel conforming to ASTM A285 Grade C and epoxy coated conforming to AWWA C213. The restraint shall be for the full circumference of the pipe utilizing machined serrations making contact with the pipe.
- D. Pipe used for directional drilling shall be fusible C900 PVC. Fusible C900 PVC pipe shall be zero leak-rate heat-fused together in one length, if space permits. C900 fusible PVC heat-fusion pipe welds will be pressure tested prior to being placed in bore hole. Pipe will be placed on pipe rollers before pulling into bore hole with rollers spaced close enough to prevent excessive sagging of pipe.

2.04 HIGH DENSITY POLYETHEYLENE (HDPE) PIPE AND FITTINGS

- A. HDPE pipe shall conform to AWWA C906, ASTM F714, and NSF 61 standards. The pipe shall be ductile iron pipe size. The pipe material shall conform to ASTM D1248 with a minimum cell classification of 345464C as measured by ASTM D3350. The pipe wall thickness shall be in accordance with AWWA C906 for a working pressure of 150 psi, the depth of cover shown on the plans, and a type 3 pipe bedding condition. The pipe thickness for AWWA C906 pipe shall not be less than pressure class 160 psi, DR11.
- B. Fittings connecting HDPE pipe shall conform to AWWA C906 and ASTM D3261 standards. The fitting material shall conform to ASTM D1248 with a minimum cell classification of 345464C as measured by ASTM D3350. The fitting wall thickness shall match the pipe and not be less than pressure class 160 psi, DR11. Fittings shall be joined to the pipe using butt fusion methods.
- C. Connections to water main pipe other than HDPE shall be made using ductile iron fittings or an approved equal. Ductile iron fittings for ground buried conditions shall be mechanical joint with restraining glands or approved equal conforming to AWWA C153. Ductile iron fittings within structures shall be flanged with full face gaskets conforming to AWWA C115. Fittings shall be suitable for a working pressure of 150 psi and not less than Class 52. The fittings shall be supplied with a standard thickness cement mortar lining conforming to AWWA C104. All exposed metal shall be epoxy coated in accordance with AWWA C116. Pipe joint gaskets shall conform to AWWA C111.
- D. All fitting joints shall be restrained with retainer glands equal to Series 2000PV Megalugs as manufactured by EBBA Iron Inc., Star Pipe Products, Inc. Stargrip series 4000, or an

approved equal. The restraint system shall be designed to withstand a working pressure of 350 psi plus a surge pressure equal to the working pressure. The body shall be fabricated from steel conforming to ASTM A285 Grade C and epoxy coated conforming to AWWA C213. The restraint shall be for the full circumference of the pipe utilizing machined serrations making contact with the pipe.

2.05 PLASTIC PIPE LOCATING METHODS

- A. Refer to Section 33 05 27 – Tracer Wire.

2.06 VALVES

- A. Resilient seated gate valves shall be provided for water mains up through 12 inch unless noted otherwise on the construction plans. Resilient seated gate valves shall be suitable for potable water service and conform to AWWA C509 and NSF 61 standards. Resilient seated gate valves shall be designed for a minimum working pressure of 250 psi. The interior of the valve body shall be epoxy coated conforming to AWWA C550. The exterior of the valve body shall be epoxy coated conforming to AWWA C116. All flanged connections shall be made with stainless steel bolts. The valve shall open counterclockwise using a 2 inch operating nut. An extension stem shall be provided to maintain the operating nut between 6 inches and 24 inches below finished ground surface. Resilient seated gate valves shall be manufactured by American Flow Control, Clow, Waterous, or approved equal.

2.07 VALVE MARKERS

- A. Valve markers shall be composite fiberglass from Carsonite Composites, Glasforms, Inc. or approved equal and placed at all valves, excluding fire hydrant valves.
- B. Valve Markers shall be a single piece marker capable of simple, permanent installation by one person using a manual driving tool. The valve marker upon proper installation shall resist displacement from wind and vehicle impact forces. The valve marker shall be of a constant flat "T" cross sectional design to accept retro-reflective sheeting with reinforcing support ribs incorporated longitudinally along each edge to provide sheeting protection and structural rigidity. The bottom end of the marker shall be pointed for ease of ground penetration.
 1. The valve marker shall be constructed of a durable, UV resistant, continuous glass fiber and marble reinforced, thermosetting composite material which is resistant to impact, ozone, and hydrocarbons within a service temperature range of -40°F to +140°F
 2. Each valve marker shall be permanently identified with the manufacturer's name and the month and year of fabrication. The letters shall be a minimum of 3/8-inch in height, and permanently affixed to the rear of the marker. A black line shall be stamped horizontally across the front of the marker near the bottom to indicate proper burial depth.
 3. The valve marker shall be capable of self-erecting and remain functional after being subjected to a series of ten head on impacts by a typical passenger sedan at 55 m.p.h. The valve marker shall retain a minimum of 60% of its sheeting.
 4. The valve markers shall be installed per manufacturer's recommendations with a minimum embedment depth of 18 inches.

2.08 HYDRANTS

- A. Fire hydrants shall conform to AWWA C502 standards. The fire hydrant waterway shall be equivalent to at least a 5 ¼ inch diameter opening. Provide a two (2) part breakable safety flange as an integral part of the barrel casting. Fire hydrants shall have a 6 inch mechanical joint connection, one 4 1/2 inch pumper connection, two - 2 ½ inch hose connections, and one (1) 5-inch STORZ connection. All outlets shall be National Standard screw threads and be fitted with caps and retainer chains. Provide a finish coat of industrial enamel, color to match Owner's standard. Each fire hydrant shall be furnished with a 6 inch mechanical joint, resilient seated gate valve, valve box, and extension stem, where required. Fire hydrant and resilient seated gate valve joints shall be restrained with retainer glands. The fire hydrant and valve shall open counterclockwise. Fire hydrants shall be located 4 to 6 feet from the edge of pavement or back of curb unless otherwise specified on plans. The resilient seated gate valve shall be located 3 feet from the fire hydrant. Fire hydrants shall be manufactured by American Flow Control, Mueller, Waterous, or approved equal.
- B. Flushing hydrants shall have a cast-iron body, 3 inch mechanical joint connection, one 2 ½ inch National Standard screw thread hose connection with cap and retainer chain. The flushing hydrant waterway shall be equivalent to at least a 2 1/8 inch diameter opening. Provide a finish coat of industrial enamel, color to match Owner's standard. Each flushing hydrant shall be furnished with a 3 inch mechanical joint, resilient seated gate valve, valve box, and extension stem, where required. Flushing hydrant and resilient seated gate valve joints shall be restrained with retainer glands. The flushing hydrant and valve shall open counterclockwise. Flushing hydrants shall be manufactured by American Flow Control, Mueller, Waterous, or approved equal.

2.09 VALVE BOXES

- A. Valve boxes shall be cast-iron, minimum inside diameter of 5 inches, minimum wall thickness of 1/8 inch, arch pattern design with a No. 6 base, and two piece screw adjustment design. The word WATER shall be cast in the cover. The valve box interior and exterior shall be coated with epoxy conforming to AWWA C116 standards. Valve boxes shall be manufactured by Ford, Mueller, Tyler, or approved equal.

2.10 SADDLE TAPS

- A. Saddle taps shall be provided with a ductile iron saddle body conforming to ASTM A536. Saddle taps shall utilize a double strap design. The straps, threaded studs, nuts and washers shall be 304 stainless steel conforming to ASTM A153. A BUNA-N taper seal gasket shall be provided to seal the saddle body to the pipe. The saddle body shall be epoxy coated conforming to AWWA C116. Saddle taps shall be manufactured by Ford, Mueller, Smith Blair, or approved equal.

2.11 TAPPING SLEEVES / CUT IN VALVES

- A. Connecting to the existing distribution system shall be done using a cut in valve. Arrangements to have materials and equipment on hand to minimize system operations interruption shall be coordinated prior to interrupting service. Cut in valve and appurtenances shall be manufactured by Clow, Mueller, Smith Blair, or approved equivalent.

PART 3 - EXECUTION

3.01 GENERAL

- A. All materials shall be handled in a manner that avoids potential damage. Pipe shall be lifted with suitable choker straps and spreaders. Appropriate protection of the pipe bell end shall be provided by the contractor to prevent damage during pipe seating operations.
- B. The interior of all pipes, fittings, valves, hydrants, cross connection control devices, and appurtenances that will contact potable water shall be free of debris prior to installation and the contractor shall take all reasonable precautions to prevent the entry of debris during the installation process.
- C. All pipes, fittings, valves, hydrants, cross connection control devices, and other accessories shall be inspected for defects prior to installation. Any defective materials shall not be installed on the project and shall be promptly removed from the project site.
- D. All plastic pipes, plastic fittings, gaskets, and other products that could be affected by UV degradation shall be covered to avoid contact with direct sunlight.

3.02 WATER PIPING LOCATION REQUIREMENTS

- A. New water mains shall be installed a minimum horizontal distance of 10 foot from any existing or proposed storm or sanitary sewer. If a 10 foot separation is not possible, the water pipe may be laid closer with SCDHEC approval prior to installation. Where possible, the water pipe shall be laid in a separate trench. If the water pipe must be laid in the same trench as the sewer pipe, the water pipe shall be laid as far as practical from the sewer pipe. In any case, the water line invert shall be at least 18 inches above the crown of the sewer pipe and the water pipe and fittings shall be of ductile iron materials.
- B. Water pipes shall have at least 36 inches of earth cover to prevent freezing.
- C. Water pipes that cross over storm or sewer pipes shall maintain an 18 inch vertical separation between the outside walls of the water and sewer pipes.
- D. Water pipes that cross under sewer pipes shall be positioned to maximize the separation distance between the water and sewer pipe joints. One full length of ductile iron sewer pipe shall be centered on the sewer pipe crossing. The connections to the existing sewer pipe shall be made with corrosion resistant, pressure type connections.
- E. No water pipe shall extend through or come in contact with any part of a sewer manhole.
- F. Water pipes shall be located outside of any area of contaminated soils.
- G. Water flushing devices shall not be directly connected to any sewer system.
- H. No cross connection shall be made between a potable water system and any private water system without proper backflow protection.
- I. Structures containing potable water piping shall not be connected directly to any sewer system.

3.03 TRENCHING, EXCAVATION AND BACKFILLING

- A. Comply with Sections 31 23 16 - Excavation, 31 23 23.13 – Backfill and Compaction, and 31 23 16.13 – Trenching for Site Utilities.
- B. Comply with AWWA C600 – Installation of Ductile iron Water Mains and Their Appurtenances, AWWA C605 – Underground Installation of PVC Pressure Pipe and Fittings for Water, and ASTM D2774 – Standard Practice for underground Installation of Thermoplastic Pressure piping.
- C. The width of water pipe trenches shall be limited to dimensions shown on the trench detail given in the construction plans.
- D. A continuous and uniform bedding material shall be provided in the trench for all buried pipe. Bedding material shall be provided at least 6 inches below the pipe invert to at least 12 inches above the pipe crown. Bedding material shall be mechanically tamped in layers to ensure uniform pipe support and minimal settlement potential. Stones, other than crushed bedding, shall not come into contact with the pipe and shall not be within 6-inches of the pipe.
- E. Backfill of the trench above the pipe bedding material shall be performed in lifts and properly compacted.

3.04 PIPE INSTALLATION

- A. Pipe shall be cut square and all burrs removed.
- B. Remove any debris from the pipe interior. Every reasonable measure shall be taken by the contractor to limit the entry of debris or ground water into the pipe during the installation process.
- C. Pipe shall be laid straight and at the grades shown on the construction plans. Pipe deflection shall not exceed manufacturer recommendations. Pipe bell ends shall face in the direction the pipe is being laid.
- D. Pipe joints shall be lubricated and fully seated using methods recommended by the pipe manufacturer. Restraining gaskets shall be used on water pipe push-on joints located within the restraint requirements of any pipe fitting or hydrant assembly.
- E. Pipe fittings shall be installed, including their retainer glands for joint restraint, making sure all mechanical connections are to the torque requirements of the manufacturer.
- F. Pipe bedding shall be placed and mechanically compacted to the crown of the pipe.
- G. Pipe grade shall be checked following pipe bedding but prior to backfill above the crown of the pipe.
- H. Contractor shall protect the open end of the pipe from debris entry until the next section of pipe is ready for installation.

3.05 WATER CROSSINGS

- A. Water pipes that cross over a water body should be located above the 50 year flood elevation for the water body. The water pipes shall be adequately supported throughout the span over the water body.
- B. Water pipes that cross under a water body shall have at least 2-feet of earth cover over the pipe. For water bodies greater than 15 feet in width, an isolation valve shall be provided on each side of the water body. A flushing hydrant shall be provided between the isolation valves in an easily accessible location. The isolation valves and flushing hydrant shall be easily accessible and not subject to flooding.
- C. Water pipes that cross under a water body may be installed using Horizontal Directional Drilling with a minimum of 4-feet of earth cover over the pipe as shown on the construction plans.

3.06 VALVE AND HYDRANT INSTALLATION

- A. Remove any debris from the valve or hydrant interior. Every reasonable measure shall be taken by the contractor to limit the entry of debris or ground water into the valve or hydrant during the installation process.
- B. Place the valve or hydrant only on a firm grade. Place compacted crushed stone to achieve a suitable subgrade condition for valves, where necessary. Place compacted washed stone 3 feet square by 1.5 feet deep at each fire hydrant.
- C. Place the valve or hydrant with the operating stem or barrel in a plumb, vertical position. The fire hydrant pumper and hose connections shall face and be reasonably square with the street.
- D. Lubricate and seat the pipe in the joint. Install the joint restraining gland and tighten all fasteners to the torque recommended by the manufacturer.
- E. Place and mechanically compact the bedding material around the pipe, valve, and hydrant making sure the valve box and hydrant barrel remain plumb.
- F. Place and mechanically compact the backfill in layers making sure the valve box and hydrant barrel remain plumb.
- G. Adjust the valve box to the approximate finished grade and complete backfill operations.
- H. Verify the proper operation of the valve and hydrant.

3.07 AIR RELEASE VALVE INSTALLATION

- A. Air release valves shall be located at each high point along the water pipe. Air relief valves shall not be installed in situations where the valve could be flooded.
- B. Air release valves shall be installed in a precast manhole or valve box with access cover.
- C. Air release valves shall be connected to the water pipe using a saddle tap, stainless steel close nipple, quarter turn bronze ball valve and stainless steel close nipple. The air release

valve shall be installed only after flushing the water distribution system but before hydrostatic pressure testing.

- D. Air release valves shall be supported from the manhole wall with a stainless steel bracket mounted with stainless steel wedge anchors.

3.08 CROSS CONNECTION DEVICE INSTALLATION

- A. The vertical pipe from the water main to the inlet of the cross connection device shall be ductile iron with restrained mechanical joints for the ground buried portion and 125 pound flanges with full face gaskets for the above ground portion.
- B. The cross connection device shall be located 24 to 30 inches above finished ground surface in an easily accessible location reasonably protected from vehicle damage or vandalism. All relief valves shall discharge onto grassed areas and shall not be connected to any storm sewer system.
- C. The cross connection device shall be supported from an 8 inch reinforced concrete slab on grade of sufficient width and length to maintain a soil bearing pressure less than 1000 lb/sf and to accommodate the laying length of the assembly. Pipe support posts shall be 2 inch schedule 40 Type 304 stainless steel with a ¼ inch stainless steel plate forming a pipe saddle to support at least 1/3 of the pipe circumference. Stiffeners of ¼ inch stainless steel plate shall be welded on each side of the pipe saddle to the support post. The support posts shall include a 6 inch square by ¼ inch thick Type 304 stainless steel plate with two ½ inch stainless steel wedge anchors fastening it to the reinforced concrete slab.

3.09 SERVICE CONNECTIONS

No service connections are proposed in this project.

3.10 THRUST BLOCKS

- A. The contractor shall use restrained mechanical joint fittings and restraining gaskets for push-on joint pipe for all new water distribution system construction.
- B. The contractor shall use thrust blocks to restrain any water distribution fitting that deflects more than 11 ¼ degrees whose joint restraint condition is unknown.
- C. The contractor shall use thrust blocks to restrain any fire hydrant whose joint restraint condition is unknown.
- D. The contractor shall construct thrust blocks using cast-in-place concrete with a compressive strength of 3000 psi in 28 days and reinforce the concrete with No. 4 deformed bars spaced at 12 inches each way. The reinforcing bars shall have a yield stress of at least 50,000 psi. The contractor shall provide a bond break between the fitting and concrete using 8 mil polyethylene sheet.
- E. Thrust blocks shall bear against undisturbed earth and the sides shall be formed. The area of the thrust block to bear against the undisturbed earth will be directed by the Engineer.
- F. Thrust blocks shall be constructed so that the fitting being restrained can be removed in the future.

3.11 FLUSHING AND PRESSURE TESTING

- A. All concrete thrust blocks shall cure for at least 7 days before system flushing and pressure testing.
- B. The contractor shall perform an initial pressure check on segments of the water system as they are constructed to more readily isolate potential leaks and enable their correction before hydrostatic pressure testing. An air test shall be used for this initial test. The air test on plastic piping shall not exceed 75 psi and be no more than 2 hours in duration.
- C. The water distribution system installed or affected during the project shall be flushed with clean water to remove any potential debris in the pipe, valves, and hydrants. The flushing process shall be at a velocity of at least 2.5 feet per second using a systematic approach to ensure every segment of pipe and hydrant lead has been properly flushed. The contractor shall remove any accumulated air from the water distribution system through the air release valves.
- D. The contractor shall perform a hydrostatic pressure test on the water distribution system at 1.5 times the system operating pressure or a minimum of 150 psi. The contractor shall supply all necessary equipment and power to perform the test. The test pressure shall be applied for not less than 2 hours. The contractor shall measure the residual pressure at the end of the test and measure the volume of water needed to restore the system to the original test pressure. All testing is to be done in accordance with SCDHEC State Primary Drinking Water Standards and Local Municipality Standards and Specifications.
 - 1. The allowable leakage rate (gallons per hour) for ductile iron pipe is pipe length (feet) times pipe diameter (inches) times test pressure (psi) divided by 266,400.
 - 2. The allowable leakage rate (gallons per hour) for PVC pipe is number of joints times pipe diameter (inches) times test pressure (psi) divided by 14,800.
 - a. If the actual leakage exceeds the allowable leakage, the contractor shall complete repairs to leaking joints in the system and retest the system. The contractor shall repeat this process until the actual leakage is less than the allowable leakage.
 - b. Each Valve located within the section piping being tested must be opened and closed several times during the test period.
 - c. Any witness to the testing of the water lines must be someone other than the Utility Contractor installing the lines and accepted by the engineer. Contractor shall prove to the witness that the entire system is being tested by relieving pressure at certain points designated by the witness.

3.12 DISINFECTION AND FLUSHING

- A. The contractor shall furnish all equipment, materials and power required to complete disinfection of the water distribution system in conformance with AWWA C651. All chemicals used in the disinfection process shall meet the requirements of NSF 60. All water mains shall be sterilized to meet SCDHEC standards and specifications.
- B. The contractor shall introduce liquid chlorine into the water distribution system with a metering pump in a manner that ensures all segments of the water distribution system are contacted by a chlorine solution not less than 25 parts per million nor more than 50 parts per million. Water shall be flushed from each hydrant and terminal end of the piping system

until a residual of at least 25 parts per million is present throughout the water distribution system. The chlorinated water shall be retained in the water distribution system at least 24 hours. The residual chlorine shall be measured at various points throughout the distribution system after the contact period to confirm a residual of at least 10 parts per million.

- C. The contractor shall flush the water distribution system and de-chlorinate the water prior to discharge. The contractor shall introduce a liquid de-chlorinating agent into the chlorinated water using a metering pump at a rate sufficient to achieve undetectable chlorine residual. The de-chlorination process shall conform to AWWA C655 standards.
 - 1. The contractor shall collect two (2) samples, 24 hours apart, near each connection point to the existing water distribution system and at intervals not more than every 1,200 feet of new water pipe. These samples shall be delivered to SCDHEC for bacteriological testing, which also needs to include the chlorine residual. Samples are to be collected by an approved sampler or laboratory representative.
 - 2. In the event any bacteriological test is positive, a third sample and test at those locations shall be completed by the contractor. The contractor shall repeat system disinfection, flushing, and sample collection should SCDHEC determine that bacteriological test is unsatisfactory.
 - 3. Contractor is responsible for supplying current bacterial test that is not expired in order for engineer to acquire the Permit to Operate from SCDHEC.

3.13 QUALITY CONTROL

- A. All trench backfill for the water distribution system shall be compacted to at least the limits specified under Section 13 23 23.13 - Backfill and Compaction.
- B. All segments of the water distribution system shall have a leakage rate less than the specified allowable rate.
- C. All segments of the water distribution system shall be shown to be bacteriologically safe based on tests performed and approved by SCDHEC.

3.14 MEASUREMENT AND PAYMENT

- A. All work under this Section will be measured and paid for as follows:
 - 1. Pipe will be paid for at the unit prices per linear foot as stated in the Bid Form and shall include cost of excavation, backfilling, fittings, joint restraint, metallic detection tape, copper tracer wire, cleanup, flushing, pressure/leakage testing, disinfection, de-chlorination, labor and equipment for a complete installation. Measurement will be from center to center of fittings with no deduction made for the length of valves or fittings.
 - a. The cost for all fittings will be included in the price bid per linear foot of pipe.
 - 1) Valves will be paid for at the price for each as stated in the Bid Form and shall include the excavation, backfill, valve, joint restraint, valve box, extension stem, valve box protection ring, labor and equipment for a complete installation.
 - 2) Tapping sleeves and valves (Cut in valve) will be paid for at the unit price for each as stated in the Bid Form and shall include the excavation, backfill,

tapping sleeve, valve, joint restraint, valve box, extension stem, labor and equipment for a complete installation.

- 3) Fire hydrants will be paid for at the unit price for each as stated in the Bid Form and shall include hydrant, valve, joint restraint, valve box, extension stem, tracer wire bracket, reflector, offset fitting, labor and equipment for a complete installation. Cost for the hydrant isolation valve and piping between the valve and hydrant to the hydrant shall be included with the price of the Fire Hydrant.
- 4) Thrust blocks and/or mechanical joint restraints shall be included in the price bid per linear foot of the pipe.
- 5) Cut-ins to existing lines will be paid for at the price per each as stated in the Bid Form and shall include all excavation, backfill, fittings, joint restraint, labor and equipment for a complete installation.
- 6) Substitution of ductile iron pipe for PVC pipe will be paid at the unit price per linear foot as stated on the Bid Form and shall include the additional material cost for the pipe, fittings, joint restraint, labor and equipment for a complete installation.

END OF SECTION

SECTION 33 11 00

PIPING - GENERAL PROVISIONS

PART 1: GENERAL

1.01 DRAWINGS

Dimensions shown on the Construction Drawings are approximate only. Verify all piping geometry in the field and to ensure proper alignment and fit of all piping consistent with the intent of the Construction Drawings. Submit field layout drawings as required for approval.

PART 2: PRODUCTS

2.01 CONTRACTOR'S RESPONSIBILITY FOR MATERIAL

- A. Examine all material carefully for defects. Do not install material which is known, or thought to be, defective.
- B. Alliance Consulting Engineers, Inc. reserves the right to inspect all material and to reject all defective material shipped to the job site or stored on the site. Failure of Alliance Consulting Engineers, Inc. to detect damaged material shall not relieve the Contractor from his total responsibility for the completed work if it leaks or breaks after installation.
- C. Lay all defective material aside for final inspection by Alliance Consulting Engineers, Inc. Alliance Consulting Engineers, Inc. will determine if corrective repairs may be made, or if the material is rejected. Alliance Consulting Engineers, Inc. shall determine the extent of the repairs.
- D. Classify defective pipe prior to Alliance Consulting Engineers, Inc.'s inspection as follows:
 - 1. Damage to interior and/or exterior paint seal coatings.
 - 2. Damage to interior cement-mortar or epoxy lining.
 - 3. Insufficient interior cement-mortar lining or epoxy thickness.
 - 4. Excessive pitting of pipe.
 - 5. Poor quality exterior paint seal coat.
 - 6. Pipe out of round.
 - 7. Pipe barrel area damaged to a point where pipe class thickness is reduced (all pipe).
 - 8. Denting or gouges in plain end of pipe (all pipe).
 - 9. Excessive slag on pipe affecting gasket seal (DIP).
 - 10. Any visible cracks, holes.

11. Embedded foreign materials.
 12. Non-uniform color, density and other physical properties along the length of the pipe.
- E. The Contractor shall be responsible for all material, equipment, fixtures, and devices furnished. These materials, equipment, fixtures and devices shall comply with the requirements and standards of all Federal, State, and local laws, ordinances, codes, rules, and regulations governing safety and health.
 - F. The Contractor shall take full responsibility for the storage and handling of all material furnished until the material is incorporated in the completed project and accepted by Alliance Consulting Engineers, Inc. Contractor shall be solely responsible for the safe storage of all material furnished to or by him until incorporated in the completed project and accepted by Alliance Consulting Engineers, Inc.
 - G. Load and unload pipe, fittings, valves, hydrants and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop these materials. Pipe handled on skidways shall not be skidded or rolled against other pipe. Handle this material in accordance with AWWA C600, C605 or C906 whichever is applicable.
 - H. Drain and store fittings and valves prior to installation in such a manner as to protect them from damage due to freezing of trapped water.

2.02 PETROLATUM TAPE COATING

- A. The tape coating shall be a cold applied, saturant tape made from either petrolatum or petroleum wax with a noncellulosic synthetic fiber fabric. The fabric shall be encapsulated and coated on both sides with the petrolatum or petroleum wax. The thickness of the tape shall be no less than 40 mil. The petrolatum or petroleum wax shall be at least 50% of the product by weight.
- B. The tape coating shall be supplied in sheets, pads or rolls. Pads and sheets shall be sized to fit the area that is to be covered, allowing for an overlap per AWWA Standards.

2.03 RUBBERIZED-BITUMEN BASED SPRAY-ON UNDERCOATING

Subject to approval by Alliance Consulting Engineers, Inc., an alternative corrosion protection for exposed buried metal is an aerosol applied rubberized coating. The material shall be rapid dry and specifically designed for corrosion protection. 3M Rubberized Underseal Undercoating 08883 or any equivalent rubberized-bitumen based spray-on undercoating may be used. Follow manufacturer's recommendations for storage and application.

PART 3: EXECUTION

3.01 INSTALLATION - GENERAL REQUIREMENTS

- A. Lay and maintain all pipes to the required lines and depths. Install fittings, valves and hydrants in strict accordance with the Specifications at the required locations with joints centered, spigots home, and all valve and hydrant stems plumb. Do not deviate from the required alignment, depth or grade without the written consent of Alliance Consulting Engineers, Inc.
- B. Buried steel lugs, rods, brackets, and flanged joint nuts and bolts are not permitted unless specifically shown on the Construction Drawings or approved in writing by Alliance Consulting Engineers, Inc. Cover any and all buried steel lugs, rods, brackets, and flanged joint nuts and bolts with approved coating in accordance with AWWA Standard C217 prior to backfilling. Encase the same in polyethylene encased if the Specifications require polyethylene encasement of the pipe, valves or fittings.
- C. Lay all pipe to the depth specified. Measure the depth from the final surface grade to the top of the pipe barrel. The minimum pipe cover shall be as shown on the Construction Drawings or as specified in the Specifications.
- D. Do not lay pipe in a wet trench, on subgrade containing frost, or when trench conditions are unsuitable for such work. If all efforts fail to obtain a stable dry trench bottom and Alliance Consulting Engineers, Inc. determines that the trench bottom is unsuitable for such work, Alliance Consulting Engineers, Inc. will order the kind of stabilization to be constructed, in writing. In all cases, water levels must be at least 6" below the bottom of the pipe.
- E. Thoroughly clean the pipes and fittings before they are installed. Keep these materials clean until the acceptance of the completed Work. Lay pipe with the bell ends facing in the direction of laying, unless otherwise shown on the Construction Drawings, or directed by Alliance Consulting Engineers, Inc. Exercise care to ensure that each length abuts the next in such a manner that no shoulder or unevenness of any kind occurs in the pipe line.
- F. Do not wedge or block the pipe during laying unless by written order of Alliance Consulting Engineers, Inc.
- G. Before joints are made, bed each section of pipe the full length of the barrel, at the required grade, and at the invert matching the previously laid pipe. Dig bell holes sufficiently large to permit proper joint making. Do not bring succeeding pipe into position until the preceding length is embedded and secure in place.
- H. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying. Take up such in-place pipe sections found to be defective and replace them with new pipe. Take up, relaying, and replacement will be at the Contractor's expense.

- I. Place enough backfill over the center sections of the pipe to prevent floating. Take all other necessary precautions to prevent the floating of the pipeline by the accumulation of water in the trench, or the collapse of the pipeline from any cause. Should floating or collapse occur, restoration will be at the Contractor's expense.
- J. Contractor shall install tracer wire along all pipelines. Tracer wire shall be installed per Specification Section 33 05 27- Tracer Wire.
- K. Bedding materials and concrete work for the pipe bedding and thrust restraint shall be as specified.
- L. Prevent foreign material from entering the pipe while it is being placed. Do not place debris, tools, clothing, or other materials in the pipe during laying operations. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work, or for other reasons such as rest breaks or meal periods.
- M. Only cut pipe with equipment specifically designed for cutting pipe such as an abrasive wheel, a rotary wheel cutter, a guillotine pipe saw, or a milling wheel saw. Do not use chisels or hand saws. Grind cut ends and rough edges smooth. Bevel the cut end slightly for push-on connections as per manufacturer recommendations.
- N. In distributing material at the site of the Work, unload each piece opposite or near the place where it is to be laid in the trench. If the pipe is to be strung out, do so in a straight line or in a line conforming to the curvature of the street. Block each length of pipe adequately to prevent movement. Block stockpiled pipe adequately to prevent movement. Do not place pipe, material, or any other object on private property, obstructing walkways or driveways, or in any manner that interferes with the normal flow of traffic.
- O. Exercise special care to avoid damage to the bells, spigots or flanged ends of pipe during handling, temporary storage, and construction. Replace damaged pipe that cannot be repaired to Alliance Consulting Engineers, Inc.'s satisfaction, at the Contractor's expense.
- P. Remove all existing pipe, fittings, valves, pipe supports, blocking, and all other items necessary to provide space for making connections to existing pipe and installing all piping required under this Contract.
- Q. Maintain the minimum required distance between water and sewer lines and other utility lines in strict accordance with all Federal, State, and local requirements and all right-of-way limitations.
- R. Provide and install polyethylene encasement for ductile iron pipe, fittings and valves as required. See Specification Section - Polyethylene Wrap.

- S. The maximum allowable deflection at the joints for push-on joint pipe shall be the lesser of manufacturer's recommendations or as described in the DIPRA Guideline, *Ductile Iron Pipe Joints and Their Uses*, as follows:

<u>Size of Pipe</u>	<u>Deflection Angle</u>	<u>Maximum Deflection (18-ft. Length)</u>	<u>Maximum Deflection (20-ft. Length)</u>
3"-12"	5 degrees	19"	21"
14"-42"	3 degrees	11"	12"
48"-64"	3 degrees	N/A	12"

- T. The maximum allowable deflection at the joints for PVC pressure pipe shall be as follows:

<u>Size of Pipe</u>	<u>Deflection Angle</u>	<u>Maximum Deflection (20-ft. Length)</u>
4"-12"	2 degrees	8"
14" +	1.5 degrees	6"

- U. Use short lengths of pipe (minimum length 3 feet, no more than three short sections), when approved by Alliance Consulting Engineers, Inc., to make curves that cannot be made with full length sections of pipe without exceeding the allowable deflection. Making these curves will be at no additional cost to Alliance Consulting Engineers, Inc. or the Owner.
- V. Furnish air relief valve assemblies in accordance with the Construction Drawings provided or as specified in Specification Special Conditions section. Alliance Consulting Engineers, Inc. will provide standard detail for additional air release valve assemblies. Any deviation from the standard detail, proposed by Contractor must be approved in advance.
- W. Exercise particular care so that no high points are established where air can accumulate. Install an air release valve and manhole, as extra Work to the Contract, when Alliance Consulting Engineers, Inc. determines that unforeseen field conditions necessitate a change in the pipe profile that requires the installation of an air release valve and manhole. If the Contractor requests a change in the pipe profile solely for ease of construction, and the requested change requires the installation of an air release valve and manhole as determined by Alliance Consulting Engineers, Inc., the cost of furnishing and installing the air release valve and manhole will be at the expense of the Contractor.
- X. All water mains 20" and greater in diameter shall be constructed using DIP only. Other construction materials, such as PVC and HDPE, are limited to water mains 16" and under in diameter. Alternate materials for larger water mains may be approved by Alliance Consulting Engineers, Inc. on a case-by-case basis.

- Y. Marking tape to be provided along all mains and service lines installed. Marking tape to be installed 12" below grade. Foil backing is not required on marking tape. Tape shall be colored blue for water mains and green for sewer. Marking tape along pressurized force mains shall be labeled "Pressurized Wastewater".

3.02 CONSTRUCTION METHODS TO AVOID CONTAMINATION

- A. Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is essential that the procedures of this Section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.
- B. Take precautions to protect the interior of pipes, fittings, and valves against contamination. String pipe delivered for construction so as to keep foreign material out of the pipe. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Use rodent-proof plugs approved by Alliance Consulting Engineers, Inc., where it is determined that watertight plugs are not practical and where thorough cleaning will be performed.
- C. Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the lower the likelihood of contamination. Complete the joints of all pipes in the trench before stopping work. If water accumulates in the trench, keep the plugs in place until the trench is dry.
- D. When encountering conditions on pre-existing pipe that requires packing, employ yarning or packing material made of molded or tubular rubber rings, or rope of treated paper or other approved materials. Do not use materials such as jute, asbestos, or hemp. Handle packing material in a manner that avoids contamination.
- E. Do not use contaminated material or any material capable of supporting prolific growth of microorganisms for sealing joints. Handle sealing material or gaskets in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. Deliver the lubricant to the job in closed containers and keep it clean.
- F. If dirt enters the pipe, and in the opinion of Alliance Consulting Engineers, Inc. the dirt will not be removed by the flushing operation, clean the interior of the pipe by mechanical means, then swab with a 1% hypochlorite disinfecting solution. Clean using a pig, swab, or "go-devil" only when Alliance Consulting Engineers, Inc. has specified such and has determined that such operation will not force mud or debris into pipe joint spaces.
- G. If the main is flooded during construction, the flooded section must be isolated from the remainder of the installation as soon as practical. Submit a plan to Alliance Consulting Engineers, Inc. on correcting the condition and do not

proceed until authorized by Alliance Consulting Engineers, Inc. Replace or fully clean and disinfect the affected pipe at no additional cost to Alliance Consulting Engineers, Inc. or the Owner.

3.03 VALVE INSTALLATION

- A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially of seating surfaces, handling damage, and cracks. Correct defective valves or hold for inspection by Alliance Consulting Engineers, Inc.
- B. Set and join to the pipe in the manner specified in Paragraph 3.01. Provide valves with adequate support, such as crushed stone and concrete pads, so that the pipe will not be required to support the weight of the valve. Set truly vertical. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut, exposed and free to be operated.
- C. Provide a valve box for each valve. Set the top of the valve box neatly to existing grade, unless directed otherwise by Alliance Consulting Engineers, Inc. Do not install in a way that allows the transfer of shock or stress to the valve. Center and plumb the box over the wrench nut of the valve. Do not use valves to bring misaligned pipe into alignment during installation. Support pipe in such manner as to prevent stress on the valve.
- D. Provide extension stem for each valve, topped with a standard 2-inch AWWA nut. Pin the extension stem to the operating nut on the valves. Extension stem shall extend to with 12-inches of finished grade.
- E. Provide valve marking posts, when authorized by Alliance Consulting Engineers, Inc., at locations designated by Alliance Consulting Engineers, Inc. and in accordance with detail drawings.

END OF SECTION

SECTION 33 11 00.11

POLYVINYL CHLORIDE (PVC) PIPE

PART 1: GENERAL

1.01 SECTION INCLUDES

PVC pressure pipe and fabricated fittings in nominal sizes 4-inches through 12-inches with cast iron pipe equivalent outside diameters.

1.02 SUBMITTALS

Submit manufacturer's product data, installation instructions and certification for all materials to be furnished in accordance with Specification Section 01 30 00 – Administrative Requirements. Submit classification and gradation test results for embedment and pipe backfill material.

PART 2: PRODUCTS

Research has documented that certain pipe materials (such as polyvinyl chloride, polyethylene, and polybutylene) and certain elastomers (such as those used in gasket material) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products supplied under this Section assume that petroleum products or organic solvents will not be encountered. If during the course of pipeline installation the Contractor identifies, or suspects the presence of petroleum products or any unknown chemical substance, notify Alliance Consulting Engineers, Inc. immediately. Stop installing piping in the area of suspected contamination until direction is provided by Alliance Consulting Engineers, Inc.

PVC Schedule 40 or 80 is not permitted for conveying wastewater or potable water within distribution or collection systems. However, it may be used in other applications, such as conveying chemicals or for drainage.

2.01 PIPE MATERIALS – WATER DISTRIBUTION

All PVC pipe shall be PVC 1120 pressure pipe made from class 12454 material as defined by ASTM D1784 with outside diameter dimensions of steel or cast iron pipe. The PVC compounds shall be treated or certified suitable for potable water products by the National Sanitation Foundation Testing Laboratory (NSF Standard No. 61). PVC pipe to be used for potable water shall be blue in color.

PVC Pipe 4-inch through 12-inch:

AWWA Standard C900, DR14 and where permitted DR18. DR25 pipe will not be allowed. PVC pipe has recently been upgraded by pressure class; however, pipe is not to be fully subject to the revised pressures in AWWA C900. DR14 shall not be subjected to pressures exceeding 250 psi. DR18 shall not be subjected to pressures exceeding 200 psi.

2.02 GRAVITY SEWER PIPE

- A. PVC gravity sanitary sewer pipe shall be green in color and in accordance with provisions in following table except where specified differently on the Drawings:

Type of service	Acceptable Materials
Gravity Mains with depth of cover \geq 5 feet < 15 feet	PVC SDR 35
Gravity Mains with depth of cover \geq 15 feet	PVC SDR 26 or Ductile Iron Pipe Class 52
Gravity Mains with depth of cover < 5 feet	Ductile Iron Pipe Class 52

- B. When solid wall PVC pipe 18-inches to 27-inches in diameter is required in SDR 26, provide pipe conforming to ASTM F679, except provide wall thickness as required for SDR 26 and pipe strength of 115 psi.
- C. For sewers up to 12-inch diameter crossing over water lines, or crossing under water lines with less than 2-foot separation, provide minimum 150 psi pressure rated pipe conforming to ASTM D2241 with suitable PVC adapter couplings.
- D. Joints: Spigot and integral wall section bell with solid cross section elastomeric or rubber ring gasket conforming to requirements of ASTM D3212 and ASTM F477, or ASTM D3139 and ASTM F477. Gaskets shall be factory-assembled and securely bonded in place to prevent displacement. Manufacturer shall test sample from each batch conforming to requirements ASTM D2444.
- E. Fittings: Provide PVC gravity sewer sanitary bends, tee, or wye fittings for new sanitary sewer construction. PVC pipe fittings shall be full-bodied, either injection molded or factory fabricated. Saddle-type tee or wye fittings are not acceptable.
- F. Conditioning: Conditioning of samples prior to and during tests is subject to approval by Alliance Consulting Engineers, Inc.. When referee tests are required, condition specimens in accordance with Procedure A in ASTM D618 at 73.4° F \pm 3.6° F and 50 percent relative humidity plus or minus 5 percent relative humidity for not less than 40 hours prior to test. Conduct tests under same conditions of temperature and humidity unless otherwise specified.
- G. Pipe Stiffness: Determine pipe stiffness at 5 percent deflection in accordance with Test Method D 2412. Minimum pipe stiffness shall be 46 psi. For diameters 4-inches through 18-inches, test three specimens, each a minimum of 6-inches (150 mm) in length. For diameters 21-inch through 36-inch, test three specimens, each a minimum of 12-inch (300 mm) in length.

- H. Flattening: Flatten three specimens of pipe, prepared in accordance with Paragraph 2.04F, in suitable press until internal diameter has been reduced to 60 percent of original inside diameter of pipe. Rate of loading shall be uniform. Test specimens, when examined under normal light and with unaided eye, shall show no evidence of splitting, cracking, breaking, or separation of pipe walls or bracing profiles. Perform the flattening test in conjunction with pipe stiffness test.
- I. Joint Tightness. Test for joint tightness in accordance with ASTM D3212, except that joint shall remain watertight at minimum deflection of 5 percent. Manufacturer will be required to provide independent third party certification for joint testing each diameter of storm sewer pipe.
- J. Purpose of Tests. Flattening and pipe stiffness tests are intended to be routine quality control tests. Joint tightness test is intended to qualify pipe to specified level of performance.

2.03 SANITARY SEWER FORCE MAIN PIPE

- A. PVC sanitary sewer force main pipe shall be green in color. Provide approved PVC pressure pipe conforming to requirements for water service pipe, and conforming to minimum working pressure rating specified in Section 33 34 00 - Sanitary Sewer Force Mains.
- B. Acceptable pipe joints are integral bell-and-spigot, containing a bonded-in elastomeric sealing ring meeting requirements of ASTM F477. In designated areas requiring restrained joint pipe and fittings, use approved joint restraint device conforming to UNI-B-13, for PVC pipe 12-inch diameter and less.
- C. Fittings: Provide ductile iron fittings as per Section - Ductile Iron Pipe and Fittings, except furnish fittings with one of following approved internal linings:
 - 1. Nominal 40 Mils (35 Mils minimum) virgin polyethylene complying with ASTM D 1248, heat fused to interior surface of fitting
 - 2. Nominal 40 Mils (35 Mils minimum) polyurethane
 - 3. Nominal 40 Mils (35 Mils minimum) ceramic epoxy
 - 4. Nominal 40 Mils (35 Mils minimum) fusion bonded epoxy
- D. Exterior Protection: Provide polyethylene wrapping of ductile-iron fittings as required by Section 33 11 00.17 - Polyethylene Wrap.
- E. Hydrostatic Tests: Hydrostatically test pressure rated pipe in accordance with Specifications.

2.04 RECEIVING, HANDLING AND STORAGE

- A. Inspect pipe and appurtenances for defects prior to installation in the trench. Set aside and clearly mark defective, damaged or unsound material and hold material for inspection by Alliance Consulting Engineers, Inc.
- B. Load and unload all materials in accordance with the manufacturer's recommendations and in such a manner as to prevent damage. Do not drop pipe and accessories or handle them in a rough manner.
- C. Provide safe storage for all materials. Cover stored pipe that will be exposed to sunlight for periods longer than 6 months. Cover with canvas or other opaque material with provision for adequate air circulation. PVC pipe shall not be stored close to heat sources, such as heaters, boilers, steam lines, or engine exhaust.

PART 3: EXECUTION

3.01 INSTALLATION

Follow the provisions of Section - Piping - General Provisions, and Sanitary Sewer Force Mains in addition to the following requirements:

- A. Remove all dirt and foreign matter from pipe before lowering it into the trench. Do not place debris, hand tools, clothing or other materials in the pipe. Keep pipe clean during and after laying.
- B. Lay pipe with the bell end pointing in the direction of work progress. Do not roll, drop or dump pipe or appurtenances into the trench.
- C. Assemble push-on joints in accordance with the pipe manufacturer's recommendations. Assemble mechanical joints in accordance with the fitting manufacturer's recommendations.
- D. Cut pipe with pipe saws, circular saws, handsaws, or similar equipment. Provide a smooth end at a right angle to the longitudinal axis of the pipe. Deburr, bevel, and re-mark insertion line on spigot ends. Match factory bevel length and angle for field bevels. When connecting to certain shallow depth bells, such as those on some cast iron fittings and valves, cut off the factory bevel and prepare a deburred, square cut end with a slight outer bevel.
- E. Clean the sealing surface of the spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets immediately before assembly. Do not remove factory installed gaskets for cleaning. Keep the joint free of dirt, sand, grit, grease or any foreign material. Apply approved lubricant when assembling gasketed joints in accordance with the pipe manufacturer's requirements. The use of improper lubricants can damage gaskets. Excessive lubricant use can

make disinfection more difficult and cause taste and odor problems when the line is placed in service.

- F. Good pipe alignment is essential for proper joint assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or “stab” the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. Avoid metal to plastic contact with the pushing the pipe home (use wood or other material to cushion moving the pipe).
- G. Assemble pipe using the following types of joints:
 - 1. Gasketed bell joint – Integral with the pipe or fitting
 - 2. Gasketed coupling – A double gasketed coupling
 - 3. Mechanical joint – Any of the several joint designs that have gaskets and bolts manufactured in accordance with AWWA standards.
- H. Tracer Wire
 - 1. Place tracer wire in accordance with Section 33 05 27- Tracer Wire.
 - 2. The wire shall be contiguous except at test stations, valve boxes, and where splicing is required. All splices shall be encased with a 3M-Gel Pack Model No. 054007-09053, or approved equal.
- I. All pressure and leakage testing shall be done in accordance with Specification Section 33 01 30.13 – Acceptance Testing for Sanitary Sewers.
- J. PVC pipe fittings shall employ ductile iron pipe fittings when used in force main construction or installation of Ductile Iron Gravity Line per Specification Section 33 11 00.15 – Ductile Iron Pipe & Fittings. See detail drawings for transitions between different pipe materials.
- K. Gaskets - Gaskets shall be as provided or recommended by the manufacturer and satisfy AWWA standard C111 in all respects. Where ductile iron pipe and PVC pipe are directly connected, the appropriate gasket material for this purpose shall be employed. As noted in the products section of this specification, some gasket materials are prone to permeation of certain hydrocarbons which may exist in the soil (see Part 2). Under these conditions and at the discretion of Alliance Consulting Engineers, Inc., Contractor shall require supplier to provide FKM (Viton, Flourel) gasket material or approved equal in areas of concern.

3.02 SERVICE CONNECTIONS - Water Distribution

- A. Install service connections in accordance with AWWA Standard C605 and the manufacturer's recommendations using the following methods:
 - 1. Tapping is only permitted through the use of service clamps or saddles.

2. Using injection molded couplings with threaded outlets.
3. Tapping with large service connections through appropriately sized tapping sleeves and valves.
4. Direct tapping of 1-inch and smaller service connections is not permitted. Use service saddles only for AWWA Standard C900 pipe, for nominal pipe sizes 6-inch through 12-inch. Corporation stops shall be threaded and conform to AWWA Standard C800.
5. The distance between the PVC pipe joint and a service tap (2-inch and smaller) shall be a minimum of 3 feet. The distance between the PVC pipe joint and a service tap (4-inch and larger) shall be a minimum of 4 feet. Where necessary, excavate along the pipe to confirm the acceptable distance before starting the tap.

END OF SECTION

SECTION 33 11 00.15

DUCTILE IRON PIPE AND FITTINGS

PART 1: GENERAL

1.01 COORDINATION OF WORK

Connection to existing pipelines may require shutdown of City facilities. Closely coordinate construction work and connections with the City of Waltherboro through Alliance Consulting Engineers, Inc. Alliance Consulting Engineers, Inc., in consultation with the City of Waltherboro, may select the time for connection to existing pipelines, including Saturdays, Sundays, or holidays, which, in the opinion of Alliance Consulting Engineers, Inc., will cause the least inconvenience to the City of Waltherboro and/or its customers. Make such connections at such times as may be directed by Alliance Consulting Engineers, Inc., at the Contract prices, with no claim for premium time or additional costs.

1.02 RELATED WORK

Section 33 11 00 Piping - General Provisions.

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature for all Contractor supplied materials promptly to Alliance Consulting Engineers, Inc. for approval in accordance with Specification 01 30 00- Administrative Requirements.

PART 2: PRODUCTS

Research has documented that certain elastomers (such as those used in gasket material) may be subject to permeation by lower-molecular weight organic solvents or petroleum products. Products supplied under this Section assume that petroleum products or organic solvents will not be encountered. If during the course of pipeline installation the Contractor identifies, or suspects the presence of petroleum products or any unknown chemical substance, notify Alliance Consulting Engineers, Inc. immediately. Stop installing piping in the area of suspected contamination until direction is provided by Alliance Consulting Engineers, Inc.

2.01 PIPE MATERIAL

A. General

Ductile iron pipe shall conform to the latest specifications as adopted by the ANSI and AWWA. Specifically, ductile iron pipe shall conform to AWWA Standard C151.

The pipe or fitting exterior shall be coated with a bituminous coating in accordance with AWWA Standard C151. The pipe or fitting interior shall be

cement mortar lined and seal coated in compliance with the latest revision of AWWA Standard C104.

For wastewater systems, the pipe or fitting interior shall be lined with fusion coated ceramic epoxy in accordance with AWWA Standard C116.

B. Quality

Pipe and fittings shall meet the following minimum quality requirements by conforming to the following:

1. AWWA C104 / ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C110 / ANSI A21.10 Ductile Iron and Gray Iron Fittings, 3 NPS through 48 NPS for Water
3. AWWA C111 / ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. AWWA C115 / ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
5. AWWA C116 / ANSI A21.16 Protective Fusion-Bonded Epoxy Coating for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service
6. AWWA C150 / ANSI A21.50 Thickness Design of Ductile-Iron Pipe
7. AWWA C151 / ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water
8. AWWA C153 / ANSI A21.53 Ductile-Iron Compact Fittings, 3 NPS through 24 NPS and 54 NPS through 64 NPS, for Water Service

Ductile iron water pipe and fittings will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification for iron fittings shall list a fitting description, quantity, bare fitting weight and source, (AWWA Standard C110, C153 or Manufacturer, if fitting is not listed in either standard). The certification shall accompany the material delivered to the project site. Alliance Consulting Engineers, Inc. reserves the right to sample and test this material subsequent to delivery at the project site. If foreign manufactured fittings are provided, then the Contractor is obligated to notify Alliance Consulting Engineers, Inc. with a submittal and provide the necessary documentation to satisfy Alliance Consulting Engineers, Inc. that the materials provided meet the specified AWWA standards and, among other documentation that may be required, provide certificates of compliance on the component supplied.

C. Pipe Class

The pressure class of pipe to be furnished shall be in accordance with Table 1 and the notes listed below.

Table 1	
MINIMUM RATED WORKING PRESSURE FOR DUCTILE IRON PIPE MANUFACTURED IN ACCORDANCE WITH AWWA Standard C151	
Pipe Size (Inch)	Pressure Class
6	350
8	350
12	350
16	300
20	300
24	250

NOTES:

1. Larger pipe sizes up to 54-inch can be installed as pressure Class 200 with cover up to 9 feet and an operating pressure of 200 psi, where approved by Alliance Consulting Engineers, Inc.. When trench depths exceed 15 feet for pipe sizes of 16-inch or larger, Alliance Consulting Engineers, Inc. shall direct the Contractor on the proper class pipe to use.
2. The noted pressure class is adequate to support 3/4 and 1-inch corporation stops. Use a full saddle for larger taps (e.g., air relief valves or larger corporations) due to limited wall thickness.
3. There are special conditions where a larger wall thickness is required. Alliance Consulting Engineers, Inc. shall direct the Contractor on the proper pressure class pipe to use in specific instances; e.g. at treatment plant or booster station sites where frequent excavation can be anticipated in the vicinity of pipe, where the pipeline is laid on a river channel bottom to prevent external damage to the pipe and minimize the potential for costly pipe replacement, etc.

D. Testing

Perform a hydrostatic test of all pipe and appurtenances as required by AWWA Standard C151, and Specification 33 10 00 Section 3.11 – Flushing and Pressure Testing or Specification 33 31 00.11 Section 3.06 C – Pipe Leakage Test as applicable.

E. Joints

1. Mechanical and Push-On

Mechanical and push-on joints including accessories shall conform to AWWA Standard C111.

2. Flanged

Flanged joints shall conform to AWWA Standard C110 or ANSI B16.1 for fittings and AWWA Standard C115 for pipe. Do not use flanged joints in underground installations except within structures.

Furnish all flanged joints with 1/8-inch thick, red rubber or styrene butadiene rubber gaskets. The bolts shall have American Standard heavy unfinished hexagonal head and nut dimensions all as specified in American Standard for Wrench Head Bolts and Nuts and Wrench Openings (ANSI B18.2). For bolts of 1-3/4-inches in diameter and larger, bolt studs with a nut on each end are recommended. The high-strength, low-alloy steel for bolts and nuts shall have the characteristics listed in Table 6 of AWWA Standard C111.

Stainless steel nuts and bolts are required on piping within wastewater treatment plants and pump stations.

3. Restrained Joint Pipe

Restrained joints for pipes shall be of the boltless push-on type which provides joint restraint independent of the joint seal. Restrained push-on joints allowed for pipe only shall have accessories conforming to AWWA Standard C111. Restrained system shall be suitable for the following minimum working pressures:

<u>Size</u> <u>(Inch)</u>	<u>Pressure</u> <u>(psi)</u>
Less than 20	300
20	300
24	250
30 - 64	200

2.02 FITTINGS

A. Ductile Iron Fittings

Standard fittings shall be ductile iron conforming to AWWA Standard C110. Compact ductile iron fittings shall meet the requirements of AWWA Standard C153.

1. Working Pressures

Fittings shall be suitable for the following working pressures unless otherwise noted in AWWA Standard C110 or C153:

Working Pressure (psi)		
Size (Inch)	Compact Fittings	Standard Fittings
3 - 24	300	250, 300 (with special gaskets)
30 - 48	250	250
54 - 64	150	N/A

The use of standard ductile iron fittings having a 250 psi pressure rating with ductile iron pipe (having a rating of 350 psi) is not permitted except by the express written approval of Alliance Consulting Engineers, Inc.

2. Coating and Lining

The fittings shall be coated on the outside with a petroleum asphaltic coating in accordance with AWWA Standard C110 or fusion-coated epoxy in accordance with AWWA Standard C116 and lined inside with cement-mortar and seal coated in accordance with AWWA Standard C104 or fusion coated epoxy in accordance with AWWA Standard C116.

Sewer lines shall be lined inside with fusion-coated epoxy. No exceptions.

B. Joints

1. Mechanical and Push-On

Mechanical and push-on joints including accessories shall conform to AWWA Standard C111. Anti-Rotation T-Bolts shall be used on mechanical joints shall be of domestic origin, high strength, low alloy steel bolts only, meeting the current provisions of ANSI/AWWA C111/A21.1 for rubber gasket joints for cast iron or ductile iron pipe and fittings. Bolt manufacturer's certification of compliance must accompany each shipment. T-bolts shall be corrosion resistant to handle corrosive conditions on any buried bolts.

2. Flanged

Flanged joints shall meet the requirements of AWWA Standard C115 or ANSI B16.1. Do not use flanged joints in underground installations except within structures. Furnish all flanged joints with minimum 1/8-inch, thick red rubber or styrene butadiene rubber full-face gaskets. The bolts shall have heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Corrosion resistant hex bolts to handle corrosive conditions shall be used on any buried flanged bolts.

Bolts and nuts shall be threaded in accordance with ASME/ANSI B1.1, Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. For bolts of 1-³/₄-inches in diameter and larger, stud bolts with a nut on each end are recommended. Material for

bolts and nuts shall conform to ASTM A307, 60,000 PSI Tensile Strength, Grade B, unless otherwise specified. Bolt manufacturer's certification of compliance must accompany each shipment.

3. Restrained

Restrained joints for valves and fittings shall be of the boltless push-on type which provides joint restraint independent of the joint seal. Field Lok gaskets are not permitted on valves or fittings. Restrained push-on joints allowed for pipe only shall have accessories conforming to AWWA Standard C111. Restrained system shall be suitable for the following minimum working pressures:

<u>Size</u> <u>(Inch)</u>	<u>Pressure</u> <u>(psi)</u>
Less than 20	300
20	300
24	250
30 - 64	250

Where adjacent fittings are to be placed (as in a mechanical joint hydrant tee and a mechanical joint hydrant valve), the use of a suitably sized Foster adaptor is permitted to facilitate restraint between the fittings.

PART 3: EXECUTION

3.01 INSTALLATION

Follow the provisions of Section- Piping - General Provisions in addition to the following requirements:

A. Push-On Joints

Clean the surfaces that the gasket will contact thoroughly, just prior to assembly using a bacteria free solution (bleach, potable water or NSF approved material). Insert the gasket into the groove in the bell. Apply a liberal coating of special lubricant to the gasket and the spigot end of the pipe before assembling the joint. Center the spigot end in the bell and push home the spigot end.

B. Mechanical Joints

Clean and lubricate all components with soapy water prior to assembly. Slip the follower gland and gasket over the pipe plain end making sure that the small side of the gasket and lip of the gland face the bell socket. Insert the plain end into socket. Push gasket into position with fingers. Seat gasket evenly. Slide gland into position, insert bolts, and tighten nuts by hand. Tighten bolts alternately (across from one another) to the recommended manufacturing rating or if not provided, to the following normal torques:

	Range of Torque
<u>Bolt Size</u>	<u>In Foot-Pounds</u>
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

After field installation, all bolts shall receive petrolatum tape or petroleum wax protection or other approved coating material.

C. Restrained Joints

1. Ball and Socket

Assemble and install the ball and socket joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

2. Push-On

Assemble and install the push-on joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when "pushing home" any pipe by using wood or other suitable (non metallic) material.

3. Mechanical Joint

Assemble and install the mechanical joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Use approved restrained joint device on fittings and valves where required and approved for use by Alliance Consulting Engineers, Inc.

D. Pipe Protection

Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when "pushing home" any pipe. Wood or other suitable material (non metallic) shall be used to push home the pipe.

E. Gaskets

Gaskets shall be as provided or recommended by the manufacturer and satisfy AWWA Standard C111 in all respects with the exception of requirements noted in Part 2.

END OF SECTION

DUCTILE IRON PIPE & FITTINGS

SECTION 33 31 00.11

GRAVITY SANITARY SEWERS

PART 1: GENERAL

1.01 SCOPE

- A. Gravity sanitary sewers and appurtenances.

1.02 SUBMITTALS

- A. Conform to requirements of Section 01 30 00 – Administrative Requirements.
- B. Submit proposed methods, equipment, materials and sequence of operations for sewer construction. Plan operations to minimize disruption of utilities to occupied facilities or adjacent property.
- C. Test Reports: Submit test reports as specified in Part 3 of this Section.

1.03 QUALITY ASSURANCE

- A. Qualifications: Install sanitary sewer that is watertight both in pipe-to-pipe joints and in pipe-to-manhole connections. Perform testing in accordance with Section 33 01 30.13 - Acceptance Testing for Sanitary Sewers.
- B. Regulatory Requirements.
 - 1. Install sewer lines to meet minimum SCDHEC mandated separation distance from potable water lines. Separation distance is defined as distance between outside of water pipe and outside of sewer pipe. Install new sanitary sewers no closer to water lines than 10 feet in all horizontal directions. Where water and sanitary sewer lines cross, a minimum vertical separation in accordance with SCDHEC and/or local standards is required when the water line passes above the sanitary sewer main. Where separation distance cannot be achieved, sanitary sewers shall be constructed of ductile iron sanitary sewer piping or encased in reinforced concrete (as detailed on the Construction Drawings) for a minimum distance of 10 feet either side of the crossing.
 - 2. Notify Alliance Consulting Engineers, Inc. immediately when water lines are uncovered during sanitary sewer installation where minimum separation distance cannot be maintained.
 - 3. Lay gravity sewer lines in straight alignment and grade.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Inspect pipe and fittings upon arrival of materials at job site.
- B. Handle and store pipe materials and fittings to protect them from damage due to impact, shock, shear or free fall. Do not drag pipe and fittings along ground. Do not roll pipe unrestrained from delivery trucks.
- C. Use mechanical means to move or handle pipe. Employ acceptable clamps, rope or slings around outside barrel of pipe and fittings. Do not use hooks, bars, or other devices in contact with interior surface of pipe to lift or move lined pipe.

PART 2: PRODUCTS

2.01 PIPE

- A. Provide piping materials for gravity sanitary sewers of sizes and types indicated on the Construction Drawings or as specified.
- B. Unlined reinforced concrete pipe is not acceptable.

2.02 PIPE MATERIAL SCHEDULE

- A. Unless otherwise shown on the Construction Drawings, use pipe materials that conform to requirements specified in one or more of following Sections:
 - 1. Section 33 11 00.15 - Ductile Iron Pipe and Fittings.
 - 2. Section 33 11 00.11 - Polyvinyl Chloride Pipe.
- B. Where shown on Drawings, provide pipe meeting minimum class, dimension ratio, or other criteria indicated.
- C. Pipe materials other than those listed above shall not be used for gravity sanitary sewers.

2.03 APPURTENANCES

- A. Laterals: Conform to requirements of Section 33 31 00.15 - Sanitary Sewer Service Laterals.
- B. Service Connections: Conform to requirements of Section 33 31 00.15 - Sanitary Sewer Service Laterals.
- C. Roof, street or other type of surface water drains shall not be connected or reconnected into sanitary sewer lines.

2.04 BEDDING AND BACKFILL MATERIAL

- A. Bedding and Backfill: Conform to requirements of Section 31 23 33 - Excavation Backfill and Compaction for Utilities and Section 31 23 23 - Utility Backfill Materials.

PART 3: EXECUTION

3.01 PREPARATION

- A. Prepare traffic control plans and set up street detours and barricades in preparation for excavation when construction will affect traffic. Conform to requirements of Manual on Uniform Traffic Control Devices (MUTCD), and/or local standards where applicable.
- B. Provide barricades, flashing warning lights, and warning signs for excavations. Conform to requirements MUTCD and/or local standards where applicable. Maintain barricades and warning lights where work is in progress or where traffic is affected.
- C. Perform work in accordance with OSHA standards. Employ trench safety system for excavations over 5 feet deep.
- D. Immediately notify agency or company owning utility line which is damaged, broken or disturbed. Obtain approval from Alliance Consulting Engineers, Inc. and agency or utility company for repairs or relocations, either temporary or permanent.
- E. Remove, repair and or replace old pavements and structures including sidewalks and driveways in accordance with installation and local and state requirements.
- F. Install and operate dewatering and surface water control measures in accordance with Contract Document requirements.
- G. Do not allow sand, debris or runoff to enter sewer system.

3.02 DIVERSION PUMPING

- A. All diversion and bypass pumping shall be performed in accordance with Section 33 01 30.51 – Pumping and Bypassing.

3.03 EXCAVATION

- A. Earthwork: Conform to requirements of Section 31 23 33 - Excavation Backfill and Compaction for Utilities. Use bedding as indicated on Drawings.
- B. Line and Grade: Establish required uniform line and grade in trench from benchmarks identified by Alliance Consulting Engineers, Inc. Maintain this control for minimum of 100 feet behind and ahead of pipe-laying operation. Use laser beam equipment to establish and maintain proper line and grade of work. Use of appropriately sized grade boards which are substantially supported is also acceptable. Protect boards and location stakes from damage or dislocation.
- C. Trench Excavation. Excavate pipe trenches to depths shown on Drawings and as specified in Section 31 23 33 - Excavation Backfill and Compaction for Utilities.

3.04 PIPE INSTALLATION BY OPEN CUT

- A. Install pipe in accordance with pipe manufacturer's recommendations and as specified in following paragraphs.
- B. Install pipe only after excavation is completed, bottom of trench fine graded, bedding material is installed, and trench has been approved by Alliance Consulting Engineers, Inc.
- C. Install pipe to line and grade indicated. Place pipe so that it has continuous bearing of barrel on bedding material and is laid in trench so interior surfaces of pipe follow grades and alignment indicated. Provide bell holes where necessary.
- D. Install pipe with spigot ends toward downstream end of flow such that water flows into bell and out the spigot.
- E. Form concentric joint with each section of adjoining pipe so as to prevent offsets.
- F. Keep interior of pipe clean as installation progresses. Remove foreign material and debris from pipe
- G. Provide lubricant, place and drive home newly laid sections with come-a-long winches so as to eliminate damage to sections. Install pipe to "home" mark where provided. Use of back hoes or similar powered equipment will not be allowed unless protective measures are provided and approved in advance by Alliance Consulting Engineers, Inc.
- H. Keep excavations free of water during construction and until final inspection.
- I. When work is not in progress, cover exposed ends of pipes with approved plug to prevent foreign material from entering pipe.
- J. Where gravity sanitary sewer is to be installed under existing water line with separation distance of less than 2 feet, construct new sewer pipe so that 20 feet of ductile iron pipe is centered on water line crossing or encase the sewer line with reinforced concrete encasement as detailed on the plans. If gravity sanitary sewer is to be installed above existing water line, construct new sewer pipe so that 20 feet of ductile iron pipe is centered on water line crossing or encase the sewer line with reinforced concrete encasement. .
- K. Where gravity sanitary sewer is to be installed under existing water line, install new sewer using ductile iron or encased in reinforced concrete encasement as shown on the Construction Drawings. Maintain a minimum of 2-foot separation distance.
- L. Where the length of the stub is not indicated, install the stub to the right-of-way line and seal the free end with an approved plug.

3.05 PIPE INSTALLATION OTHER THAN OPEN CUT

- A. For installation of pipe by directional drilling, conform to requirements of specification sections on directional drilling as appropriate.

3.06 INSTALLATION OF APPURTENANCES

- A. Service Connections. Install service connections to conform to requirements of Section 33 31 00.15- Sanitary Sewer Laterals.
- B. Construct manholes to conform to requirements of Section 03 48 10 - Precast Concrete Manholes.

3.07 INSPECTION AND TESTING

- A. Visual Inspection: Check pipe alignment in accordance with Section 33 01 30.13 - Acceptance Testing for Sanitary Sewers.
- B. Mandrel Testing. Use Mandrel Test to test flexible pipe for deflection. Refer to Section 33 01 30.13 - Acceptance Testing for Sanitary Sewers.
- C. Pipe Leakage Test. After backfilling line segment and prior to tie-in of service connections, visually inspect gravity sanitary sewers where feasible, and test for leakage in accordance with Section 33 01 30.13 - Acceptance Testing for Sanitary Sewers.

3.08 BACKFILL AND SITE CLEANUP

- A. Backfill and compact soil in accordance with Section 31 23 33 – Excavation Backfill and Compaction for Utilities.
- B. Backfill trench in specified lifts only after pipe installation is approved by Alliance Consulting Engineers, Inc.
- C. Repair and replace removed or damaged pavement, curbs, gutters, and sidewalks as specified by local base regulations.

END OF SECTION