SECTION 01001

GENERAL REQUIREMENTS

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PART 1 GENERAL

1.1 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases.

1.2 APPLICATIONS FOR PAYMENT

A. Submit four (4) copies of each application on form approved by the Engineer.

B. Content and Format: Utilize “Schedule of Bid Prices” included as an attachment to the Agreement for listing items in Application for Payment.

C. Payment Period: Monthly.

1.3 CHANGE PROCEDURES

A. Authorized Changes to the Work: Pursuant to written direction to Contractor from the Engineer or the Owner in the form of a Change Order or Field Order.

B. Change Order: Issued for changes in quantities of Work, Contract Price or Contract Time.

C. Field Order: Issued for minor changes for which there is no change in Contract Price or Contract Time.

D. Changes in Contract Price or Contract Time will be determined in accordance with Article 12 of the General Conditions.

1.4 UNIT PRICES

A. Unit Price Schedule: The “Schedule of Bid Prices” is contained in the Bid Form, included as an attachment to the Agreement.

B. All costs in connection with the proper and successful completion of the Work, including furnishing all materials, equipment, supplies and appurtenances; bonds, insurance, providing all construction plant, equipment and tools; transportation, testing and performing all necessary labor and supervision to fully complete the Work shall be included in the unit prices bid for each item.

C. All work not specifically set forth as a pay item in the Schedule of Bid Prices in the Bid Form shall be considered a subsidiary obligation of the contractor and all costs in connection therewith shall be included in the prices bid.

D. All items of Work shall be measured in the units indicated in the Schedule of Bid Prices.

1.5 COORDINATION

A. Coordinate scheduling, submittals, and Work by subcontractors under the various sections of the specifications to ensure efficient and orderly sequence of installation of interdependent construction elements.

1.6 FIELD ENGINEERING

A. Employ experienced instrument technician to locate reference datum and protect survey control and reference points.

B. Establish elevations, lines, and levels and certify elevations and locations of the Work conform to Contract Documents.

C. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.

1.7 PRECONSTRUCTION MEETINGS

A. The requirements for preconstruction meetings are outlined in the General Conditions and the Supplementary Conditions.

B. Engineer will coordinate preconstruction meetings with affected parties.
   1. Time and place: As determined by Owner or other affected agencies.
   2. Attendees: As specified in the General Conditions and in the Supplementary Conditions and as directed by the Owner or the Engineer.

1.8 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at intervals to be determined at the preconstruction meeting.

B. Preside at meetings, record minutes, and distribute copies within three days to those affected by decisions made.

1.9 SUBMITTAL PROCEDURES

A. Within 15 days after the date established in the Notice to Proceed, submit preliminary Schedule of Submittals in duplicate for Engineer's review. Include Product data, Shop Drawings, samples and certifications as required by Technical Specification Sections.

B. Submit at least five copies of each submittal. The Engineer will retain four copies and return the remainder to the Contractor.

C. Attach each submittal to a submittal form that identifies the Project, Contractor, subcontractor or supplier, and applicable Contract Document references.

D. Apply Contractor's stamp, signed or initialed, certifying that review, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

E. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of completed Work.

F. Revise and resubmit submittals as required; identify changes made since previous submittal.

1.10 CONSTRUCTION PROGRESS SCHEDULES

A. Within 15 days after the date established in the Notice to Proceed, submit preliminary Progress Schedule in duplicate for Engineer’s review. Revise and resubmit as required.

B. Submit revised schedules with each Application for Payment, identifying changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission.

1.11 QUALITY CONTROL

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer’s instructions.

C. Comply with specified standards as minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

1.12 REFERENCES

A. Conform to referenced standards, specifications and details of construction by date of issue current as of date for receiving bids.

B. When referenced standards, specifications or details of construction conflict with Contract Documents, request clarification from Engineer before proceeding.

1.13 TESTING LABORATORY SERVICES

A. All testing, including re-testing due to failure of acceptance tests, will be paid for by the Contractor.

B. Contractor will appoint, employ, and pay for specified services of an independent testing laboratory, acceptable to the Owner, to perform all testing required by the Technical Specifications.

C. Testing laboratory shall operate in accordance with ASTM C1077, ASTM D3740, ASTM D3666 and ASTM E329.

D. Cooperate with independent firm; furnish samples as requested.

E. Furnish five (5) copies of all test reports to Engineer.

1.14 TEMPORARY UTILITIES

A. Provide and pay for temporary electricity and power outlets for construction operations; connections, branch wiring, distribution boxes and flexible power cords as required.

B. Provide and maintain temporary lighting for construction operations if required.

C. Provide, maintain and pay for suitable quality water service required for construction operations.

D. Provide and maintain required sanitary facilities and enclosures.
1. Maintain in clean and sanitary condition.
2. Strictly enforce their use.

1.15 MAINTENANCE AND REMOVAL OF TEMPORARY FACILITIES

A. Maintain temporary utilities and facilities as long as needed for safe and proper completion of Work.

B. Remove temporary utilities, equipment, facilities, materials prior to Substantial Completion.

C. Clean and repair damage caused by installation or use of temporary Work.

D. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.16 PROGRESS CLEANING AND WASTE REMOVAL

A. Collect and maintain areas free of waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Deposit waste material, trash, construction debris in securely lidded metal containers and remove from site on a regular basis.

C. Waste storage containers shall meet all local and state solid waste management regulations.

D. Dispose of waste material and trash at a location offsite designated to receive such material.

E. No waste material, trash or construction debris of any kind will be buried on the site.

F. All hazardous waste shall be disposed of in accordance with state and local regulations and the manufacturer's recommendations.

1.17 PROTECTION OF INSTALLED WORK

A. Protect installed Work and provide special protection where specified in individual specification sections.

1.18 WATER CONTROL

A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

1.19 POLLUTION AND ENVIRONMENTAL CONTROL

A. Implement the Storm Water Pollution Prevention Plan (SWPPP) upon commencement of construction activities and comply with all provisions of the SWPPP throughout the construction period.

B. Periodic site inspections required by the SWPPP, along with all required inspection reports shall be provided by the Owner.

1.20 PRODUCT DELIVERY, HANDLING, STORAGE

A. Deliver, handle, store, and protect Products in accordance with manufacturer's instructions.

B. Store only enough product on site to complete the Work under this project.

C. Keep products stored in neat, orderly manner in appropriate containers and, where applicable, protected from the weather.

D. Do not place materials on private property without written permission from property owner.

E. During loading, transporting and unloading, exercise care to prevent damage to materials.

F. Store products in their original containers with original manufacturer's labels and safety data.

G. Follow manufacturer's instructions as well as all state and local regulations and recommendations for disposal of unused or waste product.

H. Mix substances only in accordance with manufacturer's instructions.

I. Contain spills and leakage and perform spill or leakage clean up immediately and in accordance with manufacturer's instructions as well as all state and local regulations and recommendations.

1.21 SUBSTITUTIONS

A. Engineer will consider requests for Substitutions only after the effective date of the Agreement.

B. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

C. Submit five copies of request for Substitution for consideration. Limit each request to one proposed Substitution.

1.22 AS-BUILT DRAWINGS

A. Water Distribution and Sanitary Sewer Systems.
   1. Maintain on site one set of Contract Drawings to be annotated for As-Built Drawings.
   2. Record in red on the As-built Drawings all deviations from the Contract Drawings, including, but not limited to, the following data for the water distribution and sanitary sewer systems:
      a. Horizontal location:
         1) Underground pipelines
         2) Fittings
         3) Valves
         4) Fire hydrants
         5) Manholes
         6) Clean-outs
         7) Service laterals
         8) Service lateral terminations
         9) Pump stations
      b. Depth of cover on all valves and fittings if greater than 3-ft.
      c. Type, size, material, joint type and manufacturer of all valves
      d. Linear feet of water line, sanitary sewer or force main
      e. Size, type (material) and class of pipe
      f. Slope of gravity sewer lines
      g. Average bury depth of pipe
      h. Identification of fittings type, material, size and joint type
      i. Elevations at manholes: Rim and inverts
      j. Elevation on top of force main connection to manhole or force main manifold
   3. Record in red on the As-Built drawings for water and sanitary sewer systems, the following data for locations at which the newly installed pipe lines cross existing pipe lines or culverts:
      a. Horizontal location of point of crossing
      b. Elevation of top and bottom of existing pipe line or culvert at point of crossing

c. Elevation of top and bottom of newly installed pipe line at point of crossing
d. Fittings used at crossing:
1) Type, size, joint type
2) Horizontal location
3) Elevation of top of fittings

4. Location and dimensional data may be obtained by field measurements or by generally accepted survey methods.
a. Field measurements:
1) All measurements shall be from permanent above-ground structures, monuments or other identifiable reference objects approved by the Engineer.
2) The location of elements by field measurements shall be defined by measurements to at least two reference objects.
b. Location by survey methods:
1) Survey must be based on the USA South Carolina State Plane, RNAD 83 Coordinate System (Map code SC83F).
2) Elevations must be based on the 1929 USGS datum.
3) Furnish data as Point Files in AutoCAD or ASCI format.

B. Storm Drainage System:
1. The Owner shall engage the services of a registered South Carolina Professional Land Surveyor to conduct a field survey of the completed storm drainage facilities and to prepare as-built drawings for the storm drainage system. The following data shall be obtained by the Surveyor and included in the as-built drawings for the storm drainage system:
a. Horizontal location of pipe ends, drainage inlets, catch basins, junction boxes, manholes, headwalls and pond inlet/outlet structures
b. Elevation of frame, grate or lid, throat, and sump (bottom) at all drainage inlets, catch basins manholes and junction boxes
c. Invert elevation of all pipe ends
d. Identification of pipe diameter and material
e. Identification of inlet or catch basin type.
f. Size and type of manhole or junction box.
g. Elevations at storm water pond:
1) Top of bank elevation
2) Bottom elevation
3) Top of embankment/berm elevation
4) Littoral shelf elevation (if applicable)
5) Invert elevation of pond emergency spillway (if applicable)
6) Weir/invert elevation(s) and dimensions of pond outlet control structure(s)

2. Data appearing on the as-built drawling for the storm drainage system shall be obtained by accepted field survey methods.
a. Horizontal information shall be based on NAD 83.
b. Vertical information shall be based on NGVD 29.

3. The as-built drawings for the storm drainage system shall be signed and sealed by the SC PLS who prepared them.

C. In the event deviations are made from approved shop drawings, a copy of the shop drawings, annotated in red showing the changes and as-built data, shall be included as part of the As-Built Drawings.

1.23 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and Work is complete in accordance with Contract Documents and ready for Engineer's inspection.

B. Deliver the following documents to the Engineer:
1. As-built drawings
2. Executed Contractor’s General Guarantee
3. Executed Certificate of Non-Litigation

C. Submit final Application for Payment identifying total adjusted Contract Sum/Price, previous payments, and amount remaining due.

1.24 FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean debris from drainage systems.

C. Remove waste and surplus materials, rubbish and construction facilities from site.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 02140

DEWATERING

PART 1 GENERAL

1.1 DESCRIPTION: This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill, and construction to be performed in the dry. Control of surface water shall be considered as part of the work under this specification.

1.2 REQUIREMENT:

A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least 1 foot below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated in a reasonably dry condition. Materials removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.

B. Reduce hydrostatic head below any excavation to extent that water level in the construction area is a minimum of 1 foot below prevailing excavation surface.

C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.

D. Maintain stability of sides and bottom of excavation.

E. Construction operations are performed in the dry.

F. Control of surface and subsurface water are part of dewatering requirements. Maintain adequate control so that the stability of excavated and constructed slopes are not adversely affected by saturated soil including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action , that erosion is controlled and that flooding of excavations or damage to structures does not occur. Drain surface water away from excavations. Protect excavations from becoming wet from surface water, or insure excavations are dry before additional work is undertaken.

1.3 RELATED WORK:

A. Materials testing and inspection during construction: Section 01001, General Requirements, Article 1.13 Testing Laboratory Services.

B. Safety Requirements: General Conditions, Article 6.13 Safety and Protection.

C. Subsurface Investigation: General Conditions, Article 4.02 Subsurface and Physical Conditions

1.4 SUBMITTALS:

A. Submit in accordance with Section 01001 General Requirements, Article 1.9 Submittal Procedures.

B. Submittals should be made to allow time for review and comment prior to scheduled time for commencement of trenching operations.

C. Drawings and Design Data:
1. Submit drawings and data showing the method to be employed in dewatering excavated areas.
2. Submitted material shall include location, depth and size of well points, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
3. Materials submitted shall be in a format acceptable for inclusion in required permit applications to any and all regulatory agencies for which permits for discharging water from the dewatering system are required due to the discharge reaching regulated bodies of water.

PART 2 PRODUCTS (Not used)

PART 3 EXECUTION

3.1 INSTALLATION:

A. Install a dewatering system to lower and control ground water in order to permit excavation, construction of structure and placement of backfill materials, to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.

B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water

levels in construction area are a minimum of 1 foot below prevailing excavation surface at all times.

3.2 OPERATION:

A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and then operate it continuously 24 hours a day, 7 days a week until all utilities and structures have been satisfactorily constructed including placement of backfill materials and dewatering is no longer required.

B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL: Dispose of water removed from the excavations in such a manner as to not endanger portions of work under construction or completed. Dispose of water in such a manner as will cause no inconvenience to others working near site. Comply with the stipulations of required permits for disposal of water.

3.4 STANDBY EQUIPMENT: Provide complete standby equipment, installed and available, for immediate operation as may be required, to adequately maintain de-watering on a continuous basis and, in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION: If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil resulting from such inadequacy or failure by contractor, at no additional cost to Owner.

3.6 REMOVAL: Insure compliance with all conditions of regulating permits and provide such information to the Engineer. Obtain written approval from Engineer before discontinuing operation of dewatering system.

END OF SECTION

SECTION 02221

BUILDING DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolishing designated buildings and structures.
2. Demolishing designated foundations.
3. Demolishing designated slabs-on-grade.
4. Disconnecting and capping designated utilities services.
5. Demolishing designated underground tanks.
6. Removing designated items for Owner's retention.
7. Protecting items designated to remain.
8. Removing demolished materials.

B. Related Sections:
1. Section 02230 - Site Clearing: Clearing outside periphery of structures.
2. Section 02300 - Earthwork

1.2 MEASUREMENT AND PAYMENT

A. Building Demolition
1. Basis of Measurement: No separate measurement will be made for building demolition.
2. Basis of Payment: Payment will be made at the lump sum bid for Building Demolition and shall include all costs for demolition, salvaging designated materials to Owner, removal of waste material and debris, disconnecting and capping utility services and all other costs of whatever nature required for the performance of the Work under this Section of the Specifications.
3. Bid Item: Unit
a. Building Demolition L.S.

1.3 SUBMITTALS

A. Section 01001 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of barricades, fences, and temporary work.

C. Design Data: Submit calculations for bracing, shoring, and underpinning, if required, signed and sealed by professional engineer.

D. Existing Building Documentation: Submit the following for existing buildings indicated to remain.

1. Survey indicating position and elevation of exterior building features.
2. Photographic survey indicating conditions before, during, and after demolition work.

E. Submit copy of permits required by regulatory agencies for demolition and sidewalk and street closings.

1.4 QUALITY ASSURANCE

A. Conform to applicable Federal, State and local codes for demolition of structures, safety of adjacent structures, dust control, runoff control and disposal.

B. Conform to applicable Federal, State and local codes for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

1.5 QUALIFICATIONS

A. Demolition Firm: Company specializing in performing work of this section.

B. Design shoring, bracing, underpinning, when required, under direct supervision of Professional Engineer experienced in design of this Work and licensed in State where the Work is located.

1.6 PROJECT CONDITIONS

A. Buildings indicated to be demolished will be vacated before start of Work.

B. Owner assumes no responsibility for actual condition of buildings to be demolished.

C. Notify Architect/Engineer upon discovery of hazardous materials.

D. Do not sell demolished materials on-site.

E. Maintain existing public sidewalks to greatest extent possible.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine existing buildings indicated to be demolished before demolition.

B. Determine where removals may result in structural deficiency or unplanned building collapse during demolition. Coordinate demolition sequence and procedures to prevent structures from becoming unstable.

C. Determine where demolition may affect structural integrity or weather resistance of adjacent buildings indicated to remain.
   1. Identify measures required to protect buildings from damage.
   2. Identify remedial work including patching, repairing, bracing, and other work required to leave buildings indicated to remain in structurally sound and weathertight and watertight condition.

D. Verify hazardous material abatement is complete before beginning demolition.

3.2 PREPARATION

A. Call Local Utility Line Information and location service not less than five working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Notify affected utility companies before starting work and comply with utility's requirements.

C. Do not close or obstruct roadways, sidewalks or hydrants without permits.

D. Erect, and maintain temporary barriers and security devices, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.

E. Protect existing landscaping materials, trees, appurtenances and structures indicated to remain.

F. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.

3.3 DEMOLITION REQUIREMENTS

A. Use of explosives is not permitted.

B. Conduct demolition to minimize interference with adjacent structures.

C. Cease operations immediately when adjacent structures appear to be in danger. Notify authority having jurisdiction and Engineer. Do not resume operations until directed.

D. Conduct operations with minimum interference to public or private accesses to occupied adjacent structures. Maintain protected egress and access from adjacent structures at all times.

E. Obtain written permission from adjacent property owners when demolition equipment will traverse, infringe upon or limit access to their property.

F. Sprinkle Work with water to minimize dust. Provide hoses and water connections required for this purpose.

3.4 DEMOLITION

A. Disconnect and cap designated utilities. Identify utilities at termination of demolition. Record termination or capped location on Record Documents.

B. Unless otherwise directed or indicated on the drawings, remove foundation walls and footings to minimum of two feet below finished grade.

C. Remove concrete slabs-on-grade.

D. Empty underground tanks located within demolition area.

E. Remove underground tanks, components, and piping from site.

F. Remove materials to be re-installed or retained in manner to prevent damage.

END OF SECTION

SECTION 02230

SITE CLEARING AND MINOR DEMOLITION

PART 1 GENERAL:

1.1 SUMMARY:

A. This Section includes the following:
   1. Protection of existing trees that are to remain.
   2. Removal of designated trees and other vegetation.
   3. Clearing and grubbing.
   4. Removal of drainage and utility pipes and structures.
   5. Abandoning existing pipes and structures in place.
   6. Removal of designated paving, curbs, gutters and sidewalks
   7. Removal of debris and all unusable material from the site

B. Related Documents:
   1. Section 02221 – Building Demolition
   2. Section 02300 – Earthwork
   3. Section 02374 – Erosion Control

1.2 MEASUREMENT AND PAYMENT

A. Tree Protection
   1. Basis of Measurement: Linear feet of tree protection installed in accordance with the details on the drawings and as specified herein.
   2. Basis of Payment: Payment will be made at the unit price bid per linear foot for Tree Protection and will include all costs for material, labor, equipment, transportation, installation, maintenance in place, removal and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
   3. Pay Item:
      a. Tree Protection

B. Clearing and Grubbing
   1. Basis of Measurement: Work under this Section will be measured by the number of acres of cleared and grubbed area. No separate measurement will be made for tree removal.
   2. Basis of Payment: Payment will be made at the unit price bid per acre for Clearing and Grubbing and shall include all costs for clearing, grubbing, tree removal, removal of all debris and waste material from the site and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
   3. Pay Item:
      a. Clearing and Grubbing

C. Pavement Removal;
   1. Basis of Measurement: Square yards of asphalt or portland cement concrete pavement removed as designated on the Drawings and in accordance with this section of the Specifications.
   2. Basis of Payment: Payment will be made at the unit price bid per square yard for Pavement Removal and shall include all costs for saw cutting, breaking, removal, loading and unloading, hauling, disposal off site and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
   3. Pay Item:
      a. Pavement Removal

D. Concrete Curb and Gutter Removal:
   1. Basis of Measurement: Linear feet of concrete curb, concrete gutter or concrete combination curb and gutter removed as designated on the Drawings and in accordance with this section of the Specifications.
   2. Basis of Payment: Payment will be made at the unit price bid per linear foot for Concrete Curb/Gutter Removal and shall include all costs for saw cutting, breaking, removal, loading and unloading, hauling, disposal off site and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
   3. Pay Item:
      a. Concrete Curb/Gutter Removal

E. Sidewalk Removal:
   1. Basis of Measurement: Square yards of portland cement concrete or asphalt sidewalk removed as designated on the Drawings and in accordance with this section of the Specifications.
   2. Basis of Payment: Payment will be made at the unit price bid per square yard for Sidewalk Removal and shall include all costs for saw cutting, breaking, removal, loading and unloading, hauling, disposal off site and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
   3. Pay Item:
      a. Sidewalk Removal

F. Pipe Removal:
   1. Basis of Measurement: Linear feet of pipe removed as designated on the Drawings and in accordance with this section of the Specifications. No measurement will be made for pipe removed and replaced with new pipe in the same location.
   2. Basis of Payment: Payment will be made at the unit price bid per linear foot for Pipe Removal and shall include all costs for locating, excavation, backfilling, disconnecting, disposal and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings. No payment will be made for removal of pipe that is replaced with new pipe in the same location. Removal of the existing pipe will be considered incidental to the installation of the new pipe.

3. Pay Item:
    a. Pipe Removal

G. Plug and Abandon Pipe In Place:
1. Basis of Measurement: Each location where existing pipe is plugged and abandoned as designated on the Drawings and in accordance with this section of the Specifications.
2. Basis of Payment: Payment will be made at the unit price bid per each for plugging and abandoning pipe in place and shall include all costs for locating, excavation, backfilling, disconnecting, installing plug and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
3. Pay Item:
    a. Plug and Abandon Pipe In Place

H. Remove Existing Drainage Structure:
1. Basis of Measurement: Each existing drainage structure removed as designated on the Drawings and in accordance with this section of the Specifications.
2. Basis of Payment: Payment will be made at the unit price bid per each for removal of existing drainage structure, type indicated, and shall include all costs for excavation, backfill, demolition, removal, disposal off site, restoration and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
3. Pay Item:
    a. Remove Existing Drainage Structure, (type indicated).

I. Remove Existing Sanitary Sewer Manhole:
1. Basis of Measurement: Each existing sanitary sewer manhole removed as designated on the Drawings and in accordance with this section of the Specifications.
2. Basis of Payment: Payment will be made at the unit price bid per each for removal of existing sanitary sewer manhole and shall include all costs for excavation, backfill, demolition, removal, disposal off site restoration and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
3. Pay Item:
    a. Remove Existing Sanitary Sewer Manhole

J. Fill and Abandon Existing Manhole/Inlet:
1. Basis of Measurement: Each existing manhole or storm inlet filled and abandoned as designated on the Drawings and in accordance with this section of the Specifications.
2. Basis of Payment: Payment will be made at the unit price bid per each for filling and abandoning existing manhole/inlet and shall include all costs for excavation, backfill, removal of castings, fill material, restoration and all other costs of whatever nature required to complete the Work as described herein and as shown on the drawings.
3. Pay Item:

a. Fill and Abandon Existing Manhole/Inlet

PART 2 PRODUCTS

2.1 Flowable Fill: SCDOT Standard Specifications, Section 210.

PART 3 EXECUTION

3.1 PREPARATI0N

A. Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct, walks or other occupied or used facilities without permission from authorities having jurisdiction.

B. Provide protection necessary to prevent damage to existing improvements indicated to remain in place.

1. Protect improvements on adjoining properties and on Owner's property;

2. Restore damaged improvements to their original condition, as acceptable to property owners.

C. Tree Protection

1. Protect existing trees and other vegetation indicated to remain in place to prevent damage resulting from unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line or any other acts which may be harmful to the continued growth of the trees to be protected.
2. Install tree protection fencing where indicated on the plans and in accordance with the details on the Drawings. Maintain tree protection during length of construction activities. Remove tree protection only after all construction operations are complete and only when permitted by the Engineer.
3. Comply with local tree ordinances.
4. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
5. Provide protection for roots over 1-1/2 inch diameter that are cut during construction operations. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible or cut off cleanly below grade.
6. Repair or replace trees and vegetation indicated to remain, which are damaged by operations, in a manner acceptable to Engineer. Employ a licensed arborist to repair damages to trees and shrubs. All tree repair

work shall be done in accordance with the most recent revision of the International Society of Arboriculture practices.

7. Replace trees which, in the opinion of the arborist cannot be repaired and restored to full-growth.
8. Carefully remove items indicated to be salvaged, and store on Owner's premises where indicated or directed.

3.2 SITE CLEARING

A. General: Remove trees, shrubs, grass and other vegetation, improvements, or obstructions required to permit installation of new construction. Remove similar items elsewhere on premises as specifically indicated. "Removal" includes digging out and off-site disposing of stumps and roots.

1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner, where such roots and branches obstruct installation of new construction.

B. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.

1. Completely remove stumps, roots, and other debris protruding through ground surface;

2. Use only hand methods for grubbing inside drip line of trees indicated to remain;

3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated;

a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.

C. Open burning on the site shall only be allowed if authorized in writing by Owner. Burning must comply with all state Air Pollution Regulations with regard to open burning as well as all local ordinances and regulations. Any permits required by state and local agencies for open burning shall be obtained by the Contractor.

D. Remove all debris and waste material from Owner's property.

3.3 MINOR DEMOLITION AND ABANDONMENT

A. Pavement Removal

1. Neatly saw cut pavement, including curb, gutter and sidewalk, at right angle to surface. Use of power driven impact tools for cutting pavement at juncture with pavement to remain is not allowed.
2. Remove pavement to the limits indicated on the Drawings.

B. Pipe Removal
   1. Remove pipe at the locations and to the limits indicated on the Drawings.
   2. Dispose of all removed pipe off the site of the Work.
   3. Backfill in accordance with Section 02324 – Trenching, Backfilling For Utilities

C. Removal of Drainage and Utility Structures
   1. When directed by the Owner or the Engineer, remove and salvage castings to Owner at location directed.
   2. Remove complete structure, including base and foundation, at locations indicated on the Drawings.
   3. Dispose of all removed and unsalvaged material off site.
   4. Backfill with suitable material.

D. Abandoning Pipes In Place
   1. Existing pipes to be abandoned in place are indicated on the Drawings.
   2. Install plug in accordance with the details shown on the Drawings at locations indicated.
   3. Where specifically called for on the Drawings, fill abandoned pipes with flowable fill for their entire length.

E. Abandoning Minor Structures In Place
   1. Where indicated on the Drawings manholes, inlets, vaults and other minor below ground structures will be abandoned in place.
   2. Remove top castings that are not cast into top slab.
   3. Remove top slab.
   4. Remove top portion of walls to a depth of 2-feet below finished grade.
   5. Plug all pipes entering and leaving structure.
   6. Fill structure to 2-feet below finished grade with a well graded granular material. Material may contain stones up to 6-inches in diameter provided there are adequate fines to completely fill all voids.
   7. Backfill to finished grade with suitable material, including topsoil where appropriate, and restore to match surrounding area.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Preparation of subgrade for building slabs, walks, and pavements;
2. Performing all grading, excavation, filling and compaction operations;
3. Remove and replace topsoil;
4. Finish grading, including shoulders and banks.

B. Excavation and backfilling of trenches for water, sewer, storm drains and other utility lines is not included in this section but may be found in Section 02324, Trenching, Backfilling For Utilities.

C. Related Sections:
1. Section 02221 – Building Demolition
2. Section 02230 – Site Clearing And Minor Demolition
3. Section 02324 – Trenching, Backfilling For Utilities
4. Section 02374 – Erosion Control
5. Section 02720 – Aggregate Base Course
6. Section 02740 – Hot Mixed Asphalt Pavement
7. Section 02750 – Portland Cement Concrete Pavement

1.2 MEASUREMENT AND PAYMENT

A. Excavation and Fill
1. Basis of Measurement: Suitable earth material excavated on site and placed in fill on site will be measured by the cubic yard, in its original location.
2. Basis of Payment: Payment will be made at the Unit Price bid for excavation and placing earth material as on-site fill and shall include all costs for excavating, stockpiling, loading, unloading, hauling, placing, compacting, moisture control, testing, disposal of unsuitable and excess material and all other costs of whatever nature required for the performance of the Work under this Section of the Specifications.
3. Pay Item:
a. Excavation and Fill

B. Excavation and Disposal
1. Basis of Measurement: Unsuitable excavated earth material disposed of off the site will be measured by the cubic yard, in its original location.
2. Basis of Payment: Payment will be made at the Unit Price bid for excavation and disposal off-site of unsuitable excavated earth material and shall include all costs for excavating, stockpiling, loading, hauling,

unloading and all other costs of whatever nature required for the performance of the Work under this Section of the Specifications.

3. Pay Item:
   a. Excavation and Disposal

C. Borrow
1. Basis of Measurement: Suitable earth material from off site borrow sources placed in fill on site will be measured by the cubic yard, in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for borrow material and shall include all costs for excavating, stockpiling, loading, hauling, unloading, placing, compacting, moisture control, testing, disposal of unsuitable and excess material and all other costs of whatever nature required for the performance of the Work under this Section of the Specifications.
3. Pay Item:
   a. Borrow

D. Stripping Topsoil
1. Basis of Measurement: Suitable topsoil stripped and placed in stockpile will be measured by the cubic yard, in its original location.
2. Basis of Payment: Payment will be made at the Unit Price bid for stripping topsoil and shall include all costs for excavating, loading, hauling, unloading, stockpiling, disposal of unsuitable material and all other costs of whatever nature required for the performance of the Work under this Section of the Specifications.
3. Pay Item:
   a. Stripping Topsoil

E. Finish Grading
1. Basis of Measurement: The areas that are finish graded as specified herein and as shown on the drawings, including areas receiving topsoil, will be measured by the square yard.
2. Basis of Payment: Payment will be made at the Unit Price bid for finish grading and shall include all costs for material, labor, loading, hauling, placing topsoil, grading, clean up, disposal and all other costs of whatever nature required for the performance of the Work under this Section of the Specifications.
3. Pay Item:
   a. Finish Grading

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM):
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.

3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.4 DEFINITIONS

A. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular base course, subbase course, drainage fill, structure foundations or topsoil materials.

B. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.

1.5 SUBMITTALS

A. Section 01001- General Requirements: Submittal Procedures:.

B. Samples: Furnish samples of fill material to testing laboratory.

C. Materials Source: Furnish information to Engineer identifying source for all fill materials. Include location of borrow areas.

D. Test Reports:
1. Laboratory test reports for all materials proposed for use in embankments or backfill.
   a. sieve analysis
   b. moisture/density curves
   c. optimum moisture analysis
2. Field test reports:
   a. In-place density tests
   b. Moisture content

PART 2 PRODUCTS

2.1 SOILS

A. Satisfactory soil materials are defined as those complying with ASTM D2487-00 soil classification groups GW, GP, GM, SM, SW, and SP. Soils classified as SM-SP with not more than 15% passing the #200 sieve may be considered acceptable.

B. Unsatisfactory soil materials are defined as those complying with ASTM D2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT. Clays, silts and organic soils will be considered unsatisfactory.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate topsoil to the depths indicated on the plans and place in stockpile on site.

B. Excavation is unclassified and includes excavation to subgrade elevations indicated, regardless of character of materials and obstructions encountered.

C. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations shown on the Drawings or directed by the Engineer.
   1. Material removed by unauthorized excavation shall be replaced with suitable material.
   2. No payment will be made for unauthorized excavation or the replacement of material removed by unauthorized excavation.

D. Satisfactory excavated material may be transported directly to and placed in fill areas within the limits of the work, subject to the requirements for moisture control as specified in subsequent sections of this specification. Stockpiling of satisfactory excavated material for later placement in fill areas on the site may be permitted subject to approval by the Engineer. No additional payment will be made for moving satisfactory material into or out of stockpiles. No satisfactory material shall be removed from the site without the express permission of the Owner.

D. Unsatisfactory material shall be transported directly off-site to a suitable disposal area.

E. Additional Excavation:
   1. Unsatisfactory material encountered at subgrade in areas to be paved shall be excavated to a minimum of 2 feet below finished subgrade and replaced with satisfactory material from on-site or borrow excavations.
   2. When excavation has reached required subgrade elevations, notify Engineer, who will make an inspection of conditions. If Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Engineer.

F. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.2 DEWATERING

A. Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

C. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

3.3 STORAGE OF EXCAVATED MATERIALS

A. When the Contractor's operations necessitate stockpiling acceptable excavated materials for later placement in fills, locate stockpiles at a location acceptable to Owner. Grade, and shape stockpiles for proper drainage.

B. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

3.4 PLACEMENT

A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

B. When existing ground surface has a density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

C. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

E. Control soil and fill compaction, providing minimum percentage of density specified for each area classification. Correct improperly compacted areas or lifts as directed by Engineer.

3.5 COMPACTION

A. Moisture Control:
   1. Moisture tempering of the soils used for embankment/fills/backfill shall be the responsibility of the Contractor. No additional payment will be made for moisture tempering of soils.
   2. Embankment/fill material shall be within +/- 4 percent of optimum moisture content before rolling to obtain the prescribed compaction. In order to achieve uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be required when necessary.
   3. The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content in order to achieve the correct density.

B. Compaction Requirements: Compact soil to not less than the following percentages of maximum density as determined in accordance with ASTM D1557 (modified effort) in the areas indicated:
   1. Under structures, building slabs and steps, curbs/gutters, and pavements, compact top 24 inches of subgrade to 98 percent of maximum density. Compact soils below the top 24 inches to a density of 95 percent of maximum density.
   2. Under lawn or unpaved areas (lagoon banks), compact top 12 inches of subgrade in cut areas and each layer of backfill or fill material to 90 percent maximum density;
   3. Under walkways, compact top 12 inches of subgrade to 98 percent maximum density. Layers below the top 12 inches may be compacted to 95 percent maximum density;

3.6 FINISH GRADING

A. General: Finish grading includes the placing of topsoil in areas outside the building lines or paved areas as indicated on the drawings.

B. Uniformly grade areas within limits of grading, including adjacent transition areas and any areas disturbed by Contractor's operations. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

C. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding. Finish surfaces free from irregular surface changes and as follows:
   1. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations;

2. Walks: Shape surface of areas under walks to line, grade, and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation;
3. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

D. Compaction: After grading, compact subgrade surfaces to the depth and indicated percentage of maximum or relative density for each area classification.

E. Topsoil Placement:
1. Place topsoil on all finish graded areas outside building lines and outside of paved or other surfaced areas
2. Loosen subgrade to a minimum depth of 4 inches. Remove stones measuring over 1 1/2 inches in any dimension. Remove sticks, roots, rubbish and other extraneous matter. Limit preparation to areas which will be planted after preparation.
3. Spread top soil to minimum depth of 4” or as indicated on the plans over all disturbed areas and lightly roll.

3.7 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Allow testing service to inspect and approve each subgrade and fill layer before further backfill or construction work is performed.
1. Perform field density tests in accordance with ASTM D1556 or ASTM D2922.
2. Building Pads: Perform at least two field density tests for every 2,000 square feet (SF) or portion thereof for each layer placed and for finished subgrade.
3. Streets and roadways: Perform at least one field density test for every 200 linear feet, alternating lanes, for each layer placed and for finished subgrade.
4. Parking fields: Perform at least one field density test for every 4800 square feet , or portion thereof, for each layer placed and for finished subgrade.
5. Curb and Gutter: Perform at least one field density tests for every 300 linear feet (LF) or portion thereof for each layer placed and for finished subgrade.
6. If in the opinion of the Engineer, based on testing service reports and inspection, subgrade or fills that have been placed are below specified density, perform additional compaction and testing until specified density is obtained.

3.8 PROTECTION AND MAINTENANCE OF FINISHED WORK

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

D. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.9 DISPOSAL OF WASTE MATERIAL

A. Remove waste materials, including unsatisfactory excavated material, trash, and debris, and dispose of it off Owner's property.

END OF SECTION

SECTION 02324

TRENCHING, BACKFILLING FOR UTILITIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating trenches for water, sanitary sewer, storm drains and other utilities.
   2. Backfilling and compaction in utility trenches.

B. Work under this section includes backfill above the pipe embedment zone (top of initial backfill). Pipe bedding and initial backfill are specified in other sections of the Technical Specifications for each type of pipe and utility.

C. Related Sections.
   1. Section 02514 – Water Distribution System
   2. Section 02536 – Sanitary Sewer Force Mains
   3. Section 02537 – Gravity Sanitary Sewer
   4. Section 02630 – Storm Drainage
   5. Section 02661 – Reuse Irrigation Water Distribution System

1.2 MEASUREMENT AND PAYMENT

A. Trench Excavation:
   1. Basis of Measurement: No measurement will be made for trench excavation.
   2. Basis of Payment: No separate payment will be made for trench excavation. The cost of this Work shall be included in the unit price bid for the pipe line.

B. Trench Backfill:
   1. Basis of Measurement: No measurement will be made for trench backfill.
   2. Basis of Payment: No separate payment will be made for trench backfill. The cost of this Work shall be included in the unit price bid for the pipe line.

C. Imported Select Trench Backfill Material:
   1. Basis of Measurement: Cubic yards of select earth material imported from off-site borrow sources for use as trench backfill when approved by the Engineer.
   2. Basis of Payment: Payment will be made at the Unit Price bid for furnishing imported select trench backfill material and shall include all costs for excavating, loading, hauling, unloading, disposal of excess

material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

3. Pay Item:
   a. Imported Select Trench Backfill Material

D. Flowable Fill:
1. Basis of Measurement: Cubic yards of flowable fill placed as trench backfill.
2. Basis of Payment: Payment will be made at the Unit Price bid for flowable fill and shall include all costs for flowable fill material, loading, unloading, hauling, placing, disposal of excess material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
   a. Flowable Fill

E. Foundation Stabilization:
1. Basis of Measurement: Cubic yards of angular stone material placed as foundation stabilization below the pipe bedding when approved by the Engineer.
2. Basis of Payment: Payment will be made at the Unit Price bid for foundation stabilization and shall include all costs for stone, hauling, placing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
   a. Foundation Stabilization

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
6. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

7. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. SCDOT Standard Specifications for Highway Construction.

1.4 SUBMITTALS

A. Section 01001 - Submittal Procedures

B. Materials Source: Submit information identifying source and location of imported backfill material.

C. Certification: Certify Products and materials meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

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

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

PART 2 PRODUCTS

2.1 BACKFILL AND FOUNDATION MATERIALS

A. Select Backfill:
1. Soil material free from organic matter and deleterious substances, containing no rocks or lumps over 2 inches in greatest dimension.
2. Acceptable material: Soil material complying with ASTM D2487 soil classification groups GW, GP, GM, GC, SC, SM, SW, and SP.
3. Unacceptable soil materials are those complying with ASTM D2487 soil classification groups, ML, MH, CL, CH, OL, OH, and PT. Silts and organic soils will be considered unacceptable.
4. Select backfill material shall be obtained first from acceptable material excavated from the trench, second from acceptable material excavated elsewhere within the construction site and last from off-site borrow sources when approved by the Engineer.

B. Flowable Fill: SCDOT Standard Specifications for Highway Construction, Section 210.

C. Foundation Stabilization Material: Processed, graded aggregate; SCDOT #57 stone, SCDOT Standard Specifications for Highway Construction.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

B. Notification Of Intent To Excavate:
   1. Comply with South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978). Notification of intent to excavate may be given by calling this toll free number: 1-800-922-0983.

C. Approximate location of certain underground lines and structures are shown on the plans for information only and additional underground lines or structures may exist that are not shown.
   1. Call Palmetto Utility Protection Service at 1-888-721-7877 between the hours of 7:00 AM and 7:00 PM Monday thru Friday at least three working days before commencing construction. Request underground utilities to be located and marked within and surrounding construction areas.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

E. Maintain and protect existing above and below grade utilities indicated to remain.
   1. 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.
   2. If existing utilities are found to interfere with the permanent facilities being constructed under this Section, immediately notify the Engineer and secure his instructions.
   3. Do not proceed with permanent relocation of utilities until written instructions are received from the Engineer.

F. 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.

G. Removing and Resetting Fences:
   1. Where existing fences must be removed to permit construction of utilities; remove such fences and, as the Work progresses, reset the fences in their original location and condition.
   2. Provide temporary fencing when required for animal control or as required by Owner.

H. 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. This requirement does not include replacement of trees and undergrowth in undeveloped sections of the rights-of-way.

I. Initiate and maintain protective measures to minimize silting and bank erosion of creeks and rivers adjacent to the work.

J. Work located within streets or highways:
1. Comply with SC Department of Highways and Public Transportation "Encroachment Permit" issued for the Work;

K. Keep at least one lane open to traffic at all times where utility pipeline is in or alongside the traveled street or highway. Where pipelines cross the street of highway, excavate only half the street or highway, install the pipe and backfill before excavating the other half of the street.

L. Maintain access to properties adjacent to the construction at all times.

M. Protection Of Persons and Property:
1. Barricade open holes and depressions occurring as part of the Work, and post warning lights on property adjacent to or with public access.
2. Operate warning lights during hours from dusk to dawn each day and as otherwise required.
3. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, washout and other hazards created by operations under this Section.
4. 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.

3.2 Dewatering:

A. Keep trenches and site construction area free from water.

B. Remove all water, including rain water, encountered during trench and sub-structure work to an approved location by pumps, drains, and other approved methods.

3.3 CUTTING EXISTING PAVEMENT

A. Use concrete saw for cutting concrete pavement.

B. Cut pavement to a neat straight line.

C. Pavement cut to extend 12-inches beyond top edge of excavation.

3.4 TRENCHING

A. Excavation for trenches is unclassified and includes all material of whatever substance encountered.

B. Perform excavation near existing utility services in accordance with utility's requirements.

C. Do not advance open trench more than 200 feet ahead of installed pipe.

D. Trench Width: Measured at the top of the pipe, adequate width to place and compact bedding material around pipe and for shoring. (See, also, other sections of these specifications.)

E. Excavate bottom portion of trench with vertical or near vertical (within 10°) side walls to a point one foot above top of pipe.

F. Excavation beyond the depths indicated on the plans or specified in other sections of these specifications in soils that are stable and that provide acceptable support for the pipes and embedment material will be considered unauthorized excavation. Unauthorized excavation shall be replaced with select material compacted to the densities specified for trench backfill. Angular stone material may be used for replacement of over excavated areas. Angular stone, when used, shall be completely wrapped in filter fabric to prevent the migration of fine grained soils from adjacent portions of the trench. No additional payment will be made for replacement of unauthorized excavation.

G. Provide uniform and continuous bearing and support for bedding material and pipe.
   1. Rock: Rock or unyielding material shall be removed to a depth of at least 6 inches below the bottom of the pipe. (See other sections of these Specifications for specific utility lines.)
   2. Unstable foundation: When unstable soils are encountered, excavation shall be continued to a depth to be determined by soil conditions or as directed by the Engineer. Foundation stabilization material shall be placed as specified in other sections of these specifications. (See other sections of these Specifications for specific utility lines.)

H. Excess and unacceptable excavated material not used in trench backfill shall be removed and used in other areas of the project, if applicable, or removed from the project site. No acceptable trench backfill material shall be removed from trench-side until the trench has been completely backfilled and compacted.

3.5 TRENCH PROTECTIVE SYSTEMS

A. Provide trench protective system in compliance with OSHA Standards, 29 CFR - 1926 Subpart P.

B. Sheeting and shoring shall be removed during the backfilling process in accordance with the requirements in 29 CFR – 1926 Subpart P unless specifically noted on the plans to be left in place.

C. Maintain the integrity of the trench protective system until its removal from the trench or until completion of backfilling in the case of shoring left in place.

D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate trench protective system.

3.6 BACKFILLING

A. Backfill trenches to contours and elevations indicated on the drawings with unfrozen fill materials.

B. Employ placement method that does not disturb or damage pipe or pipe coating.

C. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.

D. Place backfill material in continuous layers, 6-inches compacted depth, and compact as follows:

Location	Compaction Per Cent Maximum Dry density (ASTM D1557, Modified Effort)
Top 24-inches beneath paved areas, curb and gutter, sidewalks, building slabs & within 10-ft. of buildings	98
Area below the top 24-inches beneath paved areas, curb and gutter, sidewalks, building slabs & within 10-ft. of buildings	95

E. Moisture Control:
1. Backfill soils shall be within +/- 4 percent of optimum moisture content before being placed in the trench and compacted to the prescribed density.
2. In order to achieve uniform moisture content throughout the layer, wetting or drying of the material, shall be required when necessary. Moisture tempering may require spreading and manipulation of the soil excavated from the trench to accomplish the necessary wetting or drying. Moisture tempering of the soils used for backfill, either by drying or wetting, shall be the responsibility of the Contractor. No additional payment will be made for moisture tempering of soils.
3. The Contractor shall make the necessary corrections and adjustments in methods, materials or moisture content in order to achieve the correct density.

F. For trenches under existing pavement, place pavement base course material at the time the trench is backfilled. Type and thickness of base course material is shown on the drawings.

3.7 FIELD QUALITY CONTROL

A. Section 01001 – General Requirements: Testing and Inspection Laboratory Services

B. Perform laboratory material tests in accordance with ASTM D1557.

C. Perform in place compaction tests in accordance with the following:
   1. Density Tests: ASTM D2922.
   2. Moisture Tests: ASTM D3017.

D. When tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

E. Frequency of Tests:
   1. Under pavement, curb, sidewalk, lawns, building slabs, within 10 feet of building: Each 200 linear feet or fraction thereof for each 6-feet of depth above top of pipe or fraction thereof.
   2. All other areas: Each 500 linear feet or fraction thereof for each 6-feet of depth above top of pipe or fraction thereof.

3.8 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic during construction.

END OF SECTION

SECTION 02374

EROSION CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Silt fence, hay bales, filter fabric, stone rip-rap, gravel

B. Related Sections:
1. Section 02230 – Site Clearing and Minor Demolition
2. Section 02300 – Earthwork
3. Section 02514 – Water System
4. Section 02537 – Sanitary Sewer system
5. Section 02924 – Seeding and Mulching

1.2 MEASUREMENT AND PAYMENT

A. Silt Fence Sediment Barrier:
1. Basis of Measurement: Linear feet of silt fence, complete, in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for silt fence and shall include all costs for furnishing, installing, maintaining, removal and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
a. Silt Fence

B. Straw Bale Sediment Barrier:
1. Basis of Measurement; Each straw bale placed as sediment barrier at locations indicated on the plans.
2. Basis of Payment: Payment will be made at the Unit Price bid for each straw bale placed as sediment barrier and shall include all costs for furnishing, installing, maintaining, removal and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
a. Straw Bales

C. Inlet Protection:
1. Basis of Measurement: Each installation of inlet protection, regardless of type, installed as prescribed herein and as shown on the drawings, complete, in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for inlet protection and shall include all costs for furnishing, installing, maintaining, removal and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
a. Inlet Protection

D. Rip-Rap:
   1. Basis of Measurement: Square yards of rip-rap, including filter fabric, placed at the locations and to the thickness shown on the drawings, complete, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for rip-rap and shall include all costs for stone, hauling, filter fabric, placing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Item:
      a. Rip-Rap, Class ____

E. Site Entrance/Exit:
   1. Basis of Measurement: Each site entrance/exit constructed as shown on the drawings and specified herein, complete, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for site entrance/exit and shall include all costs for all material, construction, maintaining, removal and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Item:
      a. Site Entrance/Exit

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM):
   1. ASTM D448 - Standard Classification for Sizes of Aggregate for Road and Bridge Construction

B. South Carolina Department of Transportation Standard Specifications For Highway Construction

1.4 SUBMITTALS

A. Section 01001 - Submittal Procedures: Requirements for submittals.

B. Product Data: Submit manufacturer's technical product data and installation instructions for soil erosion control materials and products.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of soil erosion control systems products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 3 years of successful installation experience on projects with soil erosion control similar to that required for project.

C. Codes and Standards: Comply with all applicable Local, State and Federal Standards pertaining to soil erosion control.

PART 2 PRODUCTS

2.1 Grass seed, fertilizer, mulch: As specified in Section 02924

2.2 Hay Bales: Standard size, densely baled straw or hay, wrapped with synthetic or wire bands (two minimum per bale).

2.3 Stone Rip-Rap: Class B, South Carolina Department of Transportation Standard Specifications For Highway Construction, Section 804.02

2.4 Gravel: Stone size in accordance with ASTM D 448 size No. 1 (1.5 inch to 3.5 inch diameter).

2.5 Filter Fabric Under Rip-Rap: Comply with Section 804.11 of South Carolina Department of Transportation Standard Specifications For Highway Construction

2.6 Silt Fence:

A. Posts: Steel

B. Fabric: Comply with Section 815.06 of South Carolina Department of Transportation Standard Specifications For Highway Construction.

C. Woven Wire Backing: Comply with Section 815.06 of South Carolina Department of Transportation Standard Specifications For Highway Construction.

PART 3 EXECUTION

3.1 GENERAL

A. Grade and provide erosion protection for all disturbed areas outside structure lines by seeding or other erosion control devices. Provide sediment barriers in storm water conveyance systems at all entrances, intersections, change in direction, discharge points and other locations as shown on the drawings.

3.2 STABILIZATION BY SEEDING:

A. As specified in Section 02924 – SEEDING AND MULCHING.

3.3 SEDIMENT BARRIERS

A. Straw Bales For Sheet Flow Applications:
1. Excavate a 4 inch deep trench the width of a bale and length of the proposed barrier. The barrier should be parallel to the slope. Place barrier 5 to 6 feet away from toe of slope, unless otherwise indicated;
2. Place bales in the trench with their ends tightly abutting. Corner abutment is not acceptable. A tight fit is important to prevent sediment from escaping through spaces between the bales;
3. Install and anchor as indicated in the construction drawings;
4. Backfill the trench with the previously excavated soil and compact it. The backfill soil should conform to the ground level on the downhill side of the

barrier and should be built up to 4 inches above the ground on the uphill side of the bales;

5. Inspect and repair or replace damaged bales promptly. Remove the straw bales when the uphill sloped areas have been permanently stabilized.

B. Silt Fence For Sheet Flow Applications:
   1. Excavate a 4 inch deep, 4 inch wide trench on the uphill side of the silt fence to entrench bottom portion of geotextile filter fabric;
   2. Secure fence to steel post which are set at least 1.5 feet in the ground. Install as shown on detail;
   3. Backfill the trench with the previously excavated soil and compact it;
   4. Silt fence should generally follow the contour except in channel applications Where silt fence should continue up the bank to prevent flow around the end of fence;
   5. Inspect and repair or replace damaged silt fence or fence that is undermined; Remove silt fence when the areas above the fence have been permanently stabilized.

C. Straw Bales For Channel Flow Applications:
   1. Install straw bales as described for sheet flow with the following exceptions:
      a. Place bales in a single row, lengthwise, oriented perpendicular to the flow, and with ends of adjacent bales tightly abutting one another;
      b. Extend the barrier to such a length that the bottoms of the end bales are at a higher elevation than the top of the lowest middle bale to assure that sediment-laden runoff will flow either through or over the barrier but not around it. Place rock below the middle bale to dissipate the energy of the falling water and reduce downstream erosion.

D. Silt Fence For Channel Flow Applications:
   1. Install silt fence as described for sheet flow with the following exceptions:
      a. Silt fence in drainage channels must be backed with wire or steel mesh. Other locations on drawings may specify reinforced silt fence;
      b. Extend silt fence up banks to prevent water flow around ends of fence.

3.4 INLET CONTROL SEDIMENT BARRIERS

A. Straw bales
   1. Excavate a 4 inch deep trench around the inlet. Make the trench as wide as a straw bale;
   2. Orient straw bales with the bindings around the sides of the bales rather than over and under the bales;
   3. Place bales lengthwise around the inlet and press ends of adjacent bales together;
   4. Drive two 2 inch by 2 inch by 4 feet wood stakes through each bale to anchor the bale securely in place;

5. Backfill the excavated soil and compact it against the bales;
6. Wedge loose straw between bales to prevent water from flowing between bales.

B. Silt fence
1. Excavate a 4 inch deep, 4 inch wide trench around inlet to intrench bottom portion of geotextile filter fabric;
2. Secure fence to steel post which are set at least 1.5 feet in the ground around inlet;
3. Backfill the trench with the previously excavated soil and compact it.

3.5 RIP-RAP

A. Install quantity shown on the drawings.

B. Place by hand on undisturbed material or compacted soil covered by Filter Fabric. Form a compact layer approximately 12" in thickness. Rip-rap should be laid on the filter fabric leaving no visible fabric.

3.6 SITE ENTRANCE/EXIT

A. Install a 6 inch layer of gravel the full width of the vehicle ingress and egress area and for a length of 50 feet minimum, periodically add additional stone to maintain the proper functioning of the pad.

3.7 INSPECTION AND MAINTENANCE

A. Inspect all erosion control features at least once every seven days and within 24 hours following any storm that is 0.5 inches or greater.

B. Repair and maintain erosion control measures as needed and as directed by the Engineer and Owner.

C. Maintain required records of inspections on site and make them available to SCDHEC inspectors when required.

D. Cooperate with inspectors from SCDHEC, EPA, and Beaufort County and make modifications and repairs to erosion control devices as instructed by those agencies.

E. Maintain erosion control measures in place until all disturbed areas outside pavements are stabilized as determined by the permitting agency.

END OF SECTION

SECTION 02448

HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavation for approach trenches and pits.
   2. Horizontal directional drilling.
   3. Pipe.

B. Related Sections:
   1. Section 02324 - Trenching, Backfilling For Utilities
   2. Section 02514 - Water Distribution System
   3. Section 02536 - Sanitary Sewer Force Main
   4. Section 02537 - Gravity Sanitary Sewer System.
   5. Section 02630 - Storm Drainage.
   6. Section 02811 - Reuse Water Irrigation Systems.

1.2 SPECIAL REQUIREMENTS

A. Work specified under this section of the Specifications may be performed on Department of Transportation or railroad rights-of -way. The Contractor shall comply with all conditions and requirements contained in the applicable encroachment permit or occupancy permit, including, but not limited to, additional insurance that may be required. The Contractor shall maintain one copy of the applicable encroachment permit or occupancy permit at the site of construction.

B. Where there is a conflict between the requirements contained in these specifications and requirements of the applicable encroachment or occupancy permit, the more stringent or restrictive requirement shall prevail unless otherwise directed by the authorized representative of the Department of Transportation or railroad.

1.3 UNIT PRICE - MEASUREMENT AND PAYMENT

A. General:
   1. Section 01001 – General Requirements, Article 1.4 – Unit Prices.
   2. Payment will be made for the following items of work under this section of the specifications when the item is shown on the Schedule of Bid Prices included in the Bid Form and attached to the Agreement.

B. Mobilization For Horizontal Directional Drilling:
   1. Basis of Measurement: Each location as indicated on the construction drawings for installation of pipe by directional drilling.

2. Basis of Payment: Payment will be made at the Unit Price bid for each location where pipe is installed by directional drilling and shall include all costs for mobilizing and demobilizing directional drilling machines and equipment; excavation of approach trenches and pits; backfill; collection and disposal of drilling mud; disposal of unsuitable and excess soil material and all other costs of whatever nature required for mobilization and set-up for performance of Work under this section of the Specifications.
3. Pay Items: Units
   a. Mobilization For Horizontal Directional Drilling EA

C. Horizontal Directional Drilling:
1. Basis of Measurement: linear feet of pipe in place, installed by directional drilling, measured thru fittings.
2. Basis of Payment: Payment will be made at the Unit Price bid per lineal foot for the indicated type and size pipe installed by directional drilling and shall include all costs for pipe; drilling; pulling; testing; and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items: Units
   a. Horizontal Directional Drilling, ___ -inch Polyethylene Pipe L.F.

1.4 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. American Waterworks Association (AWWA):
1. AWWA C901 - Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service.
2. AWWA C906 - Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Th. 63 In. (1,600 mm), for Water Dist. and Trans.

C. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

7. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
8. ASTM F1962 - Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings.

D. National Utility Contractors Association:
1. NUCA - HDD Installation Guidelines.

1.5 CONTRACTOR QUALIFICATIONS:

A. Directional drilling and pipe installation shall be done only by an experienced Contractor specializing in directional drilling and whose key personnel have at least five (5) years of documented experience in this work.

1.6 SUBMITTALS

A. Section 01001 – General Requirements, Article 1.9 - Submittal Procedures.

B. Installation Plan: At least 7 days prior to mobilizing equipment, Contractor shall submit a detailed Installation Plan to the Engineer. The plan shall include:
1. A detailed plan and profile of the bores, plotted at a scale no smaller than 1 inch equals 20 feet horizontal and vertical.
2. A listing of major equipment and supervisory personnel and a description of the methods to be used.
3. Submit technical data for equipment, method of installation, and proposed sequence of construction. Include information pertaining to pits; dewatering; method and equipment for spoils removal; equipment size and capacity; equipment capabilities including installing pipe on radius; type of drill bit; drilling fluid; method of monitoring line and grade and detection of surface movement; name plate data for drilling equipment and proposed methods to prevent drilling fluid from adversely affecting the surrounding area.

C. Product Data:
1. Identify source of water used for drilling.
2. Submit copy of approvals and permits for use of water source.

D. Installer Qualifications: Submit history of previous work completed of equivalent nature and scope. Include qualification and experience of key personnel.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

F. Project Record Documents:
1. Record actual locations of pipe and invert elevations.
2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
3. Record actual depth of pipe at specified intervals.

4. Record actual horizontal location of installed pipe.
5. Show depth and location of abandoned bores.
6. Record depth and location of drill bits and drill stems not removed from bore.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with the following:
1. NUCA HDD Installation Guidelines.
2. ASTM F1962.

1.8 PRE-INSTALLATION MEETING

A. Convene on site minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01001 – General Requirements, Article 1.20 - Pollution and Environmental Control.

B. The Contractor shall visit the site and make note of all structures and site limitations at the directional drill crossing.

C. The Horizontal Directional Drilling operation shall be operated in a manner to eliminate the discharge of water, drilling mud and cuttings to the adjacent waterways, wetlands or land areas during the construction process. The Contractor shall provide equipment and procedures to maximize the recirculation or reuse of drilling mud to minimize waste. All excavated pits used in the drilling operation shall be lined by Contractor with heavy duty plastic sheeting with sealed joints to prevent the migration of drilling fluids and/or ground water. The general work areas on the entry and exit sides of the crossing shall be enclosed by a berm to contain unplanned spills or discharge.

D. Waste drilling mud and cuttings shall be dewatered, dried, and stock piled such that it can be loaded by a front end loader, transferred to a truck and hauled offsite to a suitable legal disposal site. Water from the dewatering process shall be treated by the Contractor to meet all regulatory agency requirements before being discharged.

E. Conduct operations so as not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in adjacent areas.

1.10 COORDINATION

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Coordinate work with other utilities within construction area.

PART 2 PRODUCTS

2.1 GENERAL:

A. High density polyethylene pipe in accordance with this section of the Specifications shall be used in HDD installations.

B. All piping system components shall be the products of one manufacturer and shall conform to AWWA C901, AWWA C906, ASTM D1248, ASTM D3350, and ASTM F714.

C. All polyethylene pipe shall be cut, fabricated, and installed in strict conformance with the pipe manufacturer's recommendations.

2.2 PIPING AND BENDS:

A. Piping and Bends shall be extruded from a polyethylene compound and shall conform to the following requirements:
   1. The polyethylene resin shall meet or exceed the requirements of ASTM D3350 for PE 3408 material with a cell classification of 335434C, or better.
   2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light by means of carbon black, well dispersed by pre-compounding in a concentration of not less than 2 percent.
   3. The maximum allowable hoop stress shall be 800 psi at 73.4 degrees F.
   4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture the pipe in this project.
   5. The pipe and bends shall have a minimum standard dimension ratio (SDR) wall thickness as indicated on the drawings or specified by the Engineer.
   6. Joining shall be performed by thermal butt fusion in accordance with the manufacturer's recommendations.
   7. Sanitary sewer pipe exterior shall be green in color or contain green striping. Sanitary sewer pipe interior shall be light in color for internal video inspection.
   8. Water pipe exterior shall be blue in color or contain blue striping.

2.3 TRANSPORTATION, STORAGE AND HANDLING:

A. Section 01001 - General Requirements: Product Delivery, Handling, Storage and Protection.

B. Transportation: Care shall be taken during transportation of the pipe to ensure that it is not cut, kinked, or otherwise damaged.

C. Storage: Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the

bottom layers of pipes under anticipated temperature condition. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

D. Handling Pipe:
   1. The handling of the joined pipeline shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber protected slings and straps shall be used when handling pipes. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped onto rocky or unprepared ground. Slings for handling the pipeline shall not be positioned at butt-fused joints. Sections of the pipes with cuts and gouges exceeding 10 percent of the pipe wall thickness or kinked sections shall be removed and the ends rejoined.
   2. The open ends of all sections of joined and/or installed pipe (not in service) shall be plugged at night to prevent animals or foreign material from entering the pipe line or pipe section. Waterproof nightcaps of approved design may be used and shall be so constructed that they will prevent the entrance of any type of natural precipitation into the pipe and shall be fastened to the pipe in such a manner that the wind cannot blow them loose.
   3. The practice of stuffing cloth or paper in the open ends of the pipe is unacceptable.
   4. Where possible, the pipe shall be raised and supported at a suitable distance back from the open end such that the open end will be below the level of the pipe at the point of support.

2.4 BACKFILL MATERIALS

A. Subsoil Fill: Select backfill as specified in Section 02324 – Trenching, Backfilling for Utilities.

B. Flowable Fill: As specified in Section 02324.

2.5 WATER SOURCE

A. Potable water obtained from local water utility.

2.6 UNDERGROUND PIPE MARKERS

A. Trace Wire: Electronic detection materials for non-conductive piping products.
   1. Unshielded 8 gage copper wire.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify connections to existing or proposed piping systems, size, location, and invert elevations, are in accordance with Drawings.

3.2 PREPARATION

A. Notification Of Intent To Excavate:
   1. Comply with South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978). Notification of intent to excavate may be given by calling this toll free number: 1-800-922-0983.

B. Approximate location of certain underground lines and structures are shown on the plans for information only and additional underground lines or structures may exist that are not shown.
   1. Call Palmetto Utility Protection Service at 1-888-721-7877 between the hours of 7:00 AM and 7:00 PM Monday thru Friday at least three working days before commencing construction. Request underground utilities to be located and marked within and surrounding construction areas.

C. Locate, identify, and protect utilities indicated to remain from damage.

D. Identify required lines, levels, contours, and datum locations.

E. Protect plant life, lawns and other features remaining as portion of final landscaping.

F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

G. Establish pipe elevations with not less than 3 feet of cover.

H. Establish minimum separation between water and sanitary sewer piping systems in accordance with the requirements in Section 02514 – Water Distribution Systems..

3.3 DEWATERING

A. Intercept and divert surface drainage, precipitation, and groundwater away from excavation through use of dikes, curb walls, ditches, pipes, sumps or other means.

B. Develop and maintain substantially dry subgrade during drilling and pipe installation.

C. Comply with State of South Carolina requirements for discharging water to watercourse, preventing stream degradation, and erosion and sediment control.

3.4 EXCAVATION

A. Excavate subsoil as specified in Section 02324.

B. Excavate approach trenches and pits as site conditions require. Minimize number of access pits.

C. Provide sump areas to contain drilling fluids.

D. Install excavation supports as specified in Section 02324.

E. Restore areas after completion of drilling and pipe installation.

3.5 Joining Pipe Sections:

A. Each length of pipe shall be inspected and cleaned as necessary to be free of debris immediately prior to joining.

B. Polyethylene pipe lengths to be joined by thermal butt-fusion shall be of the same type, grade, and class of polyethylene compound and supplied from the same raw material supplier.

C. Butt-Fusion Joining: Butt-fusion of pipes shall be performed in accordance with the manufacturer's recommendations as to equipment and technique. Butt-fusion joining shall be 100% efficient offering a joint weld strength equal to or greater than the tensile strength of the pipe.

D. Joining to other pipe or auxiliary equipment:
   1. Pipes 12-in diameter and larger: Flanged adapter with ASTM A240, Type 304 stainless steel backing flange, 125-pound, ANSI B16.1 standard, and gaskets as required by the manufacturer. Provide stainless steel bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to the manufacturer's standard. Re-torque the nuts after 4 hours.
   2. Pipes 3-in. thru 10-in. diameter: Fusion welded mechanical joint adaptor fittings for connect with ductile iron or PVC piping.
   3. Pipes less than 3-in. diameter: Fusion welded adaptor or transition fittings, type as required for connection to other piping.

3.6 DRILLING OPERATIONS:

A. Horizontal directional drilling shall consist of the drilling of a small diameter pilot hole from one end of the alignment to the other, followed by enlarging the hole diameter for the pipeline insertion. The exact method and techniques for completing the directionally drilled installation will be determined by the Contractor, subject to the requirements of these Specifications.

B. The Contractor shall include in his Installation Plan, descriptions of his noise reduction program, solids control plant, pilot hole drilling procedure, the reaming

operation, and the pullback procedure. All drilling operations shall be performed by supervisors and personnel experienced in horizontal directional drilling. All required support, including drilling tool suppliers, survey systems, mud cleaning, mud disposal, and other required support systems used during this operation shall be provided by the Contractor.

C. Drill pipe shall be API steel drill pipe, Range 2, Premium Class or higher, Grade S-135 in a diameter sufficient for the torque and longitudinal loads and fluid capacities required for the work. Only drill pipe inspected under API's Recommended Practice Specification API RP 7G within 30 days prior to start and certified as double white band or better shall be used.

D. A smoothly drilled pilot hole shall follow the design centerline of the pipe profile and alignment described on the construction drawings. The position of the drill string shall be monitored by the Contractor with the down hole survey instruments. Contractor shall compute the position in the X, Y and Z axis relative to ground surface from down hole survey data a minimum of once per length of each drilling pipe (approximately 31 foot interval).

E. Deviations from the acceptable tolerances described in these Specifications shall be documented and immediately brought to the attention of the Engineer for discussion and/or approval.

F. The profile and alignment defined on the construction drawings for the bores define the minimum depth and radius of curvature. At no point in the drilled profile shall the radius of curvature of the bore be less than 1,600 feet.

G. The Contractor shall maintain and provide to the Engineer, upon request, the data generated by the down hole survey tools in a form suitable for independent calculation of the pilot hole profile.

H. During the entire operation, waste and leftover drilling fluids from the pits and cuttings shall be dewatered and disposed of in accordance with all permits and regulatory agencies requirements. Remaining water shall be cleaned by Contractor to meet permit requirements.

I. Technical criteria for bentonite shall be as given in API Spec. 13A, Specification for Oil Well Drilling Fluids Material for fresh water drilling fluids. Any modification to the basic drilling fluid involving additives must describe the type of material to be used and be included in Contractor's Installation Plan submitted to the Engineer. The Owner retains the right to sample and monitor the waste drilling mud, cuttings and water.

J. When obstructions are encountered during drilling, notify Architect/Engineer immediately. Do not proceed around obstruction without Architect/Engineer's approval.

K. For conditions requiring more than 3 feet deviation in horizontal alignment, submit new shop drawings to Architect/Engineer for approval before resuming work.

L. Maintain adjusted bore alignment within easement or right-of-way where applicable.

3.7 Ream and Pullback:

A. Reaming: Reaming operations shall be conducted to enlarge the pilot after acceptance of the pilot bore. The number and size of such reaming operations shall be at the discretion of the Contractor.

B. Pulling Loads: The maximum allowable pull exerted on the HDPE pipelines shall be measured continuously and limited to the maximum allowed by the pipe manufacturer so that the pipe or joints are not over stressed.

C. Torsion and Stresses: A swivel shall be used to connect the pipeline to the drill pipe to prevent torsional stresses from occurring in the pipe.

D. The lead end of the pipe shall be closed during the pullback operation.

E. Pipeline Support: The pipelines shall be adequately supported by rollers and side booms and monitored during installation so as to prevent over stressing or buckling during the pullback operation. Such support/rollers shall be spaced at a maximum of 60 feet on centers, and the rollers to be comprised of a non-abrasive material arranged in a manner to provide support to the bottom and bottom quarter points of the pipeline allowing for free movement of the pipeline during pullback. Surface damage shall be repaired by the Contractor before pulling operations resume.

F. The contractor shall at all times handle the HDPE pipe in a manner that does not over stress the pipe. Vertical and horizontal curves shall be limited so that wall stresses do not exceed 50% of yield stress for flexural bending of the HDPE pipe. If the pipe is buckled or otherwise damaged, the damaged section shall be removed and replaced by the Contractor at his expense. The Contractor shall take appropriate steps during pullback to ensure that the HDPE pipe will be installed without damage.

G. Two 8-gage copper trace wires shall be pulled with the HDPE pipe and connected to the tracer wires for the connecting pipes.

H. Testing: The Contractor may, at his option, assemble and pressure test the entire run of pipe above ground prior to pulling it through the drill hole. Final pressure testing for acceptance shall be done after installation of the pipe in accordance with Article 3.11.

3.8 Handling Drilling Fluids and Cuttings:

A. During the drilling, reaming, or pullback operations, the Contractor shall make adequate provisions for handling the drilling fluids, or cuttings at the entry and exit pits. These fluids shall not be discharged into any waterway or wetlands. When the Contractor's facilities for storage of the fluids or cuttings on site reach their capacity, these materials shall be removed to a suitable legal disposal site. Do not discharge drilling spoils in sanitary sewers, storm sewers, or other drainage systems. The Contractor shall conduct his directional drilling operation in such a manner that drilling fluids are not forced through the sub-bottom into any waterway or wetlands. After completion of the directional drilling work, the entry and exit pit locations shall be restored to original conditions. The Contractor shall comply with all permit provisions.

B. Pits constructed at the entry or exit point area shall be so constructed to completely contain the drill fluid and prevent its escape to any waterway or wetlands.

C. The Contractor shall utilize drilling tools and procedures which will minimize the discharge of any drill fluids. The Contractor shall comply with all mitigation measures listed in the required permits and elsewhere in these Specifications.

D. To the extent practical, the Contractor shall maintain a closed loop drilling fluid system.

E. The Contractor shall minimize drilling fluid disposal quantities by utilizing a drilling fluid cleaning system which allows the returned fluids to be reused.

F. As part of the installation plan specified herein before, the Contractor shall submit a drilling fluid plan which details types of drilling fluids, cleaning and recycling equipment, estimated flow rates, procedures for minimizing drilling fluid escape and provisions for storing and disposal of drilling fluids and cuttings.

3.9 Tolerances:

A. General: Pipe installed by the directional drilled method must be located in plan as shown on the Drawings, and must be no shallower than shown on the Drawings unless otherwise approved by the Engineer.

B. Control and Monitoring:
1. The Contractor shall plot the actual horizontal and vertical alignment of the pilot bore at intervals not exceeding 30 feet. This "as built" plan and profile shall be updated as the pilot bore is advanced.
2. The Contractor shall at all times provide and maintain instrumentation that will accurately locate the pilot hole and measure drilling fluid flow and pressure.
3. The Contractor shall grant the Engineer access to all data and readout pertaining to the position of the bore head and the fluid pressures and

flows. When requested, the Contractor shall provide explanations of this position monitoring and steering equipment.

4. The Contractor shall employ experienced personnel to operate the directional drilling equipment and, in particular, the position monitoring and steering equipment.
5. No information pertaining to the position or inclination of the pilot bores shall be withheld from the Engineer.

C. Maximum Variation From Horizontal Position: 3 feet.

D. Maximum Variation From Vertical Elevation:
1. Water lines and other pressure lines: 6 inches.
2. For gravity sewers, sags in the pipeline shall not exceed 25 percent of the nominal pipe diameter. Sags will only be allowed where approved by the Engineer and where the entering and exiting grades are adequate to provide velocities through the sag area sufficient for moving solids. No more than one (1) sag area shall occur between two (2) manholes.

E. Maintain at least 4 vertical feet under the bottom of flowing streams or watercourses.

F. The Contractor must obtain approval of the alignment of each pilot bore by the Engineer before pipe can be pulled. If the pilot bore fails to conform to the above tolerances, the Engineer may, at his option, require the bore to be abandoned and a new pilot boring to be made. No additional payment will be made for abandonment of the pilot bore, including any required filling of the abandoned bore, or re-mobilization for a new pilot bore.

G. Fill abandoned bores greater than 3 inches in diameter with grout or flowable fill material.

3.10 BACKFILL

A. Backfill approach trenches and pits with subsoil fill to contours and elevations of surrounding existing grade. Compact subsoil backfill as specified in Section 02324.

3.11 FIELD QUALITY CONTROL

A. After the pipe is in place, cleaning pigs shall be used to remove residual water and debris. After the cleaning operation, the Contractor shall provide and run a sizing pig to check for anomalies in the form of buckles, dents, excessive out-of-roundness, and any other deformations. The sizing pig run shall be considered acceptable if the survey results indicate that there are no sharp anomalies (e.g. dents, buckles, gouges, and internal obstructions) greater than 2 percent of the nominal pipe diameter, or excessive ovality greater than 5 percent of the nominal pipe diameter. For gauging purposes, dent locations are those defined above which occur within a span of five feet or less. Pipe ovality shall be measured as the percent difference between the maximum and minimum pipe diameters. For

gauging purposes, ovality locations are those defined above which exceed a span of five feet. Remove and replace sections of pipe that exceed the allowable tolerances. No additional payment will be made for removal and replacement of pipe that does not met the specified tolerances.

B. Pressure Testing
   1. Pressure-test pipe after installation and before connection of the drilled piping with other parts of the system in accordance with the following:
      a. Sanitary Sewer Pipe: As specified in Section 02537 – Gravity Sanitary Sewer System.
      b. Water Distribution and Other Pressure Pipe: As specified in Section 02514 – Water Distribution System.
   2. Pressure tests shall be performed in the presence of the Engineer.
   3. In the event that the installation fails to perform as specified for the pressure test, the contractor shall take one of the following actions at the Engineer's option:
      a. Abandon the bore and re-drill at a new location as directed by the Engineer. No additional payment will be made for abandonment of the original bore, including any required filling of the abandoned bore, or re-mobilization for a new pilot bore.
      b. Remove the pipe from the bore and locate and replace defective sections, replace the pipe and retest.
      c. No additional payment will be made for either a or b above, including any required filling of the abandoned bore, or re-mobilization for a new pilot bore.

C. Compaction Testing: As specified in Section 02324.
   1. Frequency of Compaction Testing: One for each lift.
   2. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.12 CLEANING

A. Upon completion of drilling and pipe installation, remove drilling spoils, debris, and unacceptable material from approach trenches and pits. Clean up excess slurry from ground.

B. Restore approach trenches and pits to original condition.

C. Remove temporary facilities for drilling operations in accordance with Section 01001.

END OF SECTION

SECTION 02514

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Furnishing and installing pipelines and appurtenances for potable water system.

B. Work under this section of the Specifications must be performed in accordance with the requirements in the Beaufort-Jasper Water & Sewer Authority Technical Specifications, Revised July 2009. Contractor shall have a copy of the aforementioned specifications at the site of the Work for the full duration of construction.

C. In the event there is a conflict between the requirements contained in this section of the Specifications and the Beaufort-Jasper Water & Sewer Authority Technical Specifications, the requirements in the Beaufort-Jasper Water & Sewer Authority Technical Specifications shall govern.

1.2 MEASUREMENT AND PAYMENT

A. Water Line:
   1. Basis of Measurement: linear feet of pipe water line in place measured thru fittings.
   2. Basis of Payment: Payment will be made at the Unit Price bid per lineal foot for the indicated type and size water line pipe and shall include all costs for pipe, installation, marker tape, tracer wire, testing, sampling, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

B. Fittings:
   1. Basis of Measurement: Total number of fittings of each type and size indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each, type and size fitting, and shall include all costs for fittings, gaskets, glands, bolts, nuts, lubricants, installation, testing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Items:
      a. (Size) (Type:Description)

C. Additional For Restrained Joint

1. Basis of Measurement: Each restrained pipe joint installed at the locations and to the limits indicated on the Drawings.
2. Basis of Payment: Payment will be made at the Unit Price bid for each restrained pipe joint for the type and size of pipe indicated and shall include all additional costs for material, labor and other costs required to construct a restrained joint in accordance with this section of the Specifications, regardless of style of joint, over and above the costs for installing a non restrained joint.

D. Gate Valve And Valve Box
1. Basis of Measurement: Each gate valve and valve box, complete in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for each Gate Valve and Valve Box, (size indicated) and shall include all costs for valve, valve box, valve operating key, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

E. Butterfly Valve and Valve Box
1. Basis of Measurement: Each butterfly valve and valve box, complete in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for each Butterfly Valve and Valve Box, (size indicated) and shall include all costs for valve, valve box, valve operating key, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

F. Post Indicator Valve
1. Basis of Measurement: Each post indicator valve, complete in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for each Post Indicator Valve (size indicated) and shall include all costs for UL/FM approved gate valve, indicator post, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

G. Fire Line Isolation Valve And Lockable Valve Box
1. Basis of Measurement: Each fire line isolation gate valve and lockable valve box, complete in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for each Fire Line Isolation Gate Valve and Lockable Valve Box (size indicated) and shall include all costs for valve, valve box, valve operating key, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever

nature required for performance of this item of Work under this section of the Specifications.

H. Fire Hydrant With Auxiliary Gate Valve and Valve Box:
   1. Basis of Measurement: Each fire hydrant with auxiliary gate valve and valve box, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each fire hydrant with auxiliary gate valve and valve box and shall include all costs for hydrant, UL/FM approved gate valve, valve box, installation, gravel drain, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Items:
      a. Fire Hydrant With Auxiliary Gate Valve and Valve Box

I. Air Release Valve Assembly and Manhole:
   1. Basis of Measurement: Each air release valve and manhole, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each air release valve (size indicated) and manhole and shall include all costs for air release valve, tapping saddle, corporation stop, incidental piping; precast manhole, cast iron frame and cover, installation and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

J. Service Lines:
   1. Basis of Measurement: Linear feet of service line, type and size as indicated, extending from main to point of termination or to connection at meter box.
   2. Basis of Payment: Payment will be made at the Unit Price bid per linear foot for service line (type and size indicated) and shall include all costs for pipe, tapping saddle, tap, corporation stop, incidental fittings and adapters, installation, marker tape, tracer wire, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

K. Service Tap
   1. Basis of Measurement: Each service tap, size as indicated.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each service tap, size indicated, and shall include all costs for tapping saddle, making the tap, corporation stop, incidental fittings and adapters, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

3. Pay Items:
    a. Water Service Tap – 1-inch
    b. Water Service Tap – 2-inch

L. Blow-Off Hydrant
1. Basis of Measurement: Each blow-off hydrant installed at the locations indicated on the Drawings.
2. Basis of Payment: Payment will be made at the Unit Price bid for each blow-off hydrant, and shall include all costs for post type hydrant, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
    a. Post Type Blow-Off Hydrant

M. Yard Hydrant
1. Basis of Measurement: Each yard hydrant installed at the locations indicated on the Drawings.
2. Basis of Payment: Payment will be made at the Unit Price bid for each yard hydrant and shall include all costs for hydrant, incidental fittings and adapters, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item:
    a. Yard Hydrant

N. Concrete Markers
1. Basis of Measurement: Each concrete marker, in place.
2. Basis of Payment: Payment will be made at the Unit Price bid for each concrete marker and shall include all costs for precast concrete post, installation, excavation, backfill, disposal of unsuitable material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items:
    a. Concrete Markers

O. Connection To Existing Water Line – Dry Connection
1. Basis of Measurement: Each connection to existing water line using MJ tee and sleeve with existing water line de-activated.
2. Basis of Payment: Payment will be made at the Unit Price bid for each dry connection to existing water line and shall include all costs for cutting existing pipe, installation and connections to existing, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items:
    a. Connection To Existing Water Line – Dry Connection

P. Connection To Existing Water Line – Wet Connection:

1. Basis of Measurement: Each connection to existing water line using tapping sleeve and tapping valve with existing water line active (wet tap).
2. Basis of Payment: Payment will be made at the Unit Price bid for each wet tap connection to existing water line and shall include all costs for tapping valve, valve box, tapping machine, making the tap, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items;
    a. Connection To Existing Water Line – Wet Connection

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM):

1. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
2. ASTM C857 – Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
3. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
6. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
7. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
9. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
10. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA):

1. AWWA C104 - ANSI Standard for Cement Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 - ANSI Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water.
3. AWWA C111 - ANSI Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115 - ANSI Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.

5. AWWA C151 - ANSI Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
6. AWWA C153 - ANSI Standard for Ductile-Iron Compact Fittings for Water Service.
7. AWWA C500 - Gate Valves for Water and Sewage Systems.
8. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.
9. AWWA C605 - Water Treatment - Underground Installation of Polyvinyl Chloride PVC Pressure Pipe and Fittings for Water.
10. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. through 12 In. (100 mm through 300 mm), for Water Distribution.
11. AWWA C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 36 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution.

C. Beaufort-Jasper Water & Sewer Authority Water System Standards and Specifications-Revised July, 2009.
1. Chapter 2 – Earthwork
2. Chapter 6 – Pipeline Materials, Valves and Appurtenances
3. Chapter 7 – Water System Standards
4. Chapter 13 – Approved Manufacturers

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Submittal Procedures

B. Product Data: Manufacturer's Catalog cuts and product data for all pipe, fittings and appurtenances.

C. Test Reports:
1. Certified factory hydrostatic test results for each shipment of pipe.
2. Field hydrostatic test

PART 2 PRODUCTS

2.1 Comply with material requirements in Chapter 6 of Beaufort-Jasper Water & Sewer Authority Technical Specifications – Revised July, 2009.

A. Approved manufacturers
1. Beaufort-Jasper Water & Sewer Authority Technical Specifications – Revised July 2009, Chapter 13.

PART 3 EXECUTION

3.1 PREPARATION

A. Notification Of Intent To Excavate:
   1. Comply with South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978). Notification of intent to excavate may be given by calling this toll free number: 1-800-922-0983.

B. Approximate location of certain underground lines and structures are shown on the plans for information only and additional underground lines or structures may exist that are not shown.
   1. Call Palmetto Utility Protection Service at 1-888-721-7877 between the hours of 7:00 AM and 7:00 PM Monday thru Friday at least three working days before commencing construction. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 TRENCH EXCAVATION AND BACKFILL

A. Perform trench excavation and backfill in accordance with the requirements in Section 02324, Excavation, Backfill for Utilities.

3.3 PIPE INSTALLATION

A. Install pipelines and appurtenances in accordance with the requirements in Chapter 7 of Beaufort-Jasper Water & Sewer Authority Technical Specifications Revised July, 2009

3.4 FIELD QUALITY CONTROL

A. Testing and disinfection of pipe lines to be in accordance with Chapter 7 of Beaufort-Jasper Water & Sewer Authority Technical Specifications Revised July, 2009.

END OF SECTION

SECTION 02537

GRAVITY SANITARY SEWER SYSTEM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Furnishing and installing piping, manholes and appurtenances for gravity sanitary sewer system.

B. Work under this section of the Specifications must be performed in accordance with the requirements in the Beaufort-Jasper Water & Sewer Authority Technical Specifications, Revised July, 2009. Contractor shall have a copy of the aforementioned specifications at the site of the Work for the full duration of construction.

C. In the event there is a conflict between the requirements contained in this section of the Specifications and the Beaufort-Jasper Water & Sewer Authority Technical Specifications, the more restrictive or the more stringent requirement shall be applied.

1.2 MEASUREMENT AND PAYMENT

A. General:
   1. Section 01001 – General Requirements, Article 1.4 – Unit Prices.
   2. Payment will be made for the following items of work under this section of the specifications when the item is shown on the Schedule of Bid Prices included in the Bid Form and attached to the Agreement.

B. PVC Pipe Gravity Sanitary Sewer:
   1. Basis of Measurement: Linear feet of PVC gravity sanitary sewer pipe, size and depth indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for PVC Pipe Gravity Sanitary Sewer, size and depth indicated, and shall include all costs for pipe, fittings, installation, testing, excavation, backfill, trench bracing, disposal of unsuitable material, placing foundation stabilization and embedment material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

C. DIP Gravity Sanitary Sewer:
   1. Basis of Measurement: Linear feet of DIP gravity sanitary sewer pipe, size and depth indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for DIP Gravity Sanitary Sewer, size and depth indicated, and shall include all costs for pipe, fittings, installation, testing, excavation, backfill, trench bracing, disposal of unsuitable material, placing foundation stabilization

and embedment material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

D. Gravity Sanitary Sewer Service Lateral
   1. Basis of Measurement: Linear feet of gravity sanitary sewer lateral, size indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for Gravity Sanitary Sewer Service Lateral, size indicated, and shall include all costs for pipe, fittings, installation, testing, excavation, backfill, trench bracing, disposal of unsuitable material, placing foundation stabilization and embedment material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications. Service wye will be paid for under the Bid Item for PVC Wye.
   3. Pay Items:
      a. 4-inch Gravity Sanitary Sewer Service Lateral
      b. 6-inch Gravity Sanitary Sewer Service Lateral

E. PVC Cleanout:
   1. Basis of Measurement: Each PVC clean-out, size as indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for PVC Cleanout, size as indicated, and shall include all costs for pipe, fittings, installation, testing, excavation, backfill, disposal of unsuitable material, placing foundation stabilization and embedment material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

F. PVC Wye:
   1. Basis of Measurement: Each PVC wye, size as indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for PVC Wye, size as indicated, and shall include all costs for pipe, fittings, installation, testing, excavation, backfill, disposal of unsuitable material, placing foundation stabilization and embedment material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

G. Grease Trap:
   1. Basis of Measurement: Each grease trap, Size as indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for Grease Trap, size indicated and shall include all costs for grease trap, pipe, fittings, installation, testing, excavation, backfill, disposal of unsuitable material, placing foundation stabilization material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

H. Manholes To 6-ft. Depth:
   1. Basis of Measurement: Each Manhole, for a nominal depth up to 6-feet, measured from rim to invert of manhole, and with frame and cover, in place.

2. Basis of Payment: Payment will be made at the Unit Price bid for Manholes To 6-ft. Depth and shall include all costs for precast manhole barrel sections, base, top, cone section, joint gaskets, interior coating, exterior joint collars, cast iron frame and cover, flexible connectors, steps, invert fill, installation, testing, excavation, backfill, disposal of unsuitable material, placing foundation stabilization material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items:
    a. 4-ft. diameter Manhole to 6-ft. Depth.
    b. 5-ft. diameter Manhole to 6-ft. Depth.
    c. 6-ft. diameter Manhole to 6-ft. Depth.

I. Additional Manhole Depth:
1. Basis of Measurement: Additional vertical feet of depth of manhole over 6-feet.
2. Basis of Payment: Payment will be made at the Unit Price bid per vertical foot for Additional Manhole Depth and shall include all costs for additional manhole barrel, joint gaskets, interior coating, exterior joint collars, installation, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items:
    a. 4-ft. Diameter Manhole, Additional Depth.
    b. 5-ft. Diameter Manhole, Additional Depth.
    c. 6-ft. Diameter Manhole, Additional Depth.

J. Manhole Drop Pipe:
1. Basis of Measurement: Each vertical drop pipe installed at drop manhole in accordance with the details on the Drawings, length measured from the invert of the incoming sanitary sewer to the invert of the drop pipe discharging into the manhole.
2. Basis of Payment: Payment will be made at the unit price bid for each manhole drop pipe, size and length indicated, and shall include all costs for pipe, fittings, installation, concrete encasement and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

K. Connect To Existing Manhole:
1. Basis of Measurement: Each connection to an existing manhole, complete.
2. Basis of Payment: Payment will be made at the Unit Price bid for each connection to existing manhole and shall include all costs for pipe, flexible connectors, gaskets, core drilling, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item;
    a. Connection to Existing Manhole

1.3 REFERENCES

A. American Society of Testing and Materials (ASTM):
1. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
3. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
4. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
5. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
6. ASTM D2235 - Standard Specification for Solvent Cement for Acrylo nitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
7. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
8. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
9. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
10. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
11. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
12. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
13. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
14. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
15. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
16. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA):
1. AWWA C104 - American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110 - American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.
3. AWWA C111 - American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C150 - ANSI Standard for the Thickness Design of Ductile Iron Pipe.

5. AWWA C151 - American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
6. AWWA C153 - American National Standard for Ductile-Iron Compact Fittings for Water Service.

C. Beaufort-Jasper Water & Sewer Authority Technical Specifications, Revised July, 2009.
1. Chapter 2 – Earthwork
2. Chapter 6 – Pipeline Materials, Valves and Appurtenances
3. Chapter 8 – Wastewater System Standards
4. Chapter 9 – Concrete Structures, Manholes and Appurtenances
5. Chapter 13 – Approved Manufacturers

1.4 SUBMITTALS

A. Section 01001 - Submittal Procedures: Requirements for submittals.

B. Product Data: Manufacturer's catalog cuts and product data for all pipe, fittings and manholes.

C. Test Reports:
1. Air test
2. Deflection test

PART 2 PRODUCTS

2.1 Comply with material requirements in Chapter 6 of Beaufort-Jasper Water & Sewer Authority Technical Specifications – Revised July, 2009.

A. Approved manufacturers
1. Beaufort-Jasper Water & Sewer Authority Technical Specifications – Revised July, 2009, Chapter 13.

PART 3 EXECUTION

3.1 EXAMINATION

A. Notification Of Intent To Excavate:
1. Comply with South Carolina Underground Utility Damage Prevention Act (S.C. Code Ann, 58-35-10, CT-SEQ, Supp. 1978). Notification of intent to excavate may be given by calling this toll free number: 1-800-922-0983.

B. Approximate location of certain underground lines and structures are shown on the plans for information only and additional underground lines or structures may exist that are not shown.

1. Call Palmetto Utility Protection Service at 1-888-721-7877 between the hours of 7:00 AM and 7:00 PM Monday thru Friday at least three working days before commencing construction. Request underground utilities to be located and marked within and surrounding construction areas.

3.2 TRENCH EXCAVATION AND BACKFILL

A. Perform trench excavation and backfill in accordance with the requirements in Section 02324, Excavation, Backfill for Utilities.

3.3 PIPE INSTALLATION

A. Install pipelines and appurtenances in accordance with the requirements in Chapter 8 of Beaufort-Jasper Water & Sewer Authority Technical Specifications Revised July, 2009.

3.4 FIELD QUALITY CONTROL

A. Testing of sewer pipe lines to be in accordance with Chapter 8 of Beaufort-Jasper Water & Sewer Authority Technical Specifications Revised July, 2009.

END OF SECTION

SECTION 02630

STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Storm drainage piping.
2. Accessories.
3. Catch basins
4. Inlets
5. Manholes and Junction Boxes
6. Bedding and cover materials.

B. Related Sections:
1. Section 02324 – Trenching, Backfilling for Utilities

1.2 MEASUREMENT AND PAYMENT

A. Storm Drain Pipe
1. Basis of Measurement: Linear feet of storm drain pipe, type and size indicated, measured from centerline to centerline of structures, complete, in place. Depth measurement is from finished grade over pipe to invert of pipe.
2. Basis of Payment: Payment will be made at the Unit Price bid per linear foot for the type and size storm drain pipe indicated and at the depths indicated in the Schedule of Bid Prices and shall include all costs for pipe and accessories, installation, excavation, backfill, disposal of unsuitable material, foundation stabilization, pipe embedment and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications. No separate payment will be made for Class 2 or Class 3 embedment material obtained on the site of the construction. Payment for furnishing Class 2 or Class 3 material imported from off the site will be made under a separate bid item.
3. Pay Items:
a. 15-inch *(Type/ Description)* Pipe, 4.38-ft. To 7.5-ft. Depth

B. Precast Reinforced Concrete Box Culvert
1. Basis of Measurement: Linear feet of precast reinforced concrete box culvert, type and size indicated, measured from end to end, complete, in place.
2. Basis of Payment: Payment will be made at the Unit Price bid per lineal foot for precast reinforced concrete box culvert, size as indicated in the Schedule of Bid Items, and shall include all costs for precast culvert and accessories, precast concrete wing walls if applicable, installation, excavation, backfill, disposal of unsuitable material, and all other costs of

whatever nature required for performance of this item of Work under this section of the Specifications.

3. Pay Items:
   a. 2-ft. x 2-ft. Precast Reinforced Concrete Box Culvert.

C. Cast-In-Place Concrete Box Culvert
   1. Basis of Measurement: No separate measurement of quantities will be made for cast-in-place concrete box culverts.
   2. Basis of Payment: Payment will be made at the Lump Sum Price bid for each separate cast-in-place concrete box culvert, location and size as indicated in the Schedule of Bid Prices, including wing walls where applicable, and shall include all costs for installation, concrete, reinforcing, forming, excavation, backfill, disposal of excess material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

D. Straight Headwall For Circular Pipe
   1. Basis of Measurement: Each straight headwall installed at the location shown on the Drawings, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each cast-in-place concrete straight headwall for circular pipe, size as indicated in the Schedule of Bid Prices, and shall include all costs for concrete, reinforcing, forming, excavation, backfill, disposal of excess material, installation, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

E. Headwall With Wing Walls For Pipe
   1. Basis of Measurement: Each headwall with wing walls for indicated type and size pipe installed at the location shown on the Drawings, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each cast-in-place concrete headwall with wing walls for type and size pipe as indicated in the Schedule of Bid Prices, and shall include all costs for concrete, reinforcing, forming, excavation, backfill, disposal of excess material, installation, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

F. Flared End Sections
   1. Basis of Measurement: Each flared end section installed in accordance with the details on the drawings, complete, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each flared end section, type and size as indicated in the Schedule of Bid Prices, and shall include all costs for flared end section, excavation, backfill, disposal of excess material, installation, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

G. Storm Drain Structures To 6-ft. Depth

1. Basis of Measurement: Each catch basin, storm inlet, manhole or junction box constructed in accordance with the details on the drawings to a nominal depth of 6-ft., measured from grate or rim to invert of structure, and with frame and grate/cover installed.
2. Basis of Payment: Payment will be made at the Unit Price bid for each catch basin, storm inlet, manhole or junction box constructed up to a depth of 6-ft., identified by type in the Schedule of Bid Prices, and shall include all costs for excavation, backfill, disposal of excess material, construction, installation, cast iron frame and cover or grate where required, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items:
    a. Drop Inlet, To 6-ft. Depth
    b. Weir Inlet, To 6-ft. Depth
    c. Junction Box, To 6-ft. Depth

H. Storm Drain Structures, Additional Depth
1. Basis of Measurement: Additional vertical feet of depth of storm drain structure over 6-feet.
2. Basis of Payment: Payment will be made at the Unit Price bid for each additional vertical foot of structure, identified by type in the Schedule of Bid Prices, and shall include all costs for additional riser sections, joint gaskets, interior coating, exterior joint collars, installation, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications
3. Pay Items:
    a. Catch Basin, Type ____, Additional Depth
    b. Drop Inlet, Additional Depth
    c. Weir Inlet, Additional Depth
    d. Manhole, Additional Depth
    e. Junction Box, Additional Depth

I. Imported Class 2 and Class 3 Embedment Material
1. Basis of Measurement: Cubic yards of Class 2 and Class 3 material obtained from off-site borrow sources for use as embedment material. Measurement will be made in-place for material placed in accordance with the requirements of this section of the Specifications.
2. Basis of Payment: Payment will be made at the Unit Price bid for furnishing Class 2 and Class 3 Embedment Material obtained from off-site borrow sources and shall include all costs for loading, hauling, unloading, disposal of excess material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Items:
    a. Imported Embedment Material, Class 2
    b. Imported Embedment Material, Class 3

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:
   1. AASHTO M294 - Standard Specification for Corrugated Polyethylene Pipe, 300-to 900-mm (12- to 36-in.) Diameter.

B. ASTM International:
   1. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   2. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   3. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   4. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
   5. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
   6. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures
   7. ASTM C1478 - Standard Specification for Storm Drain Resilient Connectors Between Reinforced Concrete Storm Sewer Structures, Pipes and Laterals
   8. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   9. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   10. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
   11. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   12. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
   13. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   14. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
   15. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
   16. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   17. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
   18. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

19. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
20. ASTM F2306/F2306M - Standard Specification for 12 to 60 in. [300 to 1500 mm] Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Submittal Procedures

B. Product Data: Submit manufacturer's product data for:
1. Pipe, pipe accessories, gaskets, joint lubricants.
2. Inlet grates
3. Manhole frames and covers
4. Precast drainage structures.

C. Manufacturer's Installation Instructions: Submit special procedures required to install Products specified.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

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

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

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

A. Reinforced Concrete Pipe: ASTM C76, with Wall Type A, B, or C, bell and spigot joints.
1. Fittings: fabricated from reinforced concrete pipe
2. Joints: ASTM C443, rubber compression gasket.
3. Pipe Class: Class III unless otherwise indicated on the drawings.

B. Concrete Pipe: ASTM C14, unreinforced, bell and spigot joints.
1. Fittings: Fabricated from concrete pipe.
2. Joints: ASTM C443, rubber compression gasket.
3. Pipe Class; As indicated on the drawings.

C. Thermoplastic Pipe:
   1. High Density Polyethylene (HDPE): ASTM F 2306, Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.
      a. Fittings: Corrugated Polyethylene (HDPE)
      b. Joints: Bell and spigot.
   2. Polyvinyl Chloride (PVC): ASTM D3034, Type PSM, Poly (Vinyl Chloride) (PVC) material; bell and spigot style rubber ring sealed gasket joint.
      a. Fittings: PVC.
      b. Joints: ASTM F477, elastomeric gaskets.

2.2 STORM DRAIN STRUCTURES

A. Cast-in-place structures:
   1. Concrete: 28 day compressive strength – 3000 psi.
   2. Reinforcing: ASTM A615/A 615M, grade 60

B. Precast structures:
   1. Round manholes: ASTM C478
      a. Top: Precast concrete, concentric cone, eccentric cone, or flat slab type, as indicated on drawings.
      b. Base: Precast concrete, with base riser section and separate base slab, or base riser section with integral floor, as indicated on drawings.
      c. Steps: Ductile-iron or aluminum, integrally cast into manhole sidewalls.
   2. Square and rectangular structures: Design must meet or exceed the design requirements in ASTM C890 or ASTM C913.
   3. Precast reinforced concrete box with knock-out panel: Comply with the requirements on SCDOT standard drawing number 719-17 except for limitations contained herein.
      a. Precast R.C. box with knock-out panel may be used for catch basins, drop inlets, shallow junction boxes and manholes.
      b. Maximum depth from finished grade to top of box – 2’-0”.
      c. Minimum inside dimensions of box – 4’ x 4’ x 4’.
      d. Maximum inside dimensions of box – 5’ x 5’ x 6’.
      e. Maximum bury depth, i.e. finished grade to floor of box, - 8’-0”.
   4. Precast reinforced concrete box with solid wall: Comply with the requirements on SCDOT standard drawing number 719-17A except for limitations contained herein.
      a. Precast R.C. box with solid walls may be used for catch basins, drop inlets, junction boxes and manholes.

2.3 FRAMES, GRATES AND COVERS:

A. Material: ASTM A48, Class 30, gray cast iron.

B. Bearing surfaces of circular medium and heavy duty manhole frames, covers and grates shall be machined to insure proper fit and prevent rattling.

C. Unless otherwise indicated on the drawings, all frames grates and lids shall be classified heavy duty, designed for a 16,000 lb. wheel load.

D. Watertight manhole covers, where indicated on the drawings, shall be bolted and gasketed.

2.4 PIPE CONNECTORS

A. Resilient, ASTM C1478.

2.5 EMBEDMENT MATERIALS

A. Angular stone material: Processed, graded aggregate; SCDOT #57 stone, ¾" maximum size, SCDOT Standard Specifications for Highway Construction.

B. Select material: Acceptable soil material free of rocks, debris, frozen earth or foreign matter and free of excessive moisture.

C. In general, soils from the following soil groups, as defined in ASTM D2487, are acceptable for use as pipe embedment: GW, GM, GC, GP, SM, SC, SW, SP, GW-GC, SP-SM, ML, CL, except that groups GM, GC, SM and SC soil material may only be used in dry trench conditions. Acceptability of soil material for use as pipe embedment is subject to the approval of the Engineer.

D. Materials from the following soil groups as defined by ASTM D2487 are unacceptable for pipe embedment: MH, CH, OL, OH, and PT.

E. Select material shall be obtained first from acceptable material excavated from the trench, second from acceptable material excavated elsewhere within the construction site and last from off-site borrow sources when approved by the Engineer.

F. Soil material used for pipe embedment shall be placed at or near optimum moisture content. Moisture tempering of the soils used for embedment shall be the responsibility of the Contractor. No additional payment will be made for moisture tempering of soils.

PART 3 EXECUTION

3.1 TRENCH EXCAVATION

A. Excavate pipe trench in accordance with Section 02324 – Trenching, Backfilling for Utilities.

B. Excavate to lines and grades indicated on the Contract Drawings or required to accommodate installation.

C. Trench Width: Trench width at or below the top of the pipe shall be adequate to allow proper placement and consolidation of embedment material. The minimum trench width at or below the top of the pipe shall be the greater of either the pipe O.D. plus 16 inches or the pipe O.D. multiplied by 1.25 plus 12 inches.

D. Remove large stones or other hard matter capable of damaging pipe or impeding consistent backfilling or compaction.

E. Protect and support existing sewer lines, utilities and appurtenances.

F. Maintain profiles of utilities. Coordinate with other utilities to eliminate interferences. Notify Engineer where crossing conflicts occur.

3.2 INSTALLATION OF PIPE

A. General
1. Lay pipe to slope and alignment indicated on Contract Drawings. Begin at downstream end and progress upstream. Lay bell and spigot pipe with bells upstream.
2. Assemble and handle pipe in accordance with manufacturer's instructions except as modified on the Contract Drawings or by Engineer.
3. Keep pipe and fittings clean until work is completed and accepted. Clear interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. In large, accessible piping, brushes and brooms may be used for cleaning. Flush lines between manholes if required to remove collected debris.
4. Place plugs in ends of uncompleted conduit at end of day or whenever work stops.
5. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
6. Install gaskets in accordance with manufacturer's recommendations for use of lubricants and other special installation requirements.
7. Joint Adaptors: Make joints between different types of pipe with standard manufactured adapters and fittings intended for that purpose.

B. Concrete Pipe:
1. Install Concrete Pipe in accordance with American Concrete Pipe Association (ACPA) "Concrete Pipe Installation Manual".
2. Foundation for Pipe: Support pipe and bedding on firm foundation. When a firm foundation is not encountered at the required grade, remove unstable material to a depth to provide adequate support for the pipe or as directed by the Engineer. Replace the excavated material with select material in 6" maximum layers compacted to 95% Modified Proctor, ASTM D1557 up to the bottom of the bedding.
3. Pipe Bedding:
   a. Use select material, well-graded sand or gravel. Angular stone may be used for pipe bedding. When angular stone is used,

completely wrap bedding with filter fabric for drainage filtration to prevent soil migration into open voids.

b. Ensure that trenches are free of water when placing bedding.

c. Support the pipe by placing loose bedding material for a depth of the pipe O.D./24 or 3" minimum. When rock or unyielding material is encountered, extend the depth of the bedding to the pipe O.D./12 or 6" minimum.

d. Excavate bedding material at pipe bells and projected hubs to prevent excess loading and to provide uniform support for the full length of the pipe barrel.

e. Compact bedding material that is outside of the middle third of the pipe diameter in order to ensure proper support for the pipe. Ensure that bedding material outside the middle third of pipe is compacted to a minimum of 90% of the maximum dry density, Modified Effort, ASTM D1557. Ensure that compaction of bedding material does not cause the pipe to move.

f. Do not use Controlled Low Strength Material (CLSM), flowable fills or concrete for pipe bedding.

4. Haunching

a. Following placing and joining of pipe, place select material or angular stone to the spring line of the pipe. When angular stone has been used for pipe bedding, the angular stone shall also be used for haunching and the entire stone bedding and haunching envelope shall be completely wrapped with filter fabric for drainage filtration to prevent soil migration.

b. Place select material in layers not exceeding 6 inches of compacted material and thoroughly compact to 90% of the maximum dry density, Modified Effort, ASTM D1557. The first lift must be sufficiently below the spring line such that the material can be worked into the haunch zone of the pipe. Perform compaction by the use of mechanical tampers with the assistance of hand tamps when necessary. Thoroughly compact the material under the haunches of the pipe and ensure that the backfill soil is in continuous uniform contact with the side and joints of the pipe. Exercise sufficient care to prevent damaging or misaligning the pipe with the compaction equipment. Place and compact material on both sides of pipe for its full length before adding the next lift of material. Ensure that trenches are free of water when placing and compacting haunching material. Ensure that backfill process does not cause joint separation or displacement of the installed pipe.

5. Initial Backfill: Place initial backfill, consisting of select material, in 6-inch maximum layers to 1-foot above top of pipe. Carefully consolidate and compact each layer to the density specified for the remainder of the trench backfill (Section 02324 – Excavation, Backfilling for Utilities).

6. Trench Backfill: Place and compact remainder of backfill in accordance with Section 02324. Do not displace or damage pipe when compacting.

C. Thermoplastic Pipe:

1. Install PVC sanitary sewer pipe in accordance with ASTM D2321, Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications, and the details included in the Contract Drawings.
2. Pipe Embedment:
    a. In stable soils, extend trench excavation to a point 4” below the bottom of the pipe (6” in rock or unyielding material). Install pipe bedding consisting of angular stone to provide uniform support for the full length of the pipe. Excavate for pipe bells at joints. After pipe is installed to line and grade, place angular stone material in 6-inch maximum layers to spring line of pipe. Carefully consolidate each layer to completely fill space below and around pipe, taking care not to disturb the pipe.
    b. Where soft or unstable soils incapable of supporting the pipe are encountered at the bottom of the trench, extend trench excavation to the depth necessary for the soil conditions or as directed by the Engineer. Install foundation stabilization and pipe bedding consisting of angular stone material, placed and consolidated to provide uniform support for the full length of the pipe. Excavate for pipe bells at joints. After pipe is installed to line and grade, continue placing and consolidating the angular stone to the spring line of the pipe, taking care not to disturb the pipe.
    c. Completely wrap angular stone material in filter fabric to prevent migration of adjacent soils.
    d. Initial Backfill: Place initial backfill, consisting of select material, in 6-inch maximum layers to 1-foot above top of pipe. Carefully consolidate and compact each layer to 95% modified Proctor, ASTM D1557.
3. Trench Backfill: Place and compact remainder of backfill in accordance with Section 02324. Do not displace or damage pipe when compacting.

3.3 INSTALLATION – DRAINAGE STRUCTURES

A. Form bottom of excavation clean and smooth to correct elevation.

B. Form and place Cast-In-Place Concrete base pad, with provision for storm drain pipe end sections.

C. Level top surface of base pad; sleeve concrete shaft sections to receive storm sewer pipe sections.

D. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.

E. Mount cover/grate and frame level in grout, secured to top and at elevation indicated. Where manholes occur in pavements, set tops of frames and covers flush with finish surface. Elsewhere, set tops 3" above finish surface, unless otherwise indicated.

F. Provide rubber joint gasket complying with ASTM C 443-98 at joints of precast structure sections.

G. Apply bituminous mastic coating at joints of sections.

3.4 FIELD QUALITY CONTROL

A. Request inspection prior to and immediately after placing initial backfill.

B. Compaction Testing:
1. Laboratory density and moisture content: ASTM D698
2. Field density; ASTM D2922
3. Field moisture content: ASTM D3017.

C. When tests indicate work does not meet specified requirements, remove work, replace and retest.

D. Frequency of Compaction Tests: One test for each 500 linear feet of storm drain pipe or fraction thereof.

3.5 PROTECTION OF FINISHED WORK

A. Protect pipe and initial backfill from damage or displacement until backfilling operation is in progress.
1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.
2. Repair or replace pipe that is damaged or displaced from construction operations.

END OF SECTION

SECTION 02661

REUSE IRRIGATION WATER PRIMARY DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. WORK covered by this Section consists of furnishing and installing reuse irrigation water distribution pipes and appurtenances, including testing and disinfection, all in accordance with the Contract Drawings.

1.2 MEASUREMENT AND PAYMENT

A. General.
   1. Section 01001 – General Requirements, Article 1.4 – Unit Prices.
   2. Payment will be made for the following items of work under this section of the specifications when the item is called for on the Contract Drawings or in the Technical Specifications and is shown on the Schedule of Bid Prices included in the Bid Form and attached to the Agreement.

B. Irrigation Pipe:
   1. Basis of Measurement: linear feet of irrigation pipe line in place measured thru fittings.
   2. Basis of Payment: Payment will be made at the Unit Price bid per lineal foot for the indicated type and size water line pipe and shall include all costs for pipe, installation, marker tape, tracer wire, testing, sampling, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Items:

		Units
a.	___-inch PVC Pipe Irrigation Line	LF
b.	___-inch Ductile Iron Pipe Irrigation Line	LF

C. Fittings:
   1. Basis of Measurement: Each DIP fitting, size and type as indicated, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each fitting, size and type indicated, and shall include all costs for fitting, gaskets, glands, bolts, nuts, lubricants, installation, testing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Items:

		Units
a.	(*size, type fitting)*	EA

D. Additional For Restrained Joint
   1. Basis of Measurement: Each restrained pipe joint installed at the locations and to the limits indicated on the Drawings.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each restrained pipe joint for the type and size of pipe indicated and shall include all additional costs for material, labor and other costs required to construct a restrained joint in accordance with this section of the Specifications, regardless of style of joint, over and above the costs for installing a non restrained joint.

E. Gate Valve And Valve Box
   1. Basis of Measurement: Each gate valve and valve box, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each Gate Valve and Valve Box, (size indicated) and shall include all costs for valve, valve box, valve operating key, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

F. Remote Flow Control Valve and Valve Box
   1. Basis of Measurement: Each Remote Flow Control Valve and valve box, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each Remote Flow Control Valve and Valve Box, (size indicated) and shall include all costs for valve, valve box, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

G. Concrete Valve Markers
   1. Basis of Measurement: Each concrete marker, in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each concrete valve marker and shall include all costs for precast concrete post, installation, excavation, backfill, disposal of unsuitable material and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

H. Air and Vacuum Release Valve Assembly and Manhole:
   1. Basis of Measurement: Each air release or air/vacuum valve and manhole, complete in place.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each air release or air/vacuum valve (size indicated) and manhole and shall include all costs for air release or air/vacuum valve, tapping saddle, corporation stop, incidental piping; precast manhole, cast iron frame and cover, installation and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

I. Flushing Hydrant
   1. Basis of Measurement: Each flushing hydrant installed at the locations indicated on the Drawings.
   2. Basis of Payment: Payment will be made at the Unit Price bid for each flushing hydrant, and shall include all costs for post type hydrant, installation, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Item: Units
      a. Post Type Flushing Hydrant EA

J. Connection To Existing Reuse Irrigation Water Line – Wet Connection:
   1. Basis of Measurement: Each connection to existing reuse irrigation water line using tapping sleeve and tapping valve with existing line active (wet tap).
   2. Basis of Payment: Payment will be made at the Unit Price bid for each wet tap connection to existing reuse irrigation water line and shall include all costs for tapping sleeve, tapping valve, valve box, installation, tapping machine, testing, excavation, backfill, disposal of unsuitable material, foundation stabilization and bedding and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Items: Units
      a. Connection To Existing Reuse Irrigation Water Line – Wet Connection EA

K. Hydrostatic Testing and Disinfection:
   1. Basis of Measurement: No separate measurement will be made for hydrostatic testing and disinfection.
   2. Basis of Payment: Payment will be made at the Lump Sum bid for Hydrostatic Testing and Disinfection and shall include all costs for water, pumps, meters, gauges, equipment, tools, labor, disinfection chemicals, sampling, laboratory testing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Items: Units
      a. Hydrostatic Testing and Disinfection LS

1.3 RELATED WORK

A. Section 02324 – Trenching, Backfilling For Utilities

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM), Annual Book Standards.
   1. ASTM D 2122, Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.

2. ASTM F 477, Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

B. American Water Works Association (AWWA) Standards.
1. AWWA C104, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110, Standard for Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and other Liquids.
3. AWWA C111, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C151, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water or other Liquids.
5. AWWA C153, Standard for Ductile-Iron Compact Fittings, 3 in. through 24 in. and 54 in. through 64 in., for Water Service.
6. AWWA C509, Standard for Resilient – Seated Gate Valves for Water
7. AWWA C550, Standard for Protective Epoxy Interior Coatings for Valves and Hydrants.
8. AWWA C600, Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.
9. AWWA C651, Standard for Disinfecting Water Mains.
10. AWWA C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall be responsible for safe unloading, storage and care of material furnished by or to him until it has been incorporated into work.

B. Unload pipe, fittings, or valves by lifting with hoists or skidding to avoid damage.
1. Pipe shall not be unloaded by rolling or dropping off trucks.
2. Pipe handled on skid ways shall not be skidded or rolled against pipe already on ground.

C. Unload material at site of work, near place where it will be placed in trench.
1. Materials shall be placed for least interference with traffic.
2. Provide signs, lights, and barricades as necessary to protect public.

D. Handle material carefully to prevent breakage and to avoid damage to coatings and linings.
1. Keep interior of pipe, fittings, and valves, free of dirt or foreign matter at all times.
2. Do not place materials in drainage ways or ditches.

PART 2 PRODUCTS

2.1 GENERAL

Reuse irrigation water distribution piping mains shall be PVC pipe or ductile iron pipe as indicated on the Drawings. All materials used shall be certified for conformance with American

National Standards Institute/National Sanitation Foundation Standard 61 (ANSI/NSF Standard 61). All piping shall be color-coded purple. All valves and outlets shall be tagged and color-coded purple to differentiate reclaimed water from potable water. All reclaimed water valves and outlets shall be appropriately tagged or labeled “REUSE” together with the equivalent standard international symbol to warn the public and employees that the water is not intended for drinking.
All distribution and application facilities located on private properties, including residential properties, shall be color-coded purple. This includes, but is not limited to, valves, boxes and lids, valve markers, and meter box lids.

2.2 PLASTIC PIPE (PVC)

A. Pipe shall be factory dyed industry standard purple.

B. 3-inch and smaller: ASTM D2241, SDR-21, Pressure Class 200 unless otherwise indicated on the Contract Drawings.

C. Pipe sizes 4-inch thru 12-inch, AWWA C900, DR-18, Pressure Class 150 unless otherwise indicated on the Contract Drawings.

D. Pipe sizes 14-inch and larger, AWWA C905, Cast Iron Pipe OD, DR 25 unless otherwise indicated on the Contract Drawings.

E. Fittings:
1. 4-inch and larger: Ductile Iron, AWWA C110 and AWWA C153.
2. Joints: ASTM D3139 and ASTM F477, flexible elastomeric seals. Solvent-cement joints are not permitted on pipe sizes 4-inch and larger.
3. Joint Restraints: External bolted wedge action type.
4. 3-inch and smaller: Schedule 80 PVC.

2.3 DUCTILE IRON PIPE

A. Pipe shall be color coded with purple stripe.

B. Pipe: AWWA C151.
1. Bituminous outside coating: AWWA C151.
2. Cement Mortar Lining: AWWA C104.
3. Pipe Class:
   a. Pipe sizes 3-inch thru 12-inch, Pressure Class 350.
   b. Pipe sizes 14-inch and larger, Pressure Class 250, unless otherwise indicated on the Contract Drawings.

C. Fittings: Ductile iron, AWWA C110. Compact fittings: AWWA C153.
1. Bituminous Coating: AWWA C110.
2. Cement Mortar Lining: AWWA C104, double thickness.
3. Joints:
   a. Mechanical and Push-On Joints: AWWA C111.
   b. Flanged Joints: AWWA C115.
4. Joint Restraints:

a. Boltless, push-on type, independent of joint seal.
b. External bolted wedge action type.

2.4 GATE VALVES

A. Shall conform to requirements of AWWA C509 for resilient seated gate valves, iron body, with bonded epoxy coating conforming to AWWA C550.

B. Shall be designed for 250 psi working pressure and 500 psi hydrostatic test pressure.

C. Shall be of iron body, bonded epoxy, and shall have non-rising bronze stem, and shall be wrench operated.

D. Valves shall open by turning counter-clockwise, and operating nuts shall be standard two inches square.

E. Suitable stem guides shall be provided, where required.

F. Shall be furnished with mechanical joint suitable for connection to pipe into which it will be installed for buried service.

G. Small Gate Valves: Valves smaller than 3 inches shall conform to level of quality and manufacturing standards established for valves 3 inches and larger by respective AWWA Standards.

H. Gate valves shall be installed at a maximum spacing of 1000 linear feet, and at a minimum of 2 valves per 3-way tees, and at a minimum of 3 valves per 4-way crosses. Additional valves may be required as directed by the Engineer.

2.5 RATE OF FLOW CONTROL VALVE

A. GENERAL: Remote operated rate of flow control valve capable of flow regulation as well as pressure reducing and pressure sustaining. Valve shall be a combination of two elements in one body, i.e. a water meter and a double-chambered solenoid operated hydraulic valve. A pressure regulating module shall be added when required and as indicated on Drawings. Size to be determined by volume of flow and as indicated on Drawings. Complete valve assembly shall be factory tested and ready for field installation and operation.

B. MANUFACTURER and MODEL: Hydrometer by Arad Ltd. Dalia, Model BMU Series, globe type with flanged ends.

C. FLOW CONTROL VALVE BOX: Box and cover shall be Polyethylene (PE), acrylonitrile-butadlene-Styrene (ABS) or fiberglass. Contractor should use 2 boxes, one on top of the other, to provide enough space for easy service access. Boxes to be purple-colored with bolt-down cover for reclaimed use. Manufacturer to be NDS: Model # 318PBCBR 13 inches x 20 inches box for valves 4 inches

and smaller. Model # 226PBCRB 17 inches x 30 inches for valves 6 inches and larger.

2.6 AIR RELEASE VALVES

A. Shall be cast iron body with stainless steel (ASTM A240) float and synthetic seat equal to Crispin PL 10, Type N.

B. Orifice size shall be as follows:

MAXIMUM OPERATING PRESSURE (PSI)						
	50	100	150	200	250	300
ORIFICE	5/16”	5/16”	1/4”	3/16”	5/32”	1/8”

For general use a 3/16” orifice will be adequate. However, Contractor shall verify actual size with Irrigation Supplier prior to installation.

2.7 AIR/VACUUM VALVES

A. Shall be cast iron body with stainless steel (ASTM A240) trim and float equal to Crispin AL20 or approved equivalent.

B. Orifice size shall be 2” diameter.

C. Internal parts shall be stainless steel (ASTM A240) or bronze.

2.8 VALVE MARKERS

A. All bends, valves and air release valves shall be marked with a concrete marker.

B. Valve and pipeline markers installed in landscaped areas shall consist of a reinforced 4” square by 54” long concrete post. Pipe lines located in easements, rural areas, or in right-of-ways shall be marked by paired 6” square by 10 feet reinforced concrete marks placed at clearing limits.

C. Maximum line lay distance between markers is 700 feet.

D. A 2” (min.) round cast bronze or brass survey benchmark with anchoring lug shall be formed into the top of all markers.

E. Markers shall be installed on the right of way line and the marker shall be stamped with the direction and distance to the valve/bend/pipe to the nearest foot.

F. Valve and pipeline markers shall be cast with designation on the face as to its purpose.

G. All visible portions of markers above grade shall be painted with industrial enamel in Pantone Purple 522.

H. Refer to Standard Detail Drawings for dimensions, designations, and installation practices.

I. An approved alternate permanent marking system may be used to reference location of bends and valves.

2.9 VALVE BOXES AND COVERS

A. Shall be provided with valves, and cover shall display the label “REUSE” or other label as approved by the Irrigation Supplier.

B. Shall be of adjustable screw type, of length required with a minimum 6" of adjustment allowed, and installed as shown on standard details.

C. Shaft shall be 5 inch diameter with base to be minimum of 8 inch diameter by 9-inch height inside.

D. Base size and extension piece shall be as required for each individual size of valve and depth.

E. All valve boxes shall be installed with a “Debris Cap”. This device shall be as manufactured by SW Services, Inc., Phoenix, Arizona, or approved equal.

2.10 TAPPING SLEEVES AND VALVES

A. Tapping sleeve shall be all stainless steel with removable bolts and 360º gasket, equal to Ford, Style FTSS.

B. Tapping machines and competent supervision shall be provided for making of taps. All taps shall be made in the presence of a representative of the Irrigation Supplier and the Engineer.

C. Tapping sleeves shall be properly sized to fit existing pipe and shall be of split sleeve type with ends suitable for connection to pipeline to be tapped and to connecting tapping valve.

D. Taps of the same size as the existing line will be allowed only when approved by the Engineer.

E. Valves furnished with sleeves shall conform to requirements herein above for gate valves, except for modifications required to permit use of full size cutter through valves.

F. Outlet of valves shall be mechanical joint for joining with water mains.

G. After tap is completed, the “cut out” section of pipe or “coupon” shall be tagged, labeled as to date and location, and submitted to the irrigation water supplier.

H. Tapping sleeves shall be pressure tested immediately after installation as per the testing requirements of this section.

2.11 FLUSHING HYDRANTS

A. Flushing hydrants shall be equipped with an isolation valve to allow for servicing without interruption of system flows.

B. Materials

1. Hydrants shall be the cast iron, compression type, opening against pressure, and shall conform to ANSI/AWWA C502. Hydrants shall have a minimum 6” restrained mechanical joint connections with a minimum 5-1/4” main valve. Post type flushing hydrants shall be equipped with a single 2-1/2” nozzle. Hose connections shall have NST threads and comply with ANSI B26, but will not have chains attaching the caps to the upper barrel. Barrel lengths shall be for a 3-1/2 FT bury, except where other lengths are necessitated by the hydrant location and where approved by the Irrigation Supplier. Threads and operating nuts shall be as specified by the Irrigation Supplier.
2. Hydrants shall be furnished with an O-ring sealed reservoir located in the bonnet so that all threaded and bearing surfaces are automatically lubricated when the hydrant is operated. Hydrant nozzles shall be O-ring sealed, threaded in place, and retained by stainless steel set screws or clips. Hydrant shall have a bronze seat ring that threads into a bronze drain ring. All working parts shall be removable without disconnecting the hydrant.
3. Hydrants shall be furnished with a breakable feature designed to break cleanly upon impact and consisting of a two-part breakable safety flange or breakable lugs with a breakable stem coupling.
4. All retaining bolts and hardware shall be 316 stainless steel.
5. Upper and lower main stem rods shall be 316 stainless steel.
6. All bronze or brass internal working parts in contact with service water shall be a maximum of 16% in zinc content and 79% minimum in copper.
7. EPDM rubber shall be provided on all hydrant main valves.
8. Interior coating shall be two part thermosetting or fusion bonded epoxy coated, holiday free to a minimum thickness of 4 mil, and conforming to “AWWA C550 protective interior coating for valves and hydrants”.
9. Exterior casting shall indicate type, main valve size, design, date of manufacture, and location of manufacture.
10. Exterior coating shall be Pantone Purple 522 with sunlight stable pigment:
11. Flushing post hydrants shall open counter-clockwise.

2.12 DETECTION TAPE AND WIRE

A. Detector marking tape shall be non-metallic and shall be installed minimum 2 feet above the pipe. Tape shall be highly visible and minimum 2 inches wide. Lettering shall read "Caution: Buried Reuse Line".

B. FOR PVC PIPE ONLY-Detection wire shall be size #12 AWG, installed the entire length of the piping. Wire shall be installed minimum 2 feet above the pipe and properly connected to fittings and valves so line can be relocated with a pipe finder after burial.

2.13 PIPE EMBEDMENT MATERIALS

A. Angular stone material: Processed, graded aggregate; SCDOT #57 stone, ¾" maximum size, SCDOT Standard Specifications for Highway Construction.

B. Select material: Acceptable soil material free of rocks, debris, frozen earth or foreign matter and free of excessive moisture.

C. In general, soils from the following soil groups, as defined in ASTM D2487, are acceptable for use as pipe embedment: GW, GM, GC, GP, SM, SC, SW, SP, GW-GC, SP-SM, ML, CL, except that groups GM, GC, SM and SC soil material may only be used in dry trench conditions. Acceptability of soil material for use as pipe embedment is subject to the approval of the Engineer.

D. Materials from the following soil groups as defined by ASTM D2487 are unacceptable for pipe embedment: MH, CH, OL, OH, and PT.

E. Select material shall be obtained first from acceptable material excavated from the trench, second from acceptable material excavated elsewhere within the construction site and last from off-site borrow sources when approved by the Engineer.

F. Soil material used for pipe embedment shall be placed at or near optimum moisture content. Moisture tempering of the soils used for embedment shall be the responsibility of the Contractor. No additional payment will be made for moisture tempering of soils.

2.14

PART 3 EXECUTION

3.1 Compliance with DHEC Regulations: The construction and installation of the reuse water irrigation system and all its components and appurtenances shall be in strict accordance with the requirements in the South Carolina Department of Health and Environmental Control (DHEC) "R.61-67- Standards for Wastewater Facilities

Construction". References in those standards to "sewers" and "force mains" shall also apply to the reuse water irrigation system piping and appurtenances.

A. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, including the reclaimed water system, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or come into contact with any part of a sewer manhole.

B. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable main. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot separation, the Department may allow installation of the sewer closer to a potable water main, provided that the potable water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the potable water main is at least 18 inches above the top of the sewer.

C. Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of 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. Force mains. There shall be at least a 10 foot horizontal separation between sanitary sewer force mains and potable water mains. There shall be an 18 inch vertical separation at crossing as required in State Regulation subsectionR.61-67.300.A.14.b and R.61-67 .300.A.14.c.

E. Special Conditions. When it is impossible to obtain the distances specified in State Regulation 61-67.300.A.14.b. - d., the Department may allow an alternative design. Any alternative design shall:
   1. Maximize the distances between the sewer line and the potable water main and the joints of each;
   2. Use pipe materials which meet the requirements as specified in State Regulation 61-58.4(D)(1) for the sewer line; and
   3. Allow enough distance to make repairs to one of the lines without damaging the other line.

F. Sewer manholes. No potable water pipe shall pass through or come into contact with any part of a sewer manhole.

3.2 ALIGNMENT AND GRADES

A. Depth of Pipes
   1. Shall be 48 inches measured from finished grade to top of pipe unless otherwise specified.
   2. Where obstructions are encountered, depth may be greater than 48 inches.

B. Valves
   1. Shall be installed with stems vertical.

3.3 INSTALLING PIPE

A. General
   1. Curbing must be installed prior to any reuse line installation.
   2. Trenches must be dry. Pipe and appurtenances shall be installed only when trench conditions are suitable.
   3. Proper implements, tools, and facilities shall be provided by Contractor for safe and convenient performance of the work.
   4. Install pipe, fittings, and accessories in accordance with AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water or AWWA C600, Installation of Ductile-Iron Water Mains and Their Appurtenances and with the details included in the Contract Drawings.

B. Trench Excavation and Backfill: Excavate trenches and place final backfill above embedment zone in accordance with Section 02324, Trenching, Backfilling for Utilities.

C. Trench Width: Trench width at or below the top of the pipe shall be adequate to allow proper placement and consolidation of embedment material.
   1. PVC pipe: Pipe O.D. plus 12 inches minimum; pipe O.D. plus 24 inches maximum.
   2. Ductile Iron Pipe: Pipe O.D. plus 12 inches minimum; pipe O.D. plus 36 inches maximum.
   3. Widths are clear widths. Depending upon Contractor's methods, additional width may be required for placement of sheeting and shoring or for trench boxes.

D. Pipe Embedment:
   1. In stable soils, extend trench excavation to a point 4" below the bottom of the pipe (6" in rock or unyielding material). Install pipe bedding consisting of loosely placed select material to provide uniform support for the full length of the pipe. Excavate for pipe bells at joints. After pipe is installed to line and grade, place select material in 6-inch maximum layers to 6-inches above top of pipe. Carefully consolidate and moderately compact (80% - 90% Modified Proctor, ASTM D1557) each layer to completely fill space below and around pipe, taking care not to disturb the pipe.

2. Where soft or unstable soils incapable of supporting the pipe are encountered at the bottom of the trench, extend trench excavation to the depth necessary for the soil conditions or as directed by the Engineer. Install foundation stabilization and pipe bedding consisting of angular stone material, placed and consolidated to provide uniform support for the full length of the pipe. Excavate for pipe bells at joints. After pipe is installed to line and grade, continue placing and consolidating the angular stone to the spring line of the pipe, taking care not to disturb the pipe. Completely wrap angular stone material in filter fabric to prevent migration of adjacent soils.
3. Initial Backfill: Place and moderately compact (80% - 90% Modified Proctor, ASTM D1557) select material to 6" above the top of pipe.

E. Trench Backfill: Backfill trench above embedment zone in accordance with Section 02324 – Excavation, Backfilling for Utilities.

F. Handling of Pipe
1. Lower pipe, fittings, valves, and hydrants carefully into trench piece by piece by means of derrick, ropes, or other suitable tools or equipment.
2. Prevent damage to water main materials and protective coatings and linings.
3. Do not drop or dump water line materials into trench.
4. Carefully examine pipe and fittings for cracks and other defects while suspended above trench immediately before installation in final position.
   a. Defective pipe or fittings shall be clearly marked and shall be removed from site.
5. Clean bell and spigot ends of each piece of pipe thoroughly before pipe is laid.
6. Prevent foreign material from entering pipe while it is being placed in line.
   a. Provide protective covering for ends of pipe until connection is made to adjacent pipe, if necessary.
   b. No debris, tools, clothing, or other materials shall be placed in pipe during laying operations.
7. As each length of pipe is placed in trench, spigot end shall be centered in bell and pipe forced home using jacks or other approved means and brought to correct line and grade.
   a. Pipe shall be secured in place with approved backfill material tamped around it.
   b. Precautions shall be taken to prevent dirt from entering joint space.
8. Open ends of pipe shall be closed by watertight plug, or other means approved by the Engineer, at times when pipe laying is not in progress.
   a. If water is in trench, plug shall remain in place until trench is pumped completely dry. Water shall not be allowed to run into pipe at any time during construction.
9. Lay pipe with bell ends facing in direction of laying.

a. Where pipe is laid on grade of 10 percent or greater, laying shall start at bottom and shall proceed upward with bell ends of pipe upgrade.

G. Cutting Pipe: Cut pipe for inserting valves, fittings, or closure pieces in neat manner without damage to pipe or lining and so as to leave smooth end at right angles to axis of pipe.

H. Pipe Placement and Joining: Jointing of pipe, fittings, and valves shall be made in strict compliance with manufacturer's instructions.

1. Mechanical Joints
   a. Thoroughly clean outside of spigot and inside of bell prior to installation.
   b. Clean gasket.
   c. Tighten nuts with torque limiting wrench.
   d. Nuts spaced 180 degrees apart shall be tightened alternately in order to produce equal pressure.
2. Push-On Joints
   a. Furnish and install adapters if required to join bells and spigots of different sizes.
   b. Thoroughly clean inside of bell and outside of spigot end prior to installation.
   c. Insert and lubricate gasket using lubricant furnished or recommended by pipe manufacturer.
   d. Spigot end of pipe shall be entered into socket with care used to keep joint from contacting ground.
   e. Complete joint by forcing plain end to bottom of socket with forked tool or jack type tool.
3. Open ends of pipe shall be closed by watertight plug, or other means approved by the Engineer, at times when pipe laying is not in progress. If water is in trench, plug shall remain in place until trench is pumped completely dry. Water shall not be allowed to run into pipe at any time during construction.
4. Generally, lay pipe with bell ends facing in direction of laying. Where pipe is laid on grade of 10 percent or greater, laying shall start at bottom and shall proceed upward with bell ends of pipe upgrade.
5. Joint Deflection: Deflection of pipe at joints shall not exceed 90% of the maximum deflection recommended by the pipe manufacturer.

3.4 SETTING VALVES AND FITTINGS

A. Valves, fittings, plugs, and caps shall be set and joined to pipe in manner specified above for cleaning, laying and joining pipe.

B. Valves shall be set plumb and a valve box shall be provided for every valve.

1. Valve box shall not transmit shock or stress to valves and shall be centered and plumb over wrench nut of valve, with box cover flush with surface of finished pavement or such other level as may be directed.

2. For installation where there are roadside ditches, valves and valve boxes shall be placed on the back side of the ditch at least five (5) feet from the centerline of the ditch.

C. Backfill around valves shall be carefully tamped in 6 inch layers for full depth of trench with valve box in place.

3.5 JOINT RESTRAINTS

A. Joint restraints shall be used on all lines 3 inches in diameter and larger. Restrained joints for pipe and fittings shall be the ductile iron mechanical joint type designed for a working pressure of 350 PSI for 24" and under and 250 PSI for 30" and larger. Restrained joint pipe and fittings shall be capable of being deflected after assembly. Joint restraints shall be coated with a bituminous paint after installation.

B. Thrust Blocking: Cast-in-place concrete thrust blocking may be used at locations where joint restraints are not feasible when approved by the Engineer. See Contract Drawings for details of concrete thrust blocking.

3.6 CONNECTION TO EXISTING MAINS

A. No connections to existing mains shall be made without the presence of Irrigation Supplier representative. Contractor shall coordinate with the Irrigation Supplier regarding connections to existing mains.

B. Connection to existing mains shall be made at such time as to minimize disruption of irrigation water distribution system.

C. Connections to existing mains shall be made using proper fittings and specials to suit actual conditions.

D. Existing pipes, which are cut or damaged by Contractor, shall be repaired, reconnected, and returned to service in equal or better condition.

3.7 STREAM AND UTILITY CROSSINGS

A. Pipe shall be placed beneath streambeds or ditches, around, over, or under sewers, culverts, gas mains, telephone ducts, water mains, or other structures.
1. Do not pass pipe through any drainage pipe, culvert, sewer, or manhole.
2. Provide minimum of 48 inches under streambeds or ditches, unless approved by Engineer in writing.
3. Provide minimum of 6 inch earth or sand cushion between proposed water line and any other utility or structure or as indicated on drawings.

3.8 HYDROSTATIC TESTS

A. Pressure and leakage tests will be required on each section of line between valves and shall be conducted in accordance with AWWA C600.

B. General Procedure

1. Furnish and install corporation stops at high points on line to release air as line is filled with water.
2. Furnish suitable pump, connections, and necessary apparatus including means for accurately measuring water introduced into line during testing.
3. Test pressure shall be 150 pounds per square inch (psi) for a minimum of 2 hours. Pressure shall not vary by more that 5 psi during test.
4. Concurrently with pressure tests, conduct leakage tests on pipe. The maximum allowable leakage shall be based on the following formula:

$$\frac{L = SD/P}{133{,}200}$$

Where L is the allowable leakage in gallons per hour; S is the test length in feet, D is the pipe diameter in inches and P is the average test pressure in pounds per square inch.

5. Locate, remove, and replace any defective pipe, valves, fittings, or hydrants.
6. Repeat tests until satisfactory results are achieved. Contractor shall submit to the Irrigation Supplier a written record of pressure test results.

3.9 DISINFECTION

A. Pipe, fittings, valves, and appurtenances which have been exposed to contamination by construction shall be thoroughly cleaned, chlorinated, drained, and flushed in accordance with AWWA Specification C651.

B. Procedure

1. Flush line prior to disinfection. Flushing shall produce minimum velocity of 2.5 feet per second in pipe.
2. Disinfect pipe using liquid chlorine or hypochlorite to produce a dosage of 50 mg/1 for a 24 hour contact period.
3. Open and close valves several times during disinfection period.
4. After 24 hour retention period, flush chlorinated water from line until chlorine concentration of water leaving main is no higher than that generally prevailing in existing system, or less than 1.0 mg/1.
5. Disposal of the heavily chlorinated water shall be in accordance with AWWA Standard C651. The environment to which this water will be discharged shall be inspected. If there is any question that the water will damage the environment, a reducing agent shall be used to neutralize the chlorine.
6. Obtain samples from farthest point in system and have sample analyzed by a certified laboratory. Furnish copies of sample tests to Irrigation Supplier.

C. Repeat disinfection procedures until bacteriological analysis results are acceptable to the Irrigation Supplier.

END OF SECTION

SECTION 02721

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Aggregate base course placed over prepared subgrade and beneath flexible or rigid paving.
2. Aggregate base course placed over prepared subgrade and used as wearing surface with no added paving material.
3. Prime coat

B. Related Sections:
1. Section 02300 - Earthwork
2. Section02740 – Hot Mix Asphalt Pavement
3. Section 02750 – Portland Cement Concrete Pavement
4. Section 02795 – Portland Cement Pervious Pavement

1.2 MEASUREMENT AND PAYMENT

A. Aggregate Base Course:
1. Basis of Measurement: Square yards of aggregate base course, in place, compacted to thickness indicated.
2. Basis of Payment: Payment will be made at the Unit Price bid per square yard for aggregate base course, thickness indicated, and shall include all costs for material, hauling, placing, compacting, moisture control, fine grading, testing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item
a. Aggregate Base Course, __-inch Thickness

B. Bituminous Prime Coat:
1. Basis of Measurement: Gallons of prime coat applied at the rate specified herein.
2. Basis of Payment: Payment will be made at the Unit Price bid per gallon for bituminous prime coat and shall include all costs for material, hauling, application, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item
a. Bituminous Prime Coat

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials:

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

B. ASTM International:
1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
2. ASTM D1556 - Standard Test Method for Density of Soil in Place by the Sand-Cone Method.
3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
4. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

C. South Carolina Department of Transportation Standard Specifications for Highway Construction:

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Submittal Procedures

B. Materials Source: Furnish data identifying source of materials.

C. Test Reports:
1. Laboratory tests: Gradation and specified properties.
2. Field tests: Compaction

PART 2 PRODUCTS

2.1 AGGREGATE BASE COURSE

A. Graded aggregate base course meeting the requirements for Macadam Base Course or Recycled Portland Cement Concrete Base Course in Subsections 305.02, 305.03, 305.04 and 305.05 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

B. When recycled concrete aggregate is selected for use by the Contractor, the source of the material shall be identified and the Engineer shall inspect the crushing facilities as well as the stockpile of material proposed for inclusion in the Work. Recycled concrete aggregate containing metal, wood, brick, wire, rubber, plastic or other objectionable material will not be approved for inclusion in the Work.

2.2 BITUMINOUS MATERIAL

A. Bituminous material for prime coat in accordance with subsection 305.06 and section 406 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify subgrade gradients and elevations are correct, and subgrade is dry.

B. Correct irregularities in subgrade by scarifying, reshaping, and re-compacting.

C. Do not place base course on soft, muddy, or frozen surfaces.

3.2 BASE COURSE PLACEMENT

A. When the required compacted thickness is 8-inches or less, the base course may be placed in one layer. When the required compacted thickness is greater than 8-inches, place base course in two or more layers. Compacted thickness of any single layer not to exceed 8-inches.

B. Grade surfaces to elevations and gradients indicated.

C. Prevent segregation of fine from coarse aggregates during handling, spreading and shaping.

D. Compact each layer using equipment capable of obtaining the required density.

E. Compact each layer to not less than 100 percent of maximum laboratory density as determined by AASHTO T 180 (Method D).

F. Maintain optimum moisture content of base course materials to obtain required density.

G. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

H. Fines may be added only to the extent necessary to fill voids after initial compaction.

I. In areas where subgrade appears to be unstable after placing base course, remove base course, repair subgrade, replace and compact base course.

3.3 TOLERANCES

A. Smoothness: Maximum variation from flat surface not to exceed 3/8-inch when measured with 10 foot straight edge. Correct any surface irregularities that exceed the specified limits.

B. Thickness: One measurement for each 500 square yards. Excavate test holes thru compacted base course at randomly selected locations to determine thickness. Where the base course thickness is deficient by more than one-half inch, correct by scarifying, adding material and re-compacting.

C. Elevation: Maximum variation not to exceed 1/2 inch below or 0-inches above design elevation.

3.4 FIELD QUALITY CONTROL

A. Sample and test each layer of material for gradation and other requirements after placement but before compaction. Extract one full depth sample for each 500 square yards at random locations.

B. Perform compaction testing in accordance with ASTM D1556 or ASTM D2922 and at a frequency of 1 every 500 square yards of material placed.

C. When tests indicate Work does not meet specified requirements, remove Work, replace and retest.

3.5 PRIME COAT

A. Preparation:
   1. Repair all irregularities in base course
   2. Assure base course density is approved by the Engineer
   3. Clean base course of all mud, dirt, dust and caked or loose material of any kind by brooming, blowing or other methods so as to expose the coarse aggregate in the base course.

B. Application rate: 0.25 – 0.30 gallons per square yard

C. Method of application: As prescribed in subsection 401.4.18 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

END OF SECTION

SECTION 02725

ASPHALT BASE COURSE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hot Mix Asphalt Base Course, Types A and B.

B. Related Sections:
   1. Section 02300 - Earthwork
   2. Section 02721 - Aggregate Base Course
   3. Section 02740 – Hot Mix Asphalt Pavement
   4. Section 02750 – Portland Cement Concrete Pavement

1.2 MEASUREMENT AND PAYMENT

A. Asphalt Base Course – Uniform Thickness:
   1. Basis of Measurement: Square yards of Asphalt Base Course, type indicated, placed and accepted at the thickness indicated.
   2. Basis of Payment: Payment will be made at the unit price bid per square yard for Asphalt Base Course (type and thickness indicated) and will include all costs for tack coating surfaces, supplying to site, placing, compacting and rolling, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings.
   3.

Pay Item	Units
6-in. Asphalt Base Course, Type A	S.Y.

B. Asphalt Base Course – Variable Thickness:
   1. Basis of Measurement: Tons of Asphalt Base Course, type indicated, placed and accepted.
   2. Basis of Payment: Payment will be made at the unit price bid per ton for Asphalt Base Course, type indicated, and will include all costs for preparing base, tack coating surfaces, supplying to site, placing, compacting and rolling, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings
   3.

Pay Item	Units
Asphalt Base Course, Type A	Ton
Asphalt Base Course, Type B	Ton

C. Bituminous Tack Coat:
   1. Basis of Measurement: Gallons of bituminous tack coat applied at the rate specified herein.

2. Basis of Payment: Payment will be made at the Unit Price bid per gallon for bituminous tack coat and shall include all costs for material, hauling, application, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item: Unit
   a. Bituminous Tack Coat Gal.

D. No measurement or payment will be made for removal and replacement of material which does not meet the quality requirements specified herein.

1.3 REFERENCES

A. Asphalt Institute:
1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.

B. ASTM International:
1. ASTM C88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
2. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
4. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
5. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

C. South Carolina Department of Transportation (SCDOT)
1. Standard Specifications for Highway Construction
2. Supplemental Technical Specifications

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Requirements for submittals.

B. Product Data:
1. Aggregates
2. Bituminous Material

C. Job Mix Formula

D. Manufacturer's Certificate: Certify all Products meet or exceed specified requirements

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with South Carolina Department of Transportation standards except where otherwise directed in this section of the specifications.

PART 2 PRODUCTS

2.1 GENERAL: Asphalt base courses A and B mixes and materials shall comply with the requirements contained in the applicable sections of the South Carolina Department of Transportation Standard Specifications for Highway Construction cited herein along with the following SCDOT Supplemental Specifications:

A. Standard Specifications for Hot-Mix Asphalt Material Properties SCDOT Designation: SC-M-402 (06), dated July 1, 2006.

2.2 SOURCE QUALITY CONTROL AND TESTS

A. Section 01001 – General Requirements: Testing and Inspection Laboratory Services:

B. Submit proposed mix design for each class of mix for review prior to beginning of Work.

2.3 MATERIALS

A. Asphalt Binder: Performance grade binder, PG64-22 in accordance with Subsection 401.2.1 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

B. Aggregates: In accordance with Subsection 401.2.2 of South Carolina Department of Transportation Standard Specifications for Highway Construction

C. Additives: In accordance with Subsection 310.2.3 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

D. Composition of Mixture:
   1. Comply with requirements in Subsection 310.2.4 of South Carolina Department of Transportation Standard Specifications for Highway Construction.
   2. Mix Design: Prepare mix design in laboratory approved by the Engineer. Job mix formula to indicate a single definite percentage of aggregate passing each required sieve and a single definite percentage of asphalt binder to be contained in the mixture. This percentage of asphalt binder being the percentage recovered by SC-T-64 or SC-T-75 and will not include any asphalt binder that may be absorbed in the aggregates. If an anti-stripping agent or other additives are required, the percentage of each to be incorporated into the mixture will also be indicated in the job mix formula.

3. Submit intended source of materials and job mix formula in writing to the Engineer. Do not commence any asphalt paving work or accept any asphalt materials until Engineer has approved source of material and job mix formula.

2.4 EQUIPMENT

A. Comply with the requirements in Subsection 401.3 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted base course or sub base course is dry and ready to support paving.

B. Verify gradients and elevations of base are correct.

C. Verify gutter drainage grates and frames, manhole frames and valve boxes are installed in correct position and elevation.

3.2 PRIME AND TACK COATS

A. Apply prime and tack coats in accordance with Subsection 401.4.18 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

3.3 PLACING ASPHALT BASE COURSE

A. Spreading and Finishing: In accordance with Subsection 401.4.19 of South Carolina Department of Transportation Standard Specifications for Highway Construction and as specified herein.

B. Compaction:
1. Contractor may select the equipment for spreading and compacting the mixture, except that intermediate rolling is to be accomplished with a pneumatic roller.
2. The Contractor is responsible for monitoring the compaction process and will be responsible for making adjustments in equipment or roller patterns so that the finished asphalt pavement will meet the specified in-place density requirement.
3. Any patching and traffic control required during compaction monitoring and acceptance testing procedures will be furnished by the Contractor.

C. Joints: In accordance with Subsection 401.4.23 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

3.4 TOLERANCES

A. Surface Smoothness:
   1. Maximum variation of 3/8 inch using 10 foot straight edge.

B. Compacted Thickness: Within1/2 inch of specified thickness.

C. Areas of asphalt base course outside the tolerance limits shall be removed and replaced or otherwise corrected to the satisfaction of the Engineer by the Contractor and re-tested.

3.5 FIELD QUALITY CONTROL

A. Section 01001 – General Requirements: Quality Control:

B. All nuclear gage tests and cores required for compaction monitoring and acceptance testing procedures will be obtained by the Contractor using equipment and procedures approved by the Engineer.

C. Core sample locations shall be repaired by the contractor.

D. The Contractor is responsible for monitoring the lay down and compaction operations to assure that the final pavement is in compliance with the requirements specified herein. Nuclear gage testing may be used for quality control during the lay down process.

E. Acceptance testing: Acceptance of each type of hot mix asphalt pavement will be based on the following:
   1. Each day's production of hot mixed asphalt will be considered a lot.
   2. One bulk sample will be collected from each 250 tons, or portion thereof, of asphalt produced each day. The following tests and procedures will be performed on the material from each bulk sample collected:
      a. Asphalt extraction
      b. Aggregate gradation
      c. Marshall specimens (3)
         1) Bulk density determination
         2) Stability
         3) Plastic flow
   3. The average daily field laboratory density shall be the average of the bulk densities for all the samples taken from the production for that day.
   4. Marshall Specimens used for compaction control must meet required air void criteria.
   5. Core samples:
      a. Frequency: One core for each 250 tons of hot mix asphalt placed each day.
      b. Utility trench patches: Core samples not required.
      c. Location: As determined by the Engineer.
      d. Each core sample will be tested for;
         1) Density

2) Thickness

6. The average core density for a lot shall be at least 96% of the average daily field laboratory density as determined by the Marshall method of test. Individual core densities shall not be less than 95% of the average field laboratory density.

F. When an asphalt mixture is rejected, additional cores will be taken and tested by the Contractor at locations selected by the Engineer in order to determine the extent of the material to be removed and replaced.

G. Pavement that is removed and replaced shall be re-tested by coring at the frequency indicated above, but not less than one core for each separate area of replaced pavement.

3.6 PROTECTION OF FINISHED WORK

A. Protection of Finished Work: The newly constructed surfaces shall be protected from traffic until the mixture has hardened sufficiently to prevent distortion. The surface shall be kept clean and free from foreign material.

END OF SECTION

SECTION 02740

HOT MIXED ASPHALT PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hot Mix Asphalt Intermediate Courses and Hot Mix Asphalt Surface Courses.
   2. Pavement marking

B. Related Sections:
   1. Section 02300 - Earthwork
   2. Section 02721 - Aggregate Base Course
   3. Section 02750 – Portland Cement Concrete Pavement

1.2 MEASUREMENT AND PAYMENT

A. Hot Mix Asphalt Surface Course – Uniform Thickness:
   1. Basis of Measurement: Square yards of Hot Mix Asphalt Surface Course, type indicated, placed and accepted at the thickness indicated.
   2. Basis of Payment: Payment will be made at the unit price bid per square yard for Hot Mix Asphalt Surface Course (type and thickness indicated) and will include all costs for tack coating surfaces, supplying to site, placing, compacting and rolling, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings.
   3. Pay Item — Units
      6-in. Hot Mix Asphalt Surface Course, Type — S.Y.

B. Hot Mix Asphalt Intermediate Course – Uniform Thickness:
   1. Basis of Measurement: Square yards of hot mix asphalt binder course placed and accepted at the thickness indicated.
   2. Basis of Payment: Payment will be made at the unit price bid per square yard for Hot Mix Asphalt Binder Course (thickness indicated) and will include all costs for preparing base, tack coating surfaces, supplying to site, placing, compacting and rolling, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings
   3. Pay Item — Units
      6-in. Hot Mix Asphalt Intermediate Course, Type — S.Y.

C. Bituminous Tack Coat:
   1. Basis of Measurement: Gallons of bituminous tack coat applied at the rate specified herein.

2. Basis of Payment: Payment will be made at the Unit Price bid per gallon for bituminous tack coat and shall include all costs for material, hauling, application, and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item: Unit
   Bituminous Tack Coat Gal.

D. Pavement Marking:
1. Basis of Measurement: No separate measurement will be made for pavement marking.
2. Basis of Payment: Payment will be made at the Lump Sum bid for Pavement Marking and shall include all costs for furnishing and applying paint materials for pavement markings at the locations indicated on the Drawings and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
3. Pay Item: Unit
   Pavement Marking LS

E. No measurement or payment will be made for removal and replacement of pavement which does not meet the quality requirements specified herein.

1.3 REFERENCES

A. Asphalt Institute:
1. AI MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot- Mix Types.
2. AI MS-19 - Basic Asphalt Emulsion Manual.

B. ASTM International:
1. ASTM C88 - Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
2. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
3. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction.
4. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
5. ASTM D3381 - Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction.

C. South Carolina Department of Transportation (SCDOT)
1. Standard Specifications for Highway Construction
2. Supplemental Specifications

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Requirements for submittals.

B. Product Data:

1. Aggregates
2. Bituminous Material
3. Mix Design

C. Job Mix Formula

D. Manufacturer's Certificate: Certify all Products meet or exceed specified requirements

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with South Carolina Department of Transportation standards except where otherwise directed in this section of the specifications.

PART 2 PRODUCTS

2.1 GENERAL: Hot mix asphalt mixes and materials shall comply with the requirements contained in the applicable sections of the South Carolina Department of Transportation Standard Specifications for Highway Construction cited herein along with the following SCDOT Supplemental Specifications:

A. Standard Specifications for Hot-Mix Asphalt Material Properties SCDOT Designation: SC-M-402 (3/11), dated March 1, 2011.

2.2 SOURCE QUALITY CONTROL AND TESTS

A. Section 01001 – General Requirements: Testing and Inspection Laboratory Services:

B. Submit proposed mix design for each class of mix for review prior to beginning of Work.

2.3 MATERIALS

A. Binder and Additives: In accordance with Subsection 401.2.1 of South Carolina Department of Transportation Standard Specifications for Highway Construction. Performance grade binder, PG64-22.

B. Aggregates: In accordance with Subsection 401.2.2 of South Carolina Department of Transportation Standard Specifications for Highway Construction

C. Composition of Mixture:
1. Mix Design: Prepare mix design in laboratory approved by the Engineer. Job mix formula to indicate a single definite percentage of aggregate passing each required sieve and a single definite percentage of asphalt binder to be contained in the mixture. This percentage of asphalt binder being the percentage recovered by SC-T-64 or SC-T-75 and will not include any asphalt binder that may be absorbed in the aggregates. If an

anti-stripping agent or other additives are required, the percentage of each to be incorporated into the mixture will also be indicated in the job mix formula.

2. Submit intended source of materials and job mix formula in writing to the Engineer. Do not commence any asphalt paving work or accept any asphalt materials until Engineer has approved source of material and job mix formula.
3. Comply with the requirements in the following Subsections of the South Carolina Department of Transportation Standard Specifications for Highway Construction:
   a. 401.2.3.2
   b. 401.2.3.3
   c. 401.2.3.4
   d. 401.2.3.5
   e. 401.2.3.6
   f. 401.2.3.7

D. Hot Mix Asphalt Intermediate Course: In accordance with Section 402 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

E. Hot Mix Asphalt Surface Course: In accordance with Section 403 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

2.4 EQUIPMENT

A. Comply with the requirements in Subsection 401.3 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify compacted base course or sub base course is dry and ready to support paving.

B. Verify gradients and elevations of base are correct.

C. Verify gutter drainage grates and frames, manhole frames and valve boxes are installed in correct position and elevation.

3.2 PRIME AND TACK COATS

A. Apply prime and tack coats in accordance with Subsection 401.4.18 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

3.3 PLACING ASPHALT PAVEMENT

A. Spreading and Finishing: In accordance with Subsection 401.4.19 of South Carolina Department of Transportation Standard Specifications for Highway Construction and as specified herein.

B. Compaction:
   1. Contractor may select the equipment for spreading and compacting the mixture, except that intermediate rolling is to be accomplished with a pneumatic roller.
   2. The Contractor is responsible for monitoring the compaction process and will be responsible for making adjustments in equipment or roller patterns so that the finished asphalt pavement will meet the specified in-place density requirement.
   3. Any patching and traffic control required during compaction monitoring and acceptance testing procedures will be furnished by the Contractor.

C. Joints: In accordance with Subsection 401.4.23 of South Carolina Department of Transportation Standard Specifications for Highway Construction.

3.4 TOLERANCES

A. Surface Smoothness:
   1. Binder Course: Maximum variation of 1/4 inch using 10 foot straight edge.
   2. Surface Course: Maximum variation of 1/8 inch using 10 foot straight edge.

B. Compacted Thickness: Binder Course and Surface Course: Within 1/4 inch.

C. Areas of pavement outside the tolerance limits for smoothness and thickness shall be removed and replaced by the Contractor and re-tested.

3.5 FIELD QUALITY CONTROL

A. Section 01001 – General Requirements: Quality Control:

B. All nuclear gage tests and cores required for compaction monitoring and acceptance testing procedures will be obtained by the Contractor using equipment and procedures approved by the Engineer.

C. Core sample locations shall be repaired by the contractor.

D. The Contractor is responsible for monitoring the lay down and compaction operations to assure that the final pavement is in compliance with the requirements specified herein. Nuclear gage testing may be used for quality control during the lay down process.

E. Acceptance testing: Acceptance of each type of hot mix asphalt pavement will be based on the following:

1. Each day's production of hot mixed asphalt will be considered a lot.
2. One bulk sample will be collected from each 250 tons, or portion thereof, of asphalt produced each day. The following tests and procedures will be performed on the material from each bulk sample collected:
    a. Asphalt extraction
    b. Aggregate gradation
    c. Marshall specimens (3)
        1) Bulk density determination
        2) Stability
        3) Plastic flow
3. The average daily field laboratory density shall be the average of the bulk densities for all the samples taken from the production for that day.
4. Marshall Specimens used for compaction control must meet required air void criteria.
5. Core samples:
    a. Frequency: One core for each 250 tons of hot mix asphalt placed each day.
    b. Utility trench patches: Core samples not required.
    c. Location: As determined by the Engineer.
    d. Each core sample will be tested for;
        1) Density
        2) Thickness
6. The average core density for a lot shall be at least 96% of the average daily field laboratory density as determined by the Marshall method of test. Individual core densities shall not be less than 95% of the average field laboratory density.

F. When an asphalt mixture is rejected, additional cores will be taken and tested by the Contractor at locations selected by the Engineer in order to determine the extent of the material to be removed and replaced.

G. Pavement that is removed and replaced shall be re-tested by coring at the frequency indicated above, but not less than one core for each separate area of replaced pavement.

3.6 PROTECTION OF FINISHED WORK

A. Protection of Finished Work: The newly constructed surfaces shall be protected from traffic until the mixture has hardened sufficiently to prevent distortion. The surface shall be kept clean and free from foreign material.

3.7 PAVEMENT MARKINGS

A. Cleaning: Sweep and clean surface to eliminate loose material and dust.

B. Striping Paint: Use fast dry waterborne paint meeting the requirements of Subsection 625.2.2 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

C. Color: As specified on the Drawings. Where color is not specified, provide color as directed by the Engineer.

D. Do not apply traffic and lane marking paint until layout and placement has been verified with Engineer.

E. Apply paint with mechanical equipment to produce uniform straight edges.

F. Apply at manufacturer's recommended rates.

END OF SECTION

SECTION 02750

PORTLAND CEMENT CONCRETE PAVEMENT, SIDEWALK, CURBS AND GUTTERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete paved roadways and parking areas
2. Concrete sidewalks.
3. Concrete curbs and gutters.

B. Related Sections:
1. Section 02300 - Earthwork
2. Section 02740 – Hot Mixed Asphalt Pavement

1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Concrete Pavement:
1. Basis of Measurement: Square yards of concrete pavement, thickness indicated.
2. Basis of Payment: Payment will be made at the unit price bid per square yard for concrete pavement (thickness indicated) and will include all costs for concrete, preparing base, forming, placing, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings.
3.

Pay Item	Units
___-in. Concrete Pavement	S.Y

B. Concrete Curb, Gutter, and Combination Curb and Gutter:
1. Basis of Measurement: Linear feet of concrete curb, gutter or combination curb and gutter, in place.
2. Basis of Payment: Payment will be made at the unit price bid per linear foot for concrete curb, gutter or combination curb and gutter, type indicated, and will include all costs for concrete, preparing base, forming, placing, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings.
3.

Pay Item	Units
Concrete Drive-Over Curb and Gutter	L.F.
Concrete Flush Header Curb	L.F.

C. Concrete Sidewalk:
1. Basis of Measurement: Square yards of concrete sidewalk in place, thickness indicated.

2. Basis of Payment: Payment will be made at the unit price bid per square yard for concrete sidewalk, thickness indicated, and will include all costs for concrete, preparing base, forming, placing, testing, mix design and all other costs of whatever nature required to complete the Work as described herein and as shown on the Drawings.
3. Pay Item — Units
   Concrete Sidewalk — S.Y.

1.3 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

B. ASTM International:
   1. ASTM A 185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
   2. ASTM A 497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   3. ASTM A 615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   4. ASTM C 33 - Standard Specification for Concrete Aggregates.
   5. ASTM C 39 – Standard Specification Compressive Strength of Cylindrical Concrete Specimens.
   6. ASTM C 94 - Standard Specification for Ready-Mixed Concrete.
   7. ASTM C 150 - Standard Specification for Portland Cement.
   8. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   9. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   10. ASTM C 494 - Standard Specification for Chemical Admixtures for Concrete.
   11. ASTM C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
   12. ASTM C 920 – Standard Specification for Elastomeric Joint Sealants.
   13. ASTM C 1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
   14. ASTM D 1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   15. ASTM D 1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
   16. ASTM D 3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

17. ASTM E 329 - Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Submittal Procedures

B. Product Data:
   1. Joint filler
   2. Admixtures
   3. Curing compounds

C. Manufacturer's Certification: Cement

D. Test reports: Coarse aggregate and Fine aggregate

E. Concrete mix design

1.5 QUALITY ASSURANCE

A. Obtain cementitious materials from same source throughout project.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when air temperature in the shade and away from artificial heat is 40 degrees F or lower, or when surface is wet or frozen. Concrete shall not be placed when the temperature is expected to fall below 32 degrees F during the early stages of curing.

PART 2 PRODUCTS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with a non-staining form release agent that will not discolor or deface surface of concrete.

B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM A 185.

C. Reinforcing Bars: Deformed steel bars, ASTM A 615, Grade 60.

D. Dowels: ASTM A 615; 40 ksi yield grade, plain steel, galvanized finish.

E. Concrete Materials:
   1. Portland Cement: ASTM C 150, Type 1. Use only one brand cement throughout the project.

2. Concrete Aggregates: Natural aggregates, free from deleterious coatings conforming to ASTM C 33, together with all referenced ASTM Standard Specifications.
3. Fine Aggregates: Conform to ASTM C 33. Materials finer than the 200 sieve not to exceed 4 percent. Use only clean, sharp natural sand.
4. Course Aggregates: Use only natural gravels, a combination of gravels and crushed gravels, crushed stone, or a combination of these materials containing no more than 15% flat or elongated particles (long dimension more than five times the short dimension). Materials finer than the 200 sieve not to exceed 0.5%.

F. Preformed Expansion Joint Materials: Bituminous fiber type conforming to ASTM D 1751.

G. Wood Dividers: Redwood, Construction Heart Grade.

H. Anti-spalling Compound: Combination of boiled linseed oil and mineral spirits, complying with AASHTO M-233.

I. Liquid-Membrane Forming and Sealing Curing Compound: Comply with ASTM C 309, Type I, Class A. Moisture loss to be no more than .055 gr./ sq. cm. when applied at 200 sq. ft. / gal.

J. Bonding Compound: Polyvinyl acetate or acrylic base, re-wettable type.

K. Epoxy Adhesive: ASTM C 881, 2-component material suitable for use on dry or damp surfaces. Provide material "Type", "Grade", and "Class" to suit project requirements in accordance with manufacturer's instructions. .

2.2 CONCRETE MIX DESIGN

A. Design mix to produce normal-weight concrete consisting of Portland cement, aggregate, water-reducing or high-range water-reducing admixture (super plasticizer), air-entraining admixture, and water in accordance with ASTM C 94, Option A, to produce the following properties:
1. Compressive Strength: 3000 psi, minimum at 28 days.
2. Slump Limits: 3 inches (8 inches after the addition of high-range water-reducing admixture, i.e. super plasticizer).
3. Air Content: 4 to 8 percent by volume.
4. Water cement ratio: not more than 0.53 (6 gal. per bag).

2.3 SOURCE QUALITY CONTROL AND TESTS

A. Submit proposed mix design to Engineer for review prior to commencement of Work.

B. Provide manufacturer's certification that cement meets all specified requirements.

C. Sample and test aggregates in accordance with ASTM C33.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Remove loose material from compacted sub-base surface immediately before placing concrete.

B. Proof-roll prepared sub-base surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

C. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement.

D. Notify Engineer minimum 24 hours prior to commencement of concreting operations.

3.2 FORM CONSTRUCTION

A. Set forms to required grades and lines, braced and secured. Install forms to allow continuous progress of work and so that forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent as required to ensure separation from concrete without damage.

C. Check completed formwork for grade and alignment to following tolerances:
   1. Top of forms not more than 1/8 inch in 10 feet.
   2. Vertical face on longitudinal axis, not more than 1/4 inch in 10 feet.
   3. Slope step treads at 1/4 inch per foot to drain.

3.3 REINFORCEMENT

A. Locate, place and support reinforcement as indicated on the construction plans.

3.4 CONCRETE PLACEMENT

A. Do not place concrete until sub-base and forms have been checked for line and grade. Moisten sub-base if required to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

B. Place concrete by methods that prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation.

Consolidate with care to prevent dislocation of reinforcing, dowels, and joint devices.

C. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

D. Deposit and spread concrete in a continuous operation between transverse joints as far as possible. If interrupted for more than 1/2 hour, place a construction joint.

E. Curbs and Gutters: Shall be uniform in appearance and true to grade and cross-section. Any variation will not be permissible if it causes water ponding or alters the direction of flow. Face forms shall be removed as soon as possible and the exposed surfaces finished with a wood float. Straight-edging done along the edge of the gutter and top of curb and median shall conform to those requirements for the adjacent pavement, but with no irregularities to exceed 1/4" in 10 feet.

3.5 JOINTS

A. General: Concrete work shall be jointed as shown on the project drawings. If not indicated on the drawings, a jointing plan shall be prepared by the contractor and approved before paving begins. Construct expansion, weakened-plane (contraction), and construction joints true to line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated.

Joints should be laid out to aid construction and to control cracking. A square panel pattern is preferable but a dimensional ratio of 1-1/2 x 1 is permissible. Joint spacing shall not exceed 10 feet. Place joints to approximate the cracking that would occur without joints. When placing new concrete adjacent to existing or previously placed concrete, align joints with those in the existing or previously placed concrete whenever possible.

B. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth equal to at least 1/4 concrete thickness, as follows:

1. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finishing edges with a jointer.
2. Sawed Joints: Form weakened-plane joints with powered saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut joints into hardened concrete as soon as surface will not be torn, abraded, or otherwise damaged by cutting action.
3. Inserts: Use embedded strips of metal or sealed wood to form weakened-plane joints. Set strips into plastic concrete and carefully remove strips after concrete has hardened.

C. Construction Joints: Place construction joints in accordance with the details shown on the drawings at end of placements and at locations where placement operations are stopped for more than 1/2 hour, except where such placements terminate at expansion joints.

D. Expansion Joints: Provide premolded joint filler for expansion joints abutting concrete curbs, catch basins, manholes, inlets, structures, walks, and other fixed objects, unless otherwise indicated.
   1. Vehicular pavement lanes: Transverse expansion joints 50 feet on center, each lane.
   2. Sidewalks: Transverse expansion joints 50 feet on center.
   3. Curb and gutter: Transverse expansion joints 50 feet on center, coincident with pavement joints.
   4. Where sidewalk is placed adjacent to curb and against building structure on other side, place expansion joint between sidewalk and back of curb.
   5. Where sidewalk is adjacent to curb, place expansion joint between sidewalk and back of curb at intersection radius returns.
   6. Extend joint fillers full width and depth of joint, not less than 1/2 inch or more than 1 inch below finished surface where joint sealer is indicated. If no joint sealer, place top of joint filler flush with finished concrete surface.
   7. Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
   8. Protect top edge of joint filler during concrete placement with a metal cap or other temporary material. Remove protection after concrete has been placed on both sides of joint.

3.6 CONCRETE FINISHING

A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a 10-ft. straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface.

D. After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface as follows:
   1. Broom finish by drawing a fine-hair broom across concrete surface perpendicular to line of traffic. Repeat operation if required to provide a fine line texture acceptable to Engineer. Finish tool joints and edges to a smooth finish by hand after broom finish is applied.
   2. On inclined slab surfaces, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic.

E. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by Engineer.

3.7 CURING

A. Protect and cure finished concrete paving using membrane-forming curing and sealing compound or approved moist-curing methods.

B. Anti-spalling Treatment: Apply treatment to concrete surfaces no sooner than 28 days after placement, to clean, dry concrete free of oil, dirt, and other foreign material. Apply curing and sealing compound at a maximum coverage rate of 300 s.f. per gallon. Apply anti-spalling compound in 2 sprayed applications. First application at rate of 40 sq. yds. per gal.; second application, 60 sq. yds. per gallon. Allow complete drying between applications.

3.8 REPAIRS AND PROTECTIONS

A. Repair or replace broken or defective concrete, as directed by Engineer.

B. Drill test cores where directed by Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just before final inspection.

3.9 FIELD QUALITY CONTROL

A. Section 01001 – General Requirements: Testing Laboratory Services

B. Three concrete test cylinders will be taken for every 100 or less cu yds of concrete placed each day. Test cylinders will be broken at 7 and 28 days with the third cylinder held in reserve and broken at the Engineer’s discretion.

C. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents.

D. One slump test will be taken for each set of test cylinders taken. For concrete containing a high-range water-reducing admixture (super plasticizer), take slump test before the admixture is added at the job site.

E. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken.

END OF SECTION

SECTION 02795

PORTLAND CEMENT PERVIOUS PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pervious paved parking areas
2. Pervious paved streets and roadways
3. Pervious paved shoulders

B. Related Sectons:

1. Section 02300 – Earthwork
2. Section 02740 – Hot Mixed Asphalt Pavement
3. Section 02721 – Aggregate Base Course
4. Section 02620 – Subdrainage

1.2 UNIT PRICE – MEASUREMENT AND PAYMENT

1.3 REFERENCES

A. American Concrete Institute

1. ACI-308 - Standard Practice for Curing Concrete.

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO T 180 - Moisture-Density Relations of Soils Using a 10 Pound (45kg) Rammer and an 18 inch (457mm) Drop.

C. ASTM International

1. ASTM C 29, Test for Unit Weight and Voids in Aggregate
2. ASTM C 33, Specifications for Concrete Aggregates
3. ASTM C 42, Test Method for Obtaining and Testing Drilled Cores And Sawed Beams of Concrete

4. ASTM C 138, Test Method for Weight, Yield, and Air Content (Gravimetric) of Concrete

5. ASTM C 140, Methods of Sampling and Testing Concrete Masonry Units

6. ASTM C 150, Specifications for Portland Concrete (Types I or II only)

7. ASTM C 172, Practice of Sampling Fresh Concrete

8. ASTM C 260, Specifications for Air-Entrancing Admixtures for Concrete

9. ASTM C 494, Specifications for Chemical Admixtures for Concrete

10. ASTM C 595, Specifications for Blended Hydraulic Cements (Types IP or IS only)

11. ASTM C 1077, Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

12. ASTM C 448, Specifications for Standard Sizes of Coarse Aggregates for Highway Construction

13. ASTM D 1557, Test for Moisture-Density Relations Soils and Soil Aggregate Mixtures Using 10 Pound Rammer and 18-inch Drop

14. ASTM E 329, Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel and Bituminous Materials as used in construction

1.4 SUBMITTALS

A. Section 01001 – General Requirements; Submittal Procedures.

B. Product Data:

1. Admixtures

2. Curing compounds

C. Manufacturer's Certification: Cement

D. Test Reports:

1. Course Aggregate

2. Field cylinders

E. Concrete mix design.

1.5 QUALITY ASSURANCE

A. Contractor Qualifications:

1. Installing contractor shall use installation crews certified by the Portland Cement Pervious Association and having a minimum of 10% being current ACI Certified Flatwork Technicians and/or Finishers. Prior to award of the contract, the placing Contractor shall furnish Owner the following in support of his experience:

a. Owner and address of previous successfully completed pervious paving projects.

b. Test results for the referenced projects, including void content.

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If placing contractor has insufficient experience with Portland Cement Pervious Concrete Pavement, retaining an experienced consultant (as qualified above) to monitor production, handling, and placement operations, even at the placing contractor's expense, is problematic, at best and cannot compensate for the lack of proper pervious experience and/or technical knowledge necessary to a successful Installation.

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*While there is no reference for the word "raveling" in ACJ-1 "Cement and Concrete Technology," this is the first set of North American specifications developed expressly for pervious concrete by, and for, design professionals in order to assure quality installation& ACl-116 recognizes the words "pitting" and "scaling" as unacceptable conditions in conventional concrete, they are also unacceptable in porous concrete. "Raveling" is a characteristic peculiar to poorly installed pervious concrete. It refers to a simple visual inspection mechanism for determining properly installed pervious limiting the amount of loose surface stones to 2% of the total installation area, while including the combined total of the raveling with any consolidation in the 2% maximum total figure permissible before requiring the installation, or that (those) portion(s) to be removed and replaced by the contractor

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B. Test Panels:

1. Qualified Contractor shall place, joint and cure one test panel having a minimum area of 250 sq. ft. at the required project thickness in order to demonstrate to the Engineer's satisfaction that in-place unit weights can be achieved and a satisfactory pavement can be installed at the

project site. The test panel, if accepted, shall become part of the completed work.

2. Test panels may be placed at any of the Portland Cement Pervious Pavement placement locations indicated on the plans. Test panels shall be tested for thickness in accordance with ASTM C 42; and void structure in accordance with ASTM C 138.

3. The test panel must meet the following requirements in order to be found acceptable:

   a. Compacted thickness: Average thickness not more than one-quarter inch less than that called for on the Contract Drawings.

   b. Void Structure: 11% minimum, 21% maximum

   c. Surface: Combined raveling and consolidation less than 2%of total paved area.

   d. Joints: Properly installed in accordance with the details shown on the Contract Drawings

4. If the test panel fails to meet any of the above requirements, the test panel, or portions thereof, shall be removed and replaced with satisfactory work. The Engineer will determine the extent of unsatisfactory work to be removed and replaced.

5. Should the entire test panel require removal, the contractor may be required to construct another test panel for evaluation before proceeding with the Work.

PART 2 PRODUCTS

2.1 FORMS: Forms may be of wood or steel and shall be the depth of the pavement. Forms shall be of sufficient strength and stability to support mechanical equipment without deformation of plan profiles following spreading, strike-off and compaction operations.

2.2 CEMENT: Portland Cement Type I or II confirming to ASTM C 150 or Portland Cement Type IP or IS conforming to ASTM C 595.

2.3 AGGREGATE:

A. Use locally available material having record of satisfactory performance.

B. Use only washed coarse aggregate; No. 8 coarse aggregate (3/8 to No. 16), ASTM C 33; or No 89 coarse aggregate (3/8 to No 50), ASTM D 448. If other

gradation of aggregate is proposed for use, submit data on proposed material to Engineer for approval.

2.4 AIR ENTRAINING AGENT: ASTM C 260.

2.5 ADMIXTURES:

1. Type A Water Reducing Admixtures: ASTM C 494
2. Type B Retarding Admixtures: ASTM C 494
3. Type D Water Reducing/Retarding Admixtures: ASTM C 494.

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Also, a hydration stabilizer can be utilized and is recommended in the design and production of pervious concrete. This stabilizer suspends cement hydration by forming a protective barrier around the cementitious particles, which delays the particles from achieving initial set. The admixture's primary function should be as a hydration stabilizer; however, it must also

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4. Hydration Stabilizer, if used, must meet the requirements of ASTM C 494 for Type B Retarding or Type D Water Reducing/Retarding Admixtures.

2.6 Water: Comply with the requirements in sub-section 701.12 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

2.7 PROPORTIONS

A. Cement Content: The total cementitious material shall not be less than 600 pounds per cubic yard.

B. Aggregate Content: The volume of aggregate per cubic yard shall be equal to 27 cubic feet, when calculated as a function of the unit weight determined in accordance with ASTM C 29 Jigging Procedure. Only coarse aggregate is used in the mix. Fine aggregate is not used.

C. Admixtures: Shall be used in accordance with manufacturer's instructions and recommendations.

D. Mix Water: Mix water shall be such that cement paste displays a wet, metallic sheen, without causing the paste to flow from the aggregate. (Mix water yielding a cement paste with a dull-dry appearance has insufficient water for hydration.)

Insufficient water results in inconsistency in the mix and poor bond strength. High water content results in the paste sealing the void system primarily at the bottom and poor surface bond.

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E. Concrete Mix Design: Contractor shall furnish a proposed mix design with proportions of materials to Engineer prior to commencement of work.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION AND FORMWQRK:

A. Subgrade Compaction:

1. The subgrade shall be compacted by a mechanical vibratory compactor to a minimum density of 92% of maximum dry density, ASTM D 1557 or AASHTO T 180.

2. If fill material (embankment) is required to bring the subgrade to final elevation, it shall be clean and free of deleterious material and it shall be placed in eight (8) inch maximum layers, and compacted by a mechanical vibratory compactor to a minimum density of 92% of maximum dry density, ASTM D 1557 or AASHTO T 180.

3. Subgrade Moisture: Within 3% of optimum moisture content as determined by ASTM C 1557 or AASHTO T 180.

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Above Designated Frost Line Installations:

Particular care must be taken to assure uniform density and permeability of subgrade. A MINIMUM of six (6) inches of washed half-inch stone (three-quarter inch washed stone may also be used directly underneath Portland Cement Pervious Paving) should be placed on top of a predominantly sandy, six (6) inch, compacted base. Depth and gradations or combinations thereof may be increased to accommodate water retention/detention per engineering requirements Slopes in excess of 3% require a minimum 4 ounce non-woven fabric placed over compacted sandy base to mitigate sheeting and undercutting during heavy storm events.

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3.2 MIXING, HAULING AND PLACING:

A. Mixing: Truck mixers should be operated at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions of the drum.

B. Transportation:

1. The Portland cement aggregate mixture may be transported or mixed on site and must be placed within one (1) hour of the introduction of mix water, unless otherwise approved by the engineer.

2. The time between addition of mix water and placing of the mixture may be increased to 90 minutes when using a hydration stabilizer if weather conditions permit and if approved by the engineer.

C. Discharge:

1. The contents of each mixer truck will be inspected for appearance of concrete uniformity as described in 2.7.D.

2. Water may be added to obtain the required mix consistency.

3. A minimum of 20 revolutions at the manufacturer's designated mixing speed is required following any addition of water to the mix.

4. Discharge shall be a continuous operation and shall be completed as quickly as possible.

5. Concrete shall be deposited as close to its final position as is practicable and such that fresh concrete enters the mass of previously placed concrete The practice of discharging onto subgrade and pulling or shoveling to final placement is not allowed.

3.3 PLACING AND FINISHING EQUIPMENT

A. Unless otherwise approved by the owner and engineer, in writing, the contractor shall provide mechanical equipment designed for either slip form or form riding with a following compactive unit that will provide a minimum of ten (10) psi vertical force.

B. The pervious concrete pavement will be placed to the required cross section and shall not deviate more than 1/2- inch in ten (10) feet from profile grade as measured using a 10-ft. steel straight edge.

C. A full width roller or other full width compaction device that provides sufficient compactive effort shall be used immediately following strike-off operation.

D. After mechanical or other approved strike-off and compaction operations, no other finishing operation, aside from contraction jointing, minor backfilling and finish rolling is allowed.

E. If vibration, internal or surface applied, is used, it shall be shut off immediately when forward progress is halted for any reason.

F. Placement shall be a maximum of fifteen (15) feet wide, unless the contractor can demonstrate competence to provide placement widths greater than the maximum specified to the satisfaction of the Engineer.

3.4 Curing:

A. Begin curing procedures immediately but no longer than (20) minutes) after the final placement operations.

B. The pavement surface shall be covered with a minimum of six (6) mil thick polyethylene sheeting or other approved covering material.

C. Prior to covering, a fog or light mist shall be sprayed above the surface when required due to ambient conditions (temperature, wind, and low humidity).

D. The cover shall overlap all exposed edges and shall be secured, without using dirt or stone, to prevent dislocation due to winds or adjacent traffic conditions.

E. Cure Time:

1. Portland Cement Type I, II or IS:

a. Seven (7) days without any vehicular traffic.

b. No truck traffic for ten (10) days.

2. Portland Cement Type I with Retarder/Reducers added: 3 weeks without any vehicular traffic.

3.5 JOINTING:

A. Transverse control joints shall be installed at intervals as shown on the Drawings, and shall be installed at a depth of 1/4 the thickness of the pavement.

B. Longitudinal control joints shall be installed at the midpoint where shown on the Drawings.

C. Control joints may be installed in plastic concrete or saw cut. If saw cut, the procedure should begin as soon as pavement has hardened sufficiently to prevent raveling and uncontrolled cracking.

D. Transverse construction joints shall be installed whenever placing is suspended a sufficient length of time that concrete begins to harden.

3.6 TESTING, INSPECTION AND ACCEPTANCE

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The owner will retain an independent testing laboratory It is preferable to have tests performed by ACI Certified Inspectors, or at the least by those familiar with PCPA standards and procedures. The testing laboratory shall conform to the applicable requirements of ASTM B 329, *Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials Used in Construction, and ASTM C 1077, Standard Practice for Testing Concrete and Concrete Aggregates for Use in Construction, and Criteria for Laboratory Evaluation,* and shall be inspected and accredited by the Portland Cement Pervious Association, lnc. or by another, equivalent recognized national authority

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A. Acceptance Testing:

1. A minimum of one gradation test of the subgrade is required for each 5000 square feet or fraction thereof. Determine percent passing the No. 200 sieve in accordance with ASTM C 117.

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One test for each day's placement of pervious concrete in accordance with ASTM C 172 and ASTM C 29 to verify unit weight may be conducted, but is generally thought to be unnecessary for Portland Cement Pervious, as design mix can be changed numerous times during a day's placement due to changing temperature, humidity, wind and varying characteristics of the cement and stones Delivered unit weights are to be determined in accordance with ASTM C 29 using a 0.25 cubic foot cylindrical metal measure. The measure is to be filled and compacted in accordance with ASTM C 29 paragraph 11, Jigging Procedure. The unit weight of the delivered concrete shall be +/-five (5) percent of the unit design weight, but because of varying design mixes will be difficult to determine, rendering this test somewhat unreliable.

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2. Test panels shall have two cores taken from each panel in accordance with ASTM C 42 at a minimum of twenty one (21) days after placement of the pervious concrete.

    a. The cores shall be measured for thickness, void structure, and unit weight.

    b. Untrimmed, hardened core samples shall be used to determine placement thickness.

c. The average of all production cores shall not be less than the specified thickness with no individual core being more than ½ inch less than the specified thickness.

d. After thickness determination, the cores shall be trimmed and measured for unit weight in the saturated condition, ASTM C 140.

e. The trimmed cores shall be immersed in water for 24 hours, allowed to drain for one (1) minute, surface water removed with a damp cloth, then weighed immediately. Acceptable average void structure shall be not less than 11% nor more than 21%.

f. After a minimum of twenty-one (21) days following each placement, three cores may be taken in accordance with ASTM C 42. The cores shall be measured for thickness and void structure determined as described above for test panels. The core holes shall be filled with concrete meeting the pervious design.

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SPECIAL NOTE: *This information is intended to be used by the design professional competent to evaluate its sign and limitation and who will accept the responsibility for its proper application. PCPA reserves the right to change information from time to time as an ongoing Quality Improvement Process. The Portland Cement Pervious Association. Inc. disclaims any and all responsibility for any other use of the information supplied herein.*

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END OF SECTION

SECTION 02924

SEEDING AND MULCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Seeding and mulching all disturbed areas.

B. Related Sections:
   1. Section 02300: Earthwork
   2. Section 02374: Erosion Control

1.2 MEASUREMENT AND PAYMENT

A. Seed and Mulch:
   1. Basis of Measurement: Number of acres seeded and mulched under seeding schedule No. 1.
   2. Basis of Payment: Payment will be made at the Unit Price bid for seeding and mulching and shall include all costs for seed, soil amendments, soil preparation, reworking turf seeded under Schedule No. 2, application of soil amendments and seed mixture, application of mulch, watering, maintenance and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.
   3. Pay Item;
      a. Seeding and Mulching

B. No separate measurement or payment will be made for temporary seeding under seeding schedule No. 2.

1.3 SUBMITTALS

A. Section 01001 – General Requirements: Submittal Procedures:

B. Product Data: All items proposed to be provided under this Section.

C. Manufacturer's Certificate: Certificate of compliance with these Specifications.

1.4 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 S.C.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.

PART 2 PRODUCTS

2.1 PRODUCT HANDLING

A. Section 01001: General Requirements: Product Delivery, Handling, Storage

B. At time of delivery, furnish the Engineer invoices of all materials received in order that application rates may be determined.

C. Immediately remove from the site materials which do not comply with the specified requirements, and promptly replace with materials meeting the specified requirements.

2.2 FERTILIZER

A. Provide commercial balanced 10-10-10 fertilizer delivered to the site in sealed bags labeled with the manufacturer's guaranteed analysis.

2.3 GRASS SEED

A. Provide grass seed which is:
   1. Free from noxious weed seeds, and re-cleaned;
   2. Grade A recent crop seed;
   3. Treated with appropriate fungicide at time of mixing;
   4. Delivered to the site in sealed containers with dealer's guaranteed analysis.

2.4 LIME

A. Provide agricultural grade, standard ground limestone conforming to current "Rules, Regulations and Standards of the Fertilizer Board of Control" issued at Clemson University.

B. 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.

2.5 EMULSIFIED ASPHALT (ANIONIC)

A. Grade EA-P Special meeting the requirements of S.C. Highway Department Specifications, Subsection 406.05, Edition of 2000.

B. If necessary for satisfactory spraying, material may be diluted with water at the manufacturing plant.

2.6 WOOD CELLULOSE FIBER

A. Provide wood chip particles manufactured particularly for discharging uniformly on the ground surface when dispersed by a hydraulic water sprayer.

B. Material to be heat processed so as to contain no germination or growth inhibiting factors.

C. It shall be dyed (non-toxic) an appropriate color to facilitate metering.

2.7 STRAW MULCH

A. Provide straw or hay material.
   1. Straw to be stalks of wheat, rye, barley or oats;
   2. Hay to be timothy, pea vine, alfalfa, or coastal Bermuda.

B. Material to be reasonably dry and reasonably free from mature seed bearing stalks, roots, or bulblets or Johnson Grass, Nut grass, Wild Onion and other noxious weeds.

2.8 EXCELSIOR FIBER MULCH

A. To consist of 4 to 6 inches, average length, wood fibers cut from sound, green timber.

B. Make cut in such a manner as to provide maximum strength of fiber, but at a slight angle to natural grain of the wood.

PART 3 EXECUTION

3.1 GENERAL

A. Seed following areas immediately upon completion of their construction:
   1. Slopes greater than four horizontal to one vertical;
   2. Utility rights-of-way adjacent to stream banks.

B. Areas ready for planting between August 16 and February 28 shall be planted with a temporary cover in accordance with Schedule No. 2. At the acceptable seasons for planting under Schedule No. 1, the turf previously seeded under Schedule No. 2 shall be destroyed by reworking the soil and re-seeded in accordance with Schedule No. 1 as specified herein.

3.2 SEEDING SCHEDULES

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

B. Schedule No. 1 - Permanent Seeding

Permanent Seeding - Coastal

Species	Lbs/Ac	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sandy, Droughty Sites													
Browntop Millet Bahiagrass	10 lbs./ac. 40 lbs./ac.												
Browntop Millet Bahiagrass Sericea Lespedeza	10 lbs./ac. 30 lbs./ac. 40 lbs/ac.												
Browntop Millet Atlantic Coastal Panicgrass	10 lbs./ac. 15 lbs./ac. PLS												
Browntop Millet Switchgrass (Alamo) Little Bluestem Sericea Lespedeza	10 lbs./ac. 8 lbs./ac. PLS 4 lbs./ac. 20 lbs./ac.												
Browntop Millet Weeping Lovegrass	10 lbs./ac. 8 lbs./ac.												
Well drained, clayey/loamey Sites													
Browntop Millet Bahiagrass	10 lbs./ac. 40 lbs./ac.												
Rye, Grain Bahiagrass Clover, Crimson (Annual)	10 lbs./ac. 40 lbs./ac. 5 lbs./ac.												
Browntop Millet Bahiagrass Sericea lespedeza	10 lbs./ac. 30 lbs./ac. 40 lbs./ac.												
Browntop Millet Bermuda, Common Sericea lespedeza	10 lbs./ac. 10 lbs./ac. 40 lbs./ac.												
Browntop Millet Bermuda, Common Kobe Lespedeza (Annual)	10 lbs./ac. 12 lbs./ac. 10 lbs./ac.												
Browntop Millet Bahiagrass Bermuda, Common Sericea lespedeza	10 lbs./ac. 20 lbs./ac. 6 lbs./ac. 40 lbs./ac.												
Browntop Millet Switchgrass Little Bluestem Indiangrass	10 lbs./ac. 8 lbs./ac. PLS 3 lbs./ac. PLS 3 lbs./ac. PLS												

C. Schedule No. 2 - Temporary Seeding

Temporary Seeding – Coastal

Species	Lbs/Ac	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sandy, Droughty Sites													
Browntop Millet	40 lbs./ac.			■	■	■	■	■	■				
Rye, Grain	56 lbs./ac.	■	■							■	■	■	■
Ryegrass	50 lbs./ac.	■	■	■						■	■	■	■
Well drained, clayey/loamey Sites													
Browntop Millet or Japanese Millet	40 lbs./ac.			■	■	■	■	■	■				
Rye, Grain or Oats	56 lbs./ac. 75 lbs./ac.	■	■							■	■	■	■
Ryegrass	50 lbs./ac.	■	■	■	■					■	■	■	■

3.3 PREPARATION

A. Bring all areas to proper line, grade and cross section indicated on the plans.

B. Repair erosion damage prior to commencing seeding operations.

C. Loosen seed bed to minimum depth of 3 inches.

D. Remove all roots, clods, stones larger than 2 inches in any dimension, and other debris.

3.4 APPLICATION OF FERTILIZER

A. Spread uniformly over areas to be seeded at:
   1. Rate of 1,000 lbs per acre;
   2. Use approved mechanical spreaders.

B. Mix with soil to depth of approximately 3 inches.

3.5 SEEDING AND MULCHING

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 steeper than four horizontal to one vertical:
   1. Conform to Methods EA, WF or WCF as specified hereinafter;

2. Method EA (Emulsified Asphalt):
    a. Sow seed not more than 24 hours after application of fertilizer;
    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 cultipacker if seed drill does not compact soil;
    d. Within 24 hours following compaction of seeded areas, uniformly apply 0.2 gallons per square yard of emulsified asphalt over the seeded area.
3. Method WF (Excelsior Fiber Mulch):
    a. Sow seed as specified for Method EA.;
    b. Within 24 hours following covering of seeds, uniformly apply excelsior fiber at the rate of 100 pounds per 1000 square feet;
    c. Material may be applied hydraulically or dry. If applied dry, it shall be thoroughly wetted immediately following placing;
    d. Seeded areas to be lightly rolled to form a tight mat of the excelsior fibers.
4. Method WCF (Wood Fiber Mulch):
    a. Apply seed, fertilizer 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 and water;
    c. Minimum capacity of slurry tank: 1000 gallons;
    d. Apply fiber mulch at rate of 35 pounds per 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 a sweeping motion, in an arched stream, so as to fall like rain, allowing the wood fibers to build upon each other;
    g. Use color of wood pulp as guide, spraying the prepared seed bed until a uniform visible coat is obtained.

C. Seeding, slopes equal to or flatter than four horizontal to one vertical:
1. Sow seed as specified for Method EA, steps a thru c;
2. Apply straw or hay mulch at the rate of 100 pounds per 1000 square feet uniformly to the seeded area. Mulch may be applied by hand, by mechanical spreaders, or by blowers;
3. Hold mulch in place with a tack coat of emulsified asphalt, applied at the rate of 0.2 gallons per square yard.

3.6 MAINTENANCE

A. Maintain all seeded areas in satisfactory condition until final acceptance of the Work.

B. Areas not showing satisfactory evidence of germination within six weeks of the seeding date shall be immediately reseeded, fertilized and/or mulched.

C. Repair any eroded areas.

D. Mow as necessary to maintain healthy growth rate until final acceptance of the Work.

3.7 ACCEPTANCE

A. Permanently seeded areas under Schedule No. 1 will be accepted when the grass attains a height of two inches.

B. No acceptance will be made of temporary seeded areas under Schedule No. 2. Re-work and re-seed those areas in accordance with Schedule No. 1.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for the following:
   1. Foundation walls.
   2. Supported slabs.
   3. Slabs on grade.
   4. Equipment pads.
   5. Thrust blocks.
   6. Headwalls
   7. Concrete Encasement

B. Work included in this section:
   1. Concrete, cast-in-place
   2. Forms and accessories
   3. Concrete reinforcement
   4. Concrete finishing
   5. Concrete curing

C. Related Sections:
   1. Section 02750-Portland Cement Concrete Pavement, Sidewalks, curbs and gutters.

1.2 MEASUREMENT AND PAYMENT

A. Portland Cement Concrete, In Place:
   1. Basis of Measurement: No separate measurement of cast-in-place concrete will be made.
   2. Basis of Payment: No separate payment will be made for cast-in-place concrete. All costs for furnishing and placing cast-in-place concrete shall be included in the lump sum price bid for the structure in which the concrete is placed and shall include all costs for furnishing, transporting, placing, forming, finishing and all other costs of whatever nature required for performance of this item of Work under this section of the Specifications.

1.3 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete for Buildings.
   2. ACI 305 - Hot Weather Concreting.
   3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
   4. ACI 308 - Guide to Curing Concrete

B. Concrete Reinforcing Steel Institute
   1. CRSI Manual of Practice

C. American Society for Testing and Materials International:
   1. ASTM A497/A 497M - Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
   2. ASTM A615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
   3. ASTM A704/A 704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
   4. ASTM A767/A 767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
   5. ASTM C33 - Standard Specification for Concrete Aggregates.
   6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
   7. ASTM C150 - Standard Specification for Portland Cement.
   8. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   9. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
   10. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
   11. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   12. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
   13. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   14. ASTM D98 - Standard Specification for Calcium Chloride
   15. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   16. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
   17. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

D. American Welding Society
   1. Structural Welding Code – Reinforcing Steel

1.4 SUBMITTALS

A. Section 01001 – General Requirements: Submittal Procedures.

B. Product Data: Submit data on admixtures, joint devices, joint filler and sealer.

C. Design Data:

1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.

D. Manufacturer's certification: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01001 – General Requirements: Closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Use cement and aggregate from one source for all Work under this contract.

C. Conform to ACI 305 when concreting during hot weather.

D. Conform to ACI 306.1 when concreting during cold weather.

1.7 COORDINATION

A. Section 01001 – General Requirements: Coordination.

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type II – Moderate unless specifically indicated otherwise on the drawings or in Special Provisions.

B. Fine and Coarse Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.2 ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical: ASTM C494 Type A - Water Reducing, Type C – Accelerating, Type D - Water Reducing and Retarding, Type E - Water Reducing and Accelerating, Type F - Water Reducing, High Range, Type G - Water Reducing, High Range and Retarding.
   1. Type B is not allowed.

C. Fly Ash: ASTM C618 Class C or F.

D. Plasticizer: ASTM C1017.

2.3 CALCIUM CHLORIDE

A. ASTM D98, Type S or Type L.

B. May be used for cold weather work in un-reinforced concrete only. Calcium Chloride shall not be used in reinforced concrete structures or in any concrete, reinforced or un-reinforced, that is in contact with ferrous metal.

2.4 ACCESSORIES

A. Vapor Barrier: ASTM E1745 Class A; 15 mil thick clear polyethylene film; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

B. Non-Shrink Grout: ASTM C1107, Grade B or C, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 2,400 psi in 48 hours and 7,000 psi in 28 days.

2.5 JOINT FILLER MATERIALS

A. Expansion Joint Filler: ASTM D1751; Asphalt impregnated fiberboard or felt, 1/4 inch thick; tongue and groove profile.

2.6 CONCRETE MIX

A. Mix and deliver concrete in accordance with ASTM C94, Option C.

B. Select proportions for normal weight concrete in accordance with ACI 301 trial mixtures.

C. Provide concrete to the following criteria:

Concrete class Designation	28-day Compressive Strength
2500	2500 psi
3000	3000 psi
4000	4000 psi
5000	5000 psi

D. Slump: 1 inch to 4-inches, before the addition of high range water reducing add mixtures.

E. Entrained Air: 4 1/2%, plus or minus 1 1/2%.

F. Admixtures: The contractor is responsible for obtaining the desired consistency of the concrete. The addition of pozzolans and /or admixtures may be necessary to obtain the appropriate workability and consistency. The Contractor is responsible for providing additional pozzolans or admixtures as necessary at no additional cost.
   1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
   2. Use set retarding admixtures during hot weather.
   3. Add air entraining agent to normal weight concrete mix for work exposed to exterior.
   4. Type F and Type G admixtures are added at the job site just before discharge. The slump of the concrete shall be measured before the addition of these high range admixtures and shall not exceed the maximum limit specified.

2.7 WOOD FORM MATERIALS

A. Form Materials: At discretion of Contractor.

B. Lumber Forms:
   1. Application: Use for edge forms and unexposed finish concrete.
   2. Boards: 6 inches or 8 inches in width, shiplapped or tongue and groove, “Standard” Grade Spruce, Pine or Fir. Surface boards on four sides.

C. Plywood Forms:
   1. Application: Use for exposed finish concrete.
   2. Forms: Conform to PS 1; full size 4 x 8 feet panels; each panel labeled with grade trademark of APA/EWA.
   3. Plywood for Surfaces to Receive Membrane Waterproofing: Minimum of 5/8 inch thick; APA/EWA “B-B Plyform Structural I Exterior” grade.
   4. Plywood where “Smooth Finish” is required, as indicated on Drawings: APA/EWA “HD Overlay Plyform Structural I Exterior” grade, minimum of 3/4 inch thick.

2.8 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

B. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

C. Pan Type: Steel of size and profile required.

D. Tubular Column Type: Round, spirally wound laminated fiber, wood, or glass fiber material, surface treated with release agent, non-reusable, sizes as indicated on Drawings

E. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set.

F. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.

2.9 FRAMING, STUDDING AND BRACING: Stud or No. 3 structural light framing grade.

2.10 FORM LINERS: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Drawings.

A. Architectural Form Liners: Polystyrene, Acrylonitrile butadiene styrene (ABS) or Polyurethane; single use or reusable; pattern as indicated on Drawings.

2.11 FORMWORK ACCESSORIES

A. Form Ties: Snap-off type, galvanized metal, adjustable length, cone type, 3/4 inch back break dimension, free of defects capable of leaving holes larger than 1 inch in concrete surface.

B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face. Wire ties, wood spreaders or through bolts are not permitted.

C. Form Anchors and Hangers:
1. Do not use anchors and hangers for exposed concrete leaving exposed metal at concrete surface.
2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
3. Penetration of structural steel members is not permitted.

D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture or impair natural bonding or color characteristics of coating intended for use on concrete.

E. Corners: Fillet and Chamfer, rigid plastic or wood strip, maximum possible lengths.

F. Vapor Retarder: Where indicated on Drawings, 8 mil thick polyethylene sheet.

G. Bituminous Joint Filler: ASTM D1751.

H. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

I. Water Stops: Polyvinyl chloride, minimum 1,750 psi tensile strength, minimum 50 degrees F to plus 175 degrees F working temperature range, 6 inch nominal width, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

2.12 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, 60 ksi yield grade; deformed billet steel bars, unfinished.

B. Where indicated on the plans use hot dip galvanized reinforcing bars in accordance with ASTM A767/A767M, Class II finish, minimum thickness of 3.5 mils.

C. Reinforcing Steel Plain Bar and Rod Mats: ASTM A704/A704M, ASTM A615/A615M, Grade 60, steel bars or rods, unfinished.

D. Steel Welded Wire Reinforcement: ASTM A497 Deformed Type, galvanized.

2.13 REINFORCING ACCESSORY MATERIALS

A. Tie Wire: Epoxy coated

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture where applicable.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic or plastic-coated steel, type; size and shape to meet Project conditions.

D. Reinforcing Splicing Devices:
   1. Welded splices:
      a. Use only where shown on the plans or with written approval of the Engineer.
      b. Conform to AWS D1.4
      c. Lap weld: Use low hydrogen type electrodes.
      d. Exothermic welding type: Full tension and compression; sized to fit joined reinforcing.
      e. Repair hot dip galvanized welded reinforcing with a zinc rich formulation approved by the Engineer.
   2. Mechanical splices: Threaded type; full tension and compression; sized to fit joined reinforcing.

2.14 CURING MATERIALS

A. Membrane Curing Compound: ASTM C309 Type 2, Class A.

PART 3 EXECUTION

3.1 FORM ERECTION

A. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

B. When formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement before proceeding, request instructions from Architect/Engineer.

C. Earth Forms:
1. Trench earth forms neatly and accurately.
2. Trim sides and bottom of earth forms.
3. Construct wood edge strips at top of each side of trench to secure reinforcing and prevent trench from sloughing.
4. Form sides of footings where earth sloughs.
5. Tamp earth forms firm and clean forms of debris and loose material before depositing concrete.

D. Formwork - General:
1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.

E. Forms for Smooth Finish Concrete:
1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.

7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

F. Architectural Form Liners:
1. Erect architectural side of formwork first.
2. Attach form liner to forms before installing form ties.
3. Install form liners square, with joints and pattern aligned.
4. Seal form liner joints to prevent grout leaks.
5. Dress joints and edges to match form liner pattern and texture.

G. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

H. Framing, Studding and Bracing:
1. Space studs at 16 inches on center maximum for boards and 12 inches on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 2 inches thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

I. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

J. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

K. Obtain Architect/Engineer’s approval before framing openings in structural members not indicated on Drawings.

L. Install fillet and chamfer strips where indicated on the Drawings.

M. Install void forms, when required, in accordance with manufacturer's recommendations.

3.2 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive [special finishes] [or] [applied coverings] that are affected by agent. Soak

inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer's specifications. Do not coat forms for concrete indicated to receive "scored finish". Apply form coatings before placing reinforcing steel.

3.3 INSTALLATION - INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Install formed openings for items to be embedded in or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

D. Install water stops continuous without displacing reinforcement. Heat seal joints watertight.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

G. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 1 inch away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

H. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

I. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

J. Embedded Items:
   1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
   2. Do not embed wood or uncoated aluminum in concrete.
   3. Obtain installation and setting information for embedded items furnished under other Specification sections.
   4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
   5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318, Section 6.3.

K. Openings for Items Passing Through Concrete:
   1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
   2. Coordinate work to avoid cutting and patching of concrete after placement.
   3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

L. Screeds:
   1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
   2. Slope slabs to drain where required or as shown on Drawings.
   3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

M. Screed Supports:
   1. For concrete over waterproof membranes and vapor barrier membranes, use cradle, pad or base type screed supports which will not puncture membrane.
   2. Staking through membrane is not permitted.

N. Cleanouts and Access Panels:
   1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
   2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.4 FORM REMOVAL

A. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

B. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

3.5 FORM ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

B. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117.

C. Camber slabs and beams in accordance with ACI 301.

3.6 REINFORCING FABRICATION AND PLACEMENT

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice.

B. Locate reinforcement splices not indicated on Drawings, at point of minimum stress.

C. Place, support and secure reinforcement against displacement. Do not deviate from required position.

D. Use bar supports to position and support layers of reinforcing steel in slabs and beams.

E. Do not displace or damage vapor retarder.

F. Accommodate placement of formed openings.

G. Unless otherwise indicated on the Drawings, maintain concrete cover around reinforcement as follows:

Item	Cover
Beams	1 1/2 inch
Supported Slabs and Joists	3/4 inch
Column Ties	1 inch
Walls (exposed to weather or backfill)	2 inch
Footings and Concrete Formed Against Earth	3 inch
Slabs on Fill	3 inch

3.7 PLACING CONCRETE

A. Verify requirements for concrete cover over reinforcement.

B. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

D. Place concrete in accordance with ACI 301.

E. Notify Engineer minimum 24 hours prior to commencement of concrete placement operations.

F. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.

G. Install vapor barrier under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 6 inches and seal watertight by taping edges and ends.

H. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; lap over damaged areas minimum 6 inches and seal watertight.

I. Separate slabs on grade from vertical surfaces with 1/4 inch thick joint filler.

J. Extend joint filler from bottom of slab to within 1/4 inch of finished slab surface. Place floor slabs in sequence indicated on the Drawings.

K. Saw cut joints within 12 hours after placing. Use 3/16 inch thick blade, cut into 1/4 depth of slab thickness.]

L. Screed floors and slabs on grade level, maintaining surface flatness tolerance of 1/4 inch maximum in 10 ft.

3.8 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed with sack rubbed finish.

B. Finish concrete floor surfaces in accordance with ACI 301.

C. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains at 1/4 inch per foot nominal or as indicated on drawings.

3.9 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Cure floor surfaces in accordance with ACI 308.

C. Membrane Curing Compound: Apply curing compound in one coat.

3.10 PROTECTION OF FINISHED WORK

A. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

B. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by Engineer.

C. Do not permit traffic over unprotected floor surface.

3.11 FIELD QUALITY CONTROL

A. Section 01001- General Requirements: Quality Control; Testing Laboratory Services.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

E. Field testing will be performed in accordance with ACI 301.

F. Provide free access to Work and cooperate with appointed testing laboratory.

G. Submit proposed mix design of each class of concrete to testing laboratory for review prior to commencement of Work.

H. Three concrete test cylinders will be taken for every 75 or less cu yds of each class of concrete placed each day.

I. One additional test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

J. One slump measurement will be taken for each set of test cylinders taken and one measurement for each truck load delivered to the site.

K. One air content test will be made for each set of test cylinders taken.

L. Maintain records of concrete placement. Record date, location, quantity, air temperature, test samples taken and slump measurements taken.

3.12 PATCHING

A. Allow Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Engineer upon discovery.

C. Patch imperfections, including form tie holes, as directed by Engineer in accordance with ACI 301.

3.13 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements for quality.

B. Repair or replacement of defective concrete will be determined by Engineer.

C. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Engineer for each individual area.

END OF SECTION