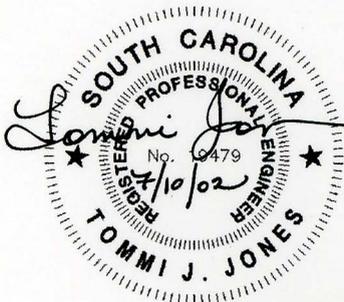
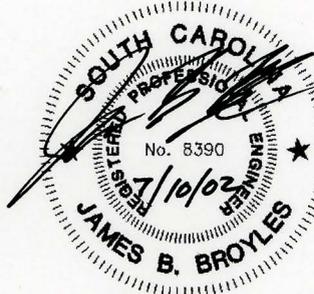


**STANDARD SPECIFICATIONS
FOR WATERLINE CONSTRUCTION**
*Electric City Utilities
City of Anderson
Anderson, South Carolina*

TECHNICAL SPECIFICATIONS
PROJECT NO. 0219
JULY 2002



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STANDARD SPECIFICATIONS FOR WATERLINE CONSTRUCTION
ELECTRIC CITY UTILITIES
CITY OF ANDERSON
SOUTH CAROLINA

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SECTION 01000

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Acceptance of Work: That point in time where the Owner, upon the Engineer's recommendation, accepts the Project, or a portion of the Work, as built.
- B. Agreement: The written agreement between the Owner and Contractor covering work to be performed.
- C. Bid: The offer or proposal of the Bidder submitted on the prescribed form setting forth the prices for the Work to be Performed.
- D. Bidder: Any person, firm or corporation submitting a Bid for the Work.
- E. Change Order: A written order to the Contractor signed by the Owner authorizing an addition, deletion or revision in the Work, or an adjustment in the Contract Price or Contract Time issued after the effective date of the Agreement.
- F. Contract Documents: The Agreement, the Contractor's Bid, the Specifications, and the Drawings.
- G. Contract Price: The total monies payable to the Contractor under the Contract Documents.
- H. Contract Time: The number of calendar days stated in the Contract Documents for the completion of Work.
- I. Contractor: The person, firm, or corporation with whom the Owner has executed the Agreement.
- J. Day: A calendar day of twenty-four (24) hours measured from midnight to the next midnight.
- K. Drawings: The Drawings which show the character and scope of the Work to be performed and which have been prepared or approved by the Engineer and which are referred to in the Contract Documents, are included in and are a part of the Contract Documents.
- L. Engineer: The professional engineers of Design South Professionals, Inc.
- M. Guaranty: Guaranty is the liability assumed by the Contractor for the performance of the Work and the products used.

- N. **Manufacturer's Representative:** A person who is a full time employee of the company supplying the materials, equipment or supplies to the Project. This person will be trained in the operation and use of the materials, equipment or supplies manufactured and used on the Project.
- O. **Owner:** The City of Anderson's Electric City Utilities.
- P. **Project:** The entire construction to be performed as provided in the Contract Documents.
- Q. **Specifications:** Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.
- R. **Subcontractor:** An individual, firm or corporation having a direct contract with the Contractor or with any other Subcontractor for the performance of a part of the Work at the site of for the furnishing of materials or equipment.
- S. **Warranty:** Warranty is the liability assumed by the Contractor for the quality of work including materials and equipment and other warranties in this Agreement by the Contractor or by others.
- T. **Work:** Any and all obligations, duties, and responsibilities necessary to the successful completion of the Project assigned to or undertaken by the Contractor under the Contract Documents, including the furnishing of all labor, materials, equipment and other incidentals and the material, equipment, and other incidentals themselves.

1.2 DESCRIPTION

- A. Provisions of Section 01000 apply to the specifications of all materials and equipment, except where otherwise noted.
- B. The information generally applies to products and the execution of work, but not all subsections apply to all work items.
- C. It is the Contractor's responsibility to complete the work in accordance with the provisions of the appropriate subsection.
- D. The specifications call attention to certain features but do not necessarily cover all details of materials or the design, fabrication, testing and installation of equipment.
- E. All items shall be the sizes shown, new and of current manufacture and complete with all supports and appurtenances. Where a system is specified, all drive units, accessories and controls shall be supplied to provide a complete operating system.
- F. The materials and equipment shall be selected, approved and supplied by the Contractor and reviewed by the Engineer in accordance specifications and drawings.

1.3 QUALITY ASSURANCE

A. Materials and equipment shall be furnished by manufacturers and suppliers with at least five (5) years experience in the supply, design and manufacture of such materials and equipment.

B. Reference Standards

1. All requirements for materials, design, fabrication, testing and installation of the equipment, its components or the system of which the equipment or its components are a part, shall be in accordance with the requirements, guidelines or recommendations issued by a Standards Institute or Manufacturers' or Users' Association. As an example, the latest edition of applicable standards or codes published by the following organizations could apply:

ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AGMA	American Gear Manufacturer's Association
AWWA	American Water Works Association
AWS	American Welding Society
AGA	American Gas Association
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
NFPA	National Fire Protection Association
NPC	National Plumbing Code
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
HI	Hydraulic Institute
UL	Underwriters Laboratories
OSHA	Occupational Safety and Health Administration
PCI	Precast Concrete Institute
SBCCI	Southern Building Code Congress International

2. For the convenience of referral and as base references, national standards are generally listed. Other recognized standards or codes may be acceptable if, in the opinion of the Engineer, the requirements of that standard or code are equal to, or better than, the standards or codes of the organizations listed above. The decision of the Engineer in this matter shall be final.

3. Except to the extent that standards or codes may be in conflict with applicable local laws, ordinances or governing codes, the requirement for compliance with codes or standards is mandatory and written certification of compliance, if required, shall be made available to the Engineer.

C. Where the specifications or drawings require a higher degree of workmanship or a better quality of materials than required by any standard or code, the higher requirements of the specifications or drawings shall prevail.

D. Where required, all surfaces requiring painting before shipment shall receive surface preparation, shop primer and final paint in accordance with the manufacturer's standard practice.

- E. Standard factory tests of the fully assembled equipment shall be conducted at the manufacturer's plant in accordance with the requirements of any applicable code or reference standard. The records of such tests, if required, shall be made available to the Engineer.

1.4 PRODUCT DELIVERY, STORAGE, HANDLING

- A. The materials and equipment shall be adequately protected and properly crated or packaged to protect against damage during loading, shipment, unloading, and storage.
- B. During loading, transporting and unloading, care shall be exercised to prevent damage to materials and equipment.
- C. All equipment parts shall be properly lubricated and protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is complete and the equipment is ready for operation.
- D. Materials and equipment shall be stored with adequate protection against adverse weather conditions.
- E. Finished ferrous surfaces not painted shall be properly protected to prevent rust and corrosion.

1.5 ALTERNATIVES

- A. The specified products establish minimum qualities that substitutes must meet to be considered acceptable. Proof of equality rests with the Bidder and adequate information must accompany the request for an alternative.
- B. If alternative materials or equipment are submitted, the Contractor shall prepare and submit for approval to the Engineer drawings showing all the necessary changes. Such drawings and changes and any other design data and criteria shall be made at the Contractor's expense.
- C. Quality, performance, finishes, availability, product costs and any modifications required to other work to facilitate the proposed alternative will all be evaluated in determining the suitability of a proposed substitution. The Owner reserves the right to reject proposed substitutions.

1.6 GUARANTEE

- A. Contractor's guarantee for items furnished covers and includes:
 - 1. Faulty or inadequate design
 - 2. Improper assembly or erection
 - 3. Defective workmanship and materials
 - 4. Leakage, breakage or other failure
- B. Provide guarantee period as specified in the Contract Documents.

PART 2 - PRODUCTS

2.1 FABRICATION AND MANUFACTURE

A. Materials

1. All materials used shall be fully suitable for the duty concerned and shall be new and of first class commercial quality, free from imperfections and selected for long life and minimum maintenance.
2. Any submerged moving parts of equipment, or the pins and spindles of the submerged moving parts, shall be of corrosion resistant metals.
3. Where stainless steel is specified or used it shall have resistance to atmospheric corrosion not less than that provided by ASTM Standards. Particular attention shall be made to the prevention of seizure by fretting where two corrosion resistant metals are in contact, by the selection of those materials, relative hardness, surface finish and the application of lubricants. Where bronze is specified or used it shall be zinc free.
4. Where dissimilar metals are in contact or close proximity and corrosion may occur through electrolytic action or differences in electrical potential, protection shall be afforded by electroplating, suitable gaskets, cathodic protection, or other means approved by the Engineer.
5. Where it is necessary to use dissimilar metals in contact, these shall be selected so that the bimetallic corrosion is as low as possible.
6. Bright parts and bearing surfaces shall be thoroughly polished and protected from corrosion by the application of a rust preventive lacquer or high melting-point grease, as approved by the Engineer, before the parts are packed. A sufficient quantity of the correct solvent for removal of the protective compounds shall be supplied and packed with each particular part.
7. The Contractor shall supply as specified, and to the satisfaction of the Engineer, reasonable excess quantities to cover wastage of those materials which would normally be subject to waste during erection, commissioning and setting to work.

PART 3 - EXECUTION

3.1 INSPECTION

A. Before Installation

1. Inspect the materials and equipment to insure that they are the proper size and fabricated and constructed to correct dimensions.
2. Verify that the materials, equipment and accessories delivered conform to specifications and show no indication of damage or visible defects.
3. Check to assure that the materials and equipment are stored in enclosures or under protective coverings.
4. Verify that the materials and equipment have been kept clean and dry, and not stored directly on the ground.
5. Assure that the materials and equipment are handled with care to prevent damage.

B. After Installation

1. Inspect the equipment and accessories for indications of defective workmanship or materials, and confirm that any necessary corrective measures have been taken.
2. Verify that materials and equipment have been properly installed, inspected, tested, checked, adjusted, lubricated, cleaned and protected, where required.
3. Obtain equipment supplier's written report certifying that equipment is in proper operating condition, where applicable.
4. See applicable specification.

3.2 INSTALLATION

- A. All materials and equipment shall be installed in accordance with the manufacturer's instructions and recommendations and any applicable code or standard requirement. Installation of equipment shall include furnishing the required lubricants and other consumable materials for initial operation in accordance with the manufacturer's recommendations.
- B. See applicable specification.

3.3 QUALITY CONTROL

- A. After the materials and equipment have been completely installed and adjusted the Contractor shall conduct such tests as are necessary to indicate that the materials and equipment performance conforms to the specifications and any applicable code or standard requirement. These tests shall be conducted in the presence of the Engineer.
- B. If the materials or equipment do not meet the specifications, code or standard requirements, corrective measures shall be taken or the materials and equipment shall be removed and replaced with materials and equipment which satisfy the conditions specified. A period of satisfactory operation of the equipment and completed systems will be required before acceptance to insure that the equipment and systems can operate under actual process conditions without undue noise, straining of parts, wear or vibration. This period will be decided by the Engineer.
- C. After installation and successful testing of the equipment, the Contractor shall provide the services of an experienced factory trained representative who has complete knowledge of the equipment to instruct the Owner's operating and maintenance personnel in the operation and maintenance of the equipment, in a schedule approved by the Engineer.

END OF SECTION

SECTION 01656

DISINFECTION OF POTABLE WATER MAINS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Section Includes:

1. Requirements for disinfection of new water mains and existing water mains which have been relocated or contaminated by construction operations.

1.2 RELATED SECTIONS

- A. Section 02501 - Pressure Piping - General
- B. Section 02502 - Valves and Accessories
- C. Section 02515 - Ductile Iron Pipe (DIP)
- D. Section 02620 - Polyvinyl Chloride (PVC) Pipe
- E. Section 02623 - Copper Piping

1.3 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA C651-86 – Standard for Disinfecting Water Mains.

1.4 SUBMITTALS

- A. Prior to starting disinfection work, furnish detailed outline of proposed sequence of operation, manner of filling and flushing units, source and quality of water to be used, and disposal of wasted water.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Disinfection work shall be acceptable to South Carolina Department of Health and Environmental Control. If requirements of this section are in conflict with requirements of regulatory agencies, the latter shall govern.

B. Source Quality Assurance:

1. Perform Work in connection with disinfection under direction of an experienced supervisor.
2. Use equipment in proper working condition and adequate for specified Work.

PART 2 - PRODUCTS

2.1 CHLORINE

- A. Chlorine gas-water solution or direct chlorine feed is preferred for disinfection.
- B. Use of high-test calcium hypochlorite or tablet method of disinfection shall be approved by the Engineer and in accordance with AWWA procedures.
- C. Tablet form calcium hypochlorite may be used only for water mains up to 12 inches in diameter and less than 2,500 feet in length.

PART 3 - EXECUTION

3.1 GENERAL

- A. Method of disinfection for water containment devices and piping systems shall conform to AWWA C651.
- B. The Contractor shall procure and pay for all water required for disinfection and flushing.
- C. The Contractor shall be liable for damages arising from direct contact of granular calcium hypochlorite with solvent welding materials used to join PVC pipe, if any.

3.2 CHLORINE PREPARATION

A. Liquid Chlorine:

1. Apply chlorine gas-water solution by means of solution feed chlorinating device or, if approved by the Engineer, dry gas may be fed directly through proper devices for regulating rate of flow and providing effective diffusion of gas into water within unit being treated.
2. Provide chlorinating devices for feeding solutions of chlorine gas that prevent backflow of water into chlorine cylinder.

B. Calcium Hypochlorite:

1. Prepare granular calcium hypochlorite as water mixture before introduction into unit. Make dry powder into paste and thin to approximately 1 percent chlorine solution.
2. To prepare chlorine solution, add 1 pound of calcium hypochlorite (65 percent to 70 percent available Cl_2 to 7.5 gallons of water).

3.3 PIPELINE PREPARATION

- A. After pressure and leakage tests are completed, flush units thoroughly to remove any foreign material. No flushing device shall be directly connected to any sewer.
- B. Release entrapped air at high points and fill units with disinfecting agent and water to allow disinfecting agent to come in contact with interior surfaces.
- C. If complete venting cannot be accomplished through available outlets, provide necessary corporation cocks and vent piping.

3.4 DISINFECTING AND SAMPLING

- A. The piping shall be disinfected by introducing the disinfecting agent into the water, which is being pumped into the system at the supply source, in such manner that the entire system will be filled with water containing a minimum chlorine concentration of 50 ppm at any point.
- B. The solution shall be retained in the pipeline for not less than 24 hours with a minimum residual concentration of 10 ppm sustained before the system is flushed out. Then flush out the line thoroughly with potable water of satisfactory bacteriological quality before starting the sampling program.
- C. The contractor shall collect a minimum of two (2) samples from each sampling site for total coliform analysis. The number of sites depends on the amount of new construction but must include all dead-end lines, be representative of the water in the newly constructed mains, and shall be collected a minimum of every 1,200 linear feet.
- D. Prior to sampling, the chlorine residual must be reduced to normal system residual levels or be non-detectable in those systems not chlorinating.
- E. These samples must be collected at least 24 hours apart and must show the water line to be absent of total coliform bacteria.
- F. The chlorine residual must also be measured and reported.
- G. If the membrane filter method of analysis is used for the coliform analysis, non-coliform growth must also be reported.
- H. If the non-coliform growth is greater than 80 colonies per 100 milliliters, the sample is invalid and must be repeated.
- I. All samples must be analyzed by a South Carolina Department of Health and Environmental Control (DHEC) certified laboratory, with results being submitted along with the registered Engineer's letter of certification.
- J. Disinfecting Valves:
 - 1. Operate valves and appurtenances while line or unit is being disinfected to ensure surfaces of valves are disinfected.

- K. Swabbing:
 - 1. Flush and swab pipe, fittings, or valves that must be placed in service immediately with 5 percent solution of calcium hypochlorite immediately prior to assembly.
 - 2. Secure approval from the Engineer before using this method of disinfection.
- L. Valve Operation: Performed by the Owner.

3.5 FINAL FLUSHING AND TEST

- A. Following chlorination, flush the unit or system until replacement water in system is proven to be comparable in quality to water which will enter unit or system.
- B. Above acceptable condition of water delivered by each unit or system shall continue for at least 2 days, as demonstrated by laboratory examination of samples. Laboratory tests shall show chlorine residual, after final flushing, of less than 1 mg/l (ppm).
- C. Repetition of Flushing and Testing:
 - 1. If initial treatment results in unsatisfactory bacterial tests, repeat disinfection until satisfactory results are obtained.
- D. Prevent entry of contaminated water into previously disinfected units or systems.
- E. No flushing device shall be directly connected to any sewer.

END OF SECTION

SECTION 01669
TESTING PIPING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Detailed requirements for hydrostatic pressure testing, low pressure air testing and high pressure air testing of new piping.
- B. Other sections identify new piping systems to be tested, identify type of test to be performed, specify test pressure, and reference this section for detailed testing requirements.

1.2 RELATED SECTIONS

- A. Section 02501 - Pressure Piping - General
- B. Section 02515 - Ductile Iron Pipe (DIP)
- C. Section 02620 - Polyvinyl Chloride (PVC) Pipe
- D. Section 02623 - Copper Piping

1.3 SUBMITTALS

- A. Test report for each piping system tested.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL

- A. Pressure and leakage tests must be conducted in accordance with AWWA Standards C600 and C605.
- B. Pressure test in presence of the Engineer.
- C. Furnish water required for testing and provide necessary piping connections between section of piping being tested and nearest available source of water or air supply, together with test pressure equipment, meters, pressure gauge, and other equipment, materials, and facilities necessary to perform specified tests.

- D. Provide bulkheads, flanges, valves, bracing, blocking or other temporary sectionalizing devices that may be required.
- E. Remove temporary sectionalizing device after tests are complete.
- F. Perform tests on exposed piping after piping is completely installed, including supports, hangers, and anchors.
- G. Perform tests on piping before insulation is installed.
- H. Perform tests on piping that is clean and free of dirt, sand or other foreign material.
- I. Plug pipe outlets with test plugs. Brace each plug securely to prevent blowouts.
- J. Add test fluid slowly.
- K. Include regulator set to avoid over pressurizing and damaging piping.
- L. Perform pressure testing in accordance with local, state, and federal requirements.
- M. Cost of testing including water, personnel, equipment, and materials shall be the Contractor's responsibility.
- N. All visible leaks shall be repaired. Correct leaks or defects and retest at Contractor's expense.

3.2 HYDROSTATIC PRESSURE TESTING

- A. Perform hydrostatic pressure testing for piping systems identified in other sections to be hydrostatically pressure tested. Test pressure shall be as specified in other sections.
- B. Open vents at high points to purge air pockets while piping system is filling. Venting may also be provided by loosening flanges or with equipment vents.
- C. Testing:
 - 1. After section of piping to be tested has been filled with water, apply test pressure by means of force pump of such design and capacity that required pressure can be applied and maintained without interruption for duration of test.
 - 2. Measure test pressure by means of tested and properly calibrated pressure gauge acceptable to the Engineer.
 - 3. Maintain test pressure for a sufficient length of time to permit the Engineer to observe piping under test, but not less than 2 hours.
 - 4. If repairs are required, repeat pressure test until pipe installation conforms to specified requirements and is acceptable to the Engineer.
- D. With the exception of buried piping with mechanical joints or push-on joints, piping systems shall show no visual evidence of weeping or leaking.

- E. Maximum allowable leakage for buried piping with mechanical joints or push-on joints shall be determined by one of the following two methods:

For Ductile Iron:

1. $L = \frac{SDP^{1/2}}{133,200}$

or

For PVC:

2. $L = \frac{NDP^{1/2}}{7,400}$

Where:

L = Leakage (gallons per hour)
S = Length of pipe tested (feet)
D = Diameter of pipe (inches)
P = Average test pressure (psig)

Where:

L = Leakage (gallons per hour)
N = Number of joints tested
D = Diameter of pipe (inches)
P = Average test pressure (psig)

3.3 TEST REPORT

- A. Prepare and submit test report for each piping system tested. Include the following information in test report.
1. Date of test.
 2. Description and identification of piping system tested.
 3. Type of test performed.
 4. Test fluid.
 5. Test pressure.
 6. Type and location of leaks detected.
 7. Corrective action taken to repair leaks.
 8. Results of retesting.

END OF SECTION

SECTION 02211
ROUGH GRADING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil.
- B. Cutting, grading, filling, rough contouring, and compacting the site for structures, building pads, and roadways.

1.2 RELATED SECTIONS

- A. Section 02230 - Site Clearing.
- B. Section 02320 - Trenching, Backfilling and Compacting.
- C. Section 02370 - Slope Protection and Erosion Control.
- D. Section 02920 - Grassing.

1.3 REFERENCES

- A. ASTM D 698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. Rammer and 12 Inch Drop.
- B. ASTM D 1556 - Test Method for Density of Soil in Place by the Sand-Cone Method.
- C. ASTM D 2937 - Test Method for Density of Soil in Place by the Drive-Cylinder Method.
- D. ASTM D 3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.4 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil Type S2:

1. Conforming to State of South Carolina Department of Transportation standard for topsoil.
- B. Topsoil Type S3:
1. Excavated and reused topsoil material generally occurring from the top of ground to a depth of 6 - 18 inches.
 2. Free of roots, rocks larger than 1/2 inch, subsoil, large weeds and foreign matter.
- C. Subsoil Type S1:
1. Excavated and re-used material.
 2. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage utilities that are designated to remain.
- D. Notify utility company to remove and relocate utilities where required.
- E. Protect plants, lawns, and other features designated to remain as a portion of final landscaping.
- F. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.3 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded.
- B. Do not excavate wet subsoil.
- C. Stockpile excavated subsoil material to be reused on site. Remove excess subsoil material not intended for reuse from site.
- D. Stability: Replace damaged or displaced subsoil to same requirements as specified fill.

3.4 FILLING

- A. Fill areas to finished contours and elevations as shown on Site Grading Plan.
- B. Place fill material in continuous layers and compact in accordance with the schedule at end of this section.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Slope grade away from building at a minimum slope of 2 inches in 10 feet, unless noted otherwise.
- E. Make grade changes gradual. Blend slope into level areas.
- F. Remove surplus fill materials from site.
- G. Do not use frozen materials for topsoil, subsoil fill, or structural fill.

3.5 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 foot from required elevation.

3.6 FIELD QUALITY CONTROL

- A. Testing: In accordance with ASTM D 698, ASTM D 1556, ASTM D 2167 and ASTM D 3017.
- B. If tests indicate Work does not meet specified requirements, remove Work, replace and retest.
- C. Frequency of Tests: 1 per 100 cubic yards.

END OF SECTION

SECTION 02230

SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protecting existing trees and vegetation to remain.
 - 2. Removing trees and other vegetation.
 - 3. Clearing and grubbing.
 - 4. Topsoil stripping.
 - 5. Removing above-grade site improvements.
 - 6. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 7. Disconnecting, capping or sealing, and removing site utilities.
- B. Related Sections include the following:
 - 1. Section 02211 - Rough Grading.
 - 2. Section 02320 - Trenching, Backfilling and Compacting.

1.3 DEFINITIONS

- A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.

1.4 MATERIALS OWNERSHIP

- A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

- A. Photographs sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.
- B. Identify and accurately locate capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.6 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site prior to start of construction.

1.7 PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing indicated removal and alteration work on property adjoining Owner's property will be obtained by Owner before award of Contract or work is performed.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where indicated.
- D. Notify utility locator service for area where Project is located before site clearing.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 02320 – Trenching, Backfilling and Compacting.
 - 1. Obtain approved borrow soil materials off-site when satisfactory soil materials are not available on site.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Locate and clearly flag trees and vegetation to remain or to be relocated.
- D. During construction, protect from damage any existing site improvements to remain.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

- A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
 - 1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
 - 2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.
- B. Do not excavate within drip line of trees, unless otherwise indicated.
- C. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
 - 1. Cover exposed roots with burlap and water regularly.
 - 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
 - 3. Coat cut faces of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 - 4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
- D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Engineer.
 - 1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 - 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified arborist.

3.3 UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing when requested by Contractor.
 - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
- C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Engineer not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Engineer's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. 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.

3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed subgrade.

4. Use only hand methods for grubbing within drip line of remaining trees.

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

1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within drip line of remaining trees.

3. Dispose of excess topsoil as specified for waste material disposal.

4. Stockpile surplus topsoil and allow for respreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above and below-grade improvements as indicated and as necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.

3.7 DISPOSAL

- A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 02320

TRENCHING, BACKFILLING AND COMPACTING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent and location of trenching, backfilling and compacting are shown on the drawings.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Excavating, backfilling and compacting trenches for waterlines.
- B. Related Sections include the following:
 - 1. Section 02501 - Pressure Piping - General
 - 2. Section 02743 - Asphaltic Concrete Paving
 - 3. Section 02920 - Grassing

1.3 UNIT PRICES (FOR CONSTRUCTION CONTRACTS)

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
 - 1. 6 inches below invert of pipe.
 - 2. 24 inches wider than nominal diameter of pipe or 36 inches, whichever is greater.
- B. Unit prices for rock excavation include replacement with approved materials.

1.4 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- D. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as directed by Engineer. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
- E. Fill: Soil materials used to raise existing grades.
- F. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cubic yard for bulk excavation or 3/4 cubic yard for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 36-inch wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 pound-foot and stick-crowd force of not less than 18,700 pound-foot; measured according to SAE J-1179.
 2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000 pound-foot breakout force; measured according to SAE J-732.
- G. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders with 3/4 cubic yards or more in volume, that when tested by an independent geotechnical testing agency, according to ASTM D 1586, exceeds a standard penetration resistance of 100 blows per 2 inches.
- H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- I. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
- J. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- K. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

- A. Product Data: For the following:
1. Each type of plastic warning tape.
 2. Drainage fabric.
 3. Separation fabric.
- B. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:

1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
- C. Blasting plan approved by authorities having jurisdiction, for record purposes.
- D. Seismic survey agency report, for record purposes.

1.6 QUALITY ASSURANCE

- A. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
 2. Seismographic monitoring services during blasting operations.
- B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Engineer not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Engineer's written permission.
 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials.
- E. Subbase: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2 inch sieve and not more than 12 percent passing a No. 200 sieve.
- F. Base: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.
- G. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.
- H. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-1/2 inch sieve and not more than 8 percent passing a No. 200 sieve.
- I. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2- inch sieve and 0 to 5 percent passing a No. 8 sieve.
- J. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

- A. Tracer Wire: To ensure all water mains can be located within 3 feet with electronic locating equipment, solid strand 14 gauge copper wire with insulation rated for underground service shall be installed within 6 inches of waterline in a continuous fashion.
- B. Warning Tape: For waterlines, provide acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored blue.
- C. Detectable Warning Tape: Provide acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 12 inches deep; colored as follows:

1. Red: Electric.
 2. Yellow: Gas, oil, steam, and dangerous materials.
 3. Orange: Telephone and other communications.
 4. Green: Sewer systems.
- D. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 110 pound-foot; ASTM D 4632.
 2. Tear Strength: 40 pound-foot; ASTM D 4533.
 3. Puncture Resistance: 50 pound-foot; ASTM D 4833.
 4. Water Flow Rate: 150 gpm per square foot; ASTM D 4491.
 5. Apparent Opening Size: No. 50; ASTM D 4751.
- E. Separation Fabric: Woven geotextile, specifically manufactured for use as a separation geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 200 pound-foot; ASTM D 4632.
 2. Tear Strength: 75 pound-foot; ASTM D 4533.
 3. Puncture Resistance: 90 pound-foot; ASTM D 4833.
 4. Water Flow Rate: 4 gpm per square foot; ASTM D 4491.
 5. Apparent Opening Size: No. 30; ASTM D 4751.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXCAVATION, GENERAL

A. Classified Excavation: Excavation to subgrade elevations classified as earth and rock. Rock excavation will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
 - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock.
 - a. Do not excavate rock until it has been classified and cross-sectioned by Engineer.

3.4 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.5 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Install piping as specified in Section 02501.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 30 inches higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 12 inches on each side of pipe or conduit or as indicated on the drawings, whichever is greater.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes 4 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference.
2. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.6 APPROVAL OF SUBGRADE

- A. Notify Engineer when excavations have reached required subgrade.
- B. If Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer.

3.7 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Provide 4-inch thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1 inch, to a height of 30 inches over the utility pipe 12 inches in diameter and 36 inches over the utility pipe larger than 12 inches in diameter.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- G. Place and compact final backfill of satisfactory soil material to final subgrade.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

- I. In unpaved areas, the remainder of the backfill shall be deposited and then compacted by mechanical tampers. Mechanical tampers of layers in unpaved areas shall be to a maximum thickness of 12 inches. In areas to be paved or repaved, the entire depth of backfill shall be deposited in layers and compacted by hand or mechanical tampers to a maximum thickness of 6 inches. Compaction shall be carried out to achieve a density of 98 percent maximum density as determined by the Standard Proctor Method ASTM D 698.
- J. In areas to be paved, density tests for the determination of the specified compaction shall be made by a testing laboratory and spaced one in every 300 feet of trench cut. It is the intent of this specification to secure a condition where no further settlement of trenches will occur. When backfilling is completed, the roadway base for the pavement replacement may be placed immediately. It will be the responsibility of the Contractor to restore the surface to the original grade wherever settlement occurs.
- K. Trenching, backfilling and compaction within State Highways rights-of-way shall be in accordance with the requirements of the State of South Carolina Department of Transportation in addition to the requirements of these specifications.

3.9 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.10 COMPACTION OF BACKFILLS AND FILLS

- A. 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.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry density according to ASTM D 698:
 - 1. Under pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
 - 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
 - 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.11 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 - 1. Provide a smooth transition between adjacent existing grades and new grades.
 - 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1-inch.
 - 2. Walks: Plus or minus 1-inch.
 - 3. Pavements: Plus or minus ½-inch.

3.12 SUBBASE AND BASE COURSES

- A. Under pavements and walks, place subbase course on prepared subgrade and as follows:
 - 1. Place base course material over subbase.
 - 2. Compact subbase and base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
 - 3. Shape subbase and base to required crown elevations and cross-slope grades.
 - 4. When thickness of compacted subbase or base course is 6 inches or less, place materials in a single layer.
 - 5. When thickness of compacted subbase or base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.
- B. Pavement Shoulders: Place shoulders along edges of subbase and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry density weight according to ASTM D 698.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality control testing. Contractor is responsible for notifying testing agency at least 24 hours in advance of requiring testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.
- C. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2937, and ASTM D 3017, as applicable. Tests will be performed at the following locations and frequencies:

1. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.14 PROTECTION

A. Exercise reasonable precaution to prevent the silting of streams. Provide at Contractor's expense temporary erosion and sediment control measures to prevent the silting of streams and existing drainage facilities.

B. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

C. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

D. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.15 RESTORATION OF SURFACE IMPROVEMENTS

A. Roadways, including shoulders, alleys and driveways of stabilized soil or gravel, grass plots, sod, shrubbery, ornamental trees, signs, fences, mailboxes, or other surface improvements on public or private property which have been damaged or removed in excavating, shall be restored to conditions equal or better than the conditions existing prior to beginning work. Restoration of shoulders shall consist of seeding and mulching as specified in Section 02920 - Grassing.

B. Materials for unpaved roadways, road shoulders, alleys, or driveways, shall be compacted to a minimum of 95 percent of the maximum density as determined by ASTM D 698. The cost of this work and furnishing new materials shall be included in the cost of the applicable items of work as no separate payment will be made, unless a separate bid item is provided.

3.16 EXCAVATION NEAR EXISTING UTILITIES AND STRUCTURES

A. Existing Utilities: Attention is directed to the fact that there may be pipe, drains and other utilities in locations along the proposed work.

B. Where information is available as to the location of existing pipes, drains and other utilities, the approximate locations have been indicated on the drawings; however, the completeness or accuracy of the information given is not guaranteed.

- C. As the excavation approaches pipes, conduits, or other underground structures, discontinue digging by machinery and excavate by means of hand tools. Such manual excavation when incidental to normal excavation is included in the work to be done under items involving normal excavation.
- D. Where determination of the exact location of a pipe or other underground structures is necessary for doing work properly, the Contractor may be required to excavate test pits to determine such locations. When such test pits may be properly considered as incidental to other excavation, the work is understood to be included as part of the excavation.

3.17 PAVEMENT REMOVAL AND REPLACEMENT

- A. Asphalt pavement shall be removed by cutting on a straight line with edges as vertical as possible. Concrete pavement or asphaltic concrete pavement shall be removed by cutting with a concrete saw in a straight line and vertically as possible. Materials to replace State Highway paving shall conform to the specifications required by the State of South Carolina Department of Transportation. Other asphalt pavement replacement shall conform to the requirements of the applicable Department of Transportation Specifications for Type I asphaltic concrete surface course.
- B. Prior to replacing concrete or asphalt pavement, a stabilized gravel or concrete base shall be laid. The base for concrete or asphalt pavements on state primary roads shall consist of 10 inches of 2,500 psi concrete (see Standard Details for Type A Pavement Replacement). The base course for concrete or asphalt pavements on state or county secondary roads shall consist of 6 inches of McAdam base material stabilized with 5 percent Portland cement (see Standard Details for Type B Pavement Replacement). Stabilized aggregate base courses shall be compacted to a minimum of 95 percent of the maximum density as determined by, ASTM D 698.
- C. Non-asphalt pavement replacement shall be replaced of like material and thickness. Asphalt or built-up asphalt pavement shall be replaced with like material or concrete as directed by the Engineer. Where asphalt or built-up asphalt pavement is replaced by concrete, the concrete shall have a minimum of 6 inches thickness and be reinforced with 6 by 6 No. 6 gage weld fabric. Concrete for paving shall be 3,000 psi design strength. Where the pavement replacement is of like material, it shall be replaced in thickness equal to or greater than that existing at the time of removal.
- D. Pavement replacement shall be to the thicknesses and dimensions as shown on the drawings or otherwise specified.
- E. Unless base is sealed or other temporary paving applied over areas to be repaved, pavement shall be replaced not later than three weeks after completion of backfill.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 02371

RIPRAP

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent and location of riprap are shown on the drawings.

PART 2 - PRODUCTS

2.1 STONE

- A. Stone used for riprap shall be hard quarry or field stone and shall be of such quality that they will not disintegrate on exposure to water or weathering. The stone shall be suitable in all respects for the purpose intended.
- B. Stone shall range in weight from a minimum of 25 pounds to a maximum of 150 pounds. At least 50 percent of the stone pieces shall weigh more than 60 pounds. The stone pieces, except spalls, shall have a minimum dimension of at least 12 inches.
- C. Acceptable concrete, broken into proper size pieces and meeting the requirements as specified may be used in lieu of stone for hand-placed riprap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The thickness of hand-placed riprap shall be no less than that specified, measured perpendicular to the slope. 12-inch riprap shall be placed at a minimum thickness of 12 inches.
- B. Stone shall be placed on properly prepared compacted slope, each piece being placed, by hand, perpendicular to the slope or earth surface. It shall be firmly imbedded against the earth material and the adjoining piece with the sides in contact and with well broken joints. The spaces between the layer pieces shall be filled with spalls of suitable size which will be thoroughly rammed into place. The finished surface shall present an even, tight surface true to line, grade and section.
- C. Stone and broken concrete shall not be mixed.

END OF SECTION

SECTION 02445

STEEL PIPE AND SLEEVES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section covers steel pipe to be used as casing pipe for road and railway crossings. The extent of steel casing pipe used is shown on the drawings and specified.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Section 02501 - Pressure Piping - General.

PART 2 - PRODUCTS

2.1 HIGHWAY SLEEVES

- A. Pipe for sleeves under highways, unless otherwise specified in the encroachment permit, shall be steel conforming to ASTM A 139, latest revision, Grade B, with a yield strength of 35,000 psi. Sleeve pipe shall be of the length shown on the drawings and be bituminous coated outside.
- B. The sizes and wall thicknesses of the sleeve pipe shall be as follows:

<u>Carrier Pipe Size (Inches)</u>	<u>Sleeve Pipe Size (Inches)</u>	<u>Sleeve Pipe Wall Thickness (Inches)</u>
4	10	0.312
6	12	0.312
8	16	0.312
10	18	0.312
12	20	0.375
14	22	0.375
16	24	0.375
18	26	0.375
20	30	0.375
24	36	0.375
30	42	0.500
36	48	0.500
42	56	0.500
48	62	0.500

2.2 CASING SPACERS

- A. Provide "spider" type casing spacers for positioning carrier pipe within the casing pipe, Model SI as manufactured by Advance Products & Systems, Inc., Lafayette, Louisiana, or approved equal.

2.3 END SEALS

- A. Provide pull-on type synthetic rubber end seals for casing pipe, Model AC as manufactured by Advance Products & Systems, Inc., Lafayette, Louisiana, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Highway Crossing:
 - 1. All pipe crossings under highways shall be installed in accordance with the requirements of the South Carolina Department of Transportation governing the method and materials of construction. The Contractor will be held responsible for any and all expense such authority incurs in protecting its highway while pipes are being placed under same and for any damage to the highway. The Contractor shall arrange with the governing authority for the proper bracing, shoring, and other necessary protection of the highway before excavation beneath any of said highway.

3.2 CARRIER PIPE INSTALLATION

- A. Install carrier pipe by using "spider" type casing spacers and synthetic rubber end seals as described in Paragraph 2.2 and 2.3. Install spacers and seals in accordance with manufacturer's recommendations with a minimum of 2 spiders per pipe joint.

END OF SECTION

SECTION 02501

PRESSURE PIPING - GENERAL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The work covered by this section and the related sections following consists of providing all labor, equipment, material and supplies and performing all operations required to install the various piping, valves, accessories, and fire hydrant assemblies for water lines as specified and shown on the drawings.
- B. Related Work Specified Elsewhere:
 - 1. Section 02320 - Trenching, Backfilling and Compacting
 - 2. Section 02445 - Steel Pipe and Sleeves
 - 3. Section 02502 - Valves and Accessories
 - 4. Section 02515 - Ductile Iron Pipe (DIP)
- C. Service: Potable Water Transmission Main

1.2 SUBMITTALS

- A. Submittals for the various types of pipe and fittings is specified in the individual sections.
- B. Shop drawings or catalog cuts shall be submitted for all valves, boxes and restrained joints.
- C. Pipe elevations shall be submitted as specified under "Installation", in this Section.
- D. The manufacturer shall furnish a sworn affidavit that the pipe, fittings and lining furnished under the Contract or Agreement comply with all applicable provisions of the ANSI and/or AWWA Standards.
- E. Reports on pressure and leakage tests for all pipelines shall be submitted by the Contractor.
- F. Reports on bacteriological tests shall be submitted by the Contractor for potable water system piping.

1.3 JOB CONDITIONS

- A. Interruptions to utility service shall be minimized. The Contractor shall submit plans and schedules to the Engineer for approval by the proper authority before any shutdown or any interruption in service takes place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All materials used in the construction of potable water distribution systems shall be considered "lead free". "Lead free" as used in these specifications is defined as containing less than 0.2 percent lead in solder and flux, and containing less than 8.0 percent lead in pipe fittings.
- B. All materials which will come in contact with potable water, including valves, fittings, piping, packing, and jointing and gasket material shall be third party certified as meeting the specifications of the American National Standard Institute/ National Sanitation Foundation Standard 61, Drinking Water System Components – Health Effects. The certifying party shall be accredited by ANSI.
- C. All pipe, fittings, packing, jointing materials, valves and fire hydrants shall conform to the appropriate Section C of the AWWA Standards.
- D. All piping materials shall be new. Used materials shall not be acceptable.
- E. Steel pipe shall not be used for potable waterlines.

PART 3 - EXECUTION

3.1 INSPECTION

- A. All pipe shall be subject to inspection at the factory by the Engineer or Owner. The Contractor shall provide a production schedule in sufficient time so plans can be made for in-plant inspection of the pipe or fittings during production, should it be required.
- B. Special markings shall be plainly marked on the applicable pipe indicating the weight, proper location of the pipe or fitting in the line by reference to layout drawings and schedules, class of pipe, casting period, manufacturer's mark and year pipe was produced.

3.2 TESTS

- A. All tests shall be made in the presence of the Owner or Engineer unless waived in writing. The Contractor shall notify the Engineer in sufficient time when tests are being conducted to allow for travel time to the manufacturer's plant.

3.3 INSTALLATION OF UNDERGROUND PIPING

- A. Installation of waterlines and all appurtenances shall be conducted in accordance with the appropriate Section C of the AWWA Standards, and/or manufacturer's recommended installation procedures.

- B. Excavation, trenching and backfilling for the installation of underground piping system shall be as specified in Section 02320, Trenching, Backfilling and Compacting. Pipe shall be laid in a level trench. Irregularities shall be smoothed out or filled in with sand and tamped. Holes shall be scooped out where the bells occur leaving the entire barrel of the pipe bearing on the pipe bed. Pipe sizes 12 inches and less shall be installed a minimum of 30 inches below grade. Pipe sizes larger than 12 inches shall be installed a minimum of 36 inches below grade. If pipe material is steel, concrete, or DIP, the Engineer may allow an installation depth less than 30 inches. Prior approval by the Engineer is required.
- C. Laying of the pipe shall be commenced immediately after the excavation is started, and every means must be used to keep pipe laying closely behind the trenching. The Engineer may stop trenching when, in his opinion, the trench is open too far in advance of the pipe laying operation. Pipe may be laid in the best manner adapted to securing speed and good results. It shall, however, be in accordance with the manufacturer's instructions and recommendations. Damaged or unsound pipe or fittings will be removed and replaced by the Contractor at no additional cost to the Owner. Before jointing of the pipe, all lumps, blisters, excess coating material or oil shall be removed from the bell and spigot ends of the pipe.
- D. Water lines 2.5 inches in diameter and larger shall be restrained as shown on the drawings and as specified in *Exhibit "A"* Standard Details - Watermain Anchorage System to prevent movement of lines under pressure. Restraints shall be furnished by the Contractor.
- E. Where there is no adequate natural foundation upon which to construct a pipe bed, the pipe shall be constructed on a prepared stabilized subgrade or rock bedding of Class I materials as defined in ASTM D 2774. Unsuitable subgrade materials shall be replaced or stabilized as described in Section 02320. Gravel or graded stone used for pipe bedding, when ordered in writing, shall be paid for under bid item for such material. Where dewatering is required, Class I materials shall be used as described in ASTM D 2774.
- F. Pipe and fittings shall be placed along the route of construction with the spigots pointing in the direction of flow. Pipe shall be placed where it will cause least interference with traffic. Pipe shall be handled by mechanical equipment. Before the pipe is lowered into the trench, it shall be swabbed or brushed out to insure that no dirt or foreign material gets into the finished line. Trench waters shall be kept out of the pipe and the pipe kept closed by means of a test plug whenever work is not in progress. The Contractor shall provide the means for dewatering the trench and the cost thereof shall be included in the price for installing the pipe.
- G. Deflections from a straight line or grade made necessary by vertical curves or horizontal curves or offsets shall not exceed the manufacturer's recommendations. If the specified or required alignment requires deflection in excess of those recommended, the Contractor shall either provide special bends as approved by the Engineer or a sufficient number of shorter lengths of pipe to provide angular deflections within the required limit.
- H. All joints shall be watertight and any leaks or defects discovered shall be immediately repaired to the satisfaction of the Engineer. Any pipe which has been disturbed after being laid shall be taken up, the joints cleaned and the pipes properly re-laid. Any superfluous material inside the pipe shall be flushed or removed by means of an

approved follower or scraper after joints are made. Installation of fittings and pipe joints shall be in strict accordance with the manufacturer's recommendations.

- I. Where water mains are stubbed out with a reducer and valve, in addition to thrust blocks, the stub-outs shall have restrained joints from the valve back to the tee.
- J. For the protection of exposed reinforcing in anchor blocks, the Contractor shall furnish and apply two coats of Koppers Bitumastic No. 505 protective coating.
- K. Plastic pipe shall be installed in strict accordance with the provisions of ASTM D 2774, including those provisions in respect to compaction of bedding and haunching material.

3.4 MISCELLANEOUS INSTALLATION CONDITIONS

A. Sewer and Water Main Crossing:

- 1. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer. The distance shall be measured edge to edge.
- 2. Water mains crossing sanitary sewers, either above or below, shall be laid to provide a minimum vertical separation of 18 inches between the outside of the water main and the outside of the sewer. Whenever possible, the water main shall cross on top of the sewer. Adequate structural support shall be provided for water mains crossing under sewers.
- 3. Where water mains and sanitary sewers cross, the pipe shall be a 20-foot section of ductile iron pipe, centered over the point of crossing. For waterlines less than 4-inches, the pipe shall be encased in concrete.
- 4. Where water mains are laid within 10 feet horizontally of a sanitary sewer, it must be placed in a separate trench or on an undisturbed earth shelf located on one side of the sewer at an elevation such that the bottom of the water main is at least 18 inches above the top of the sewer.
- 5. Water mains shall not come in contact with or penetrate sewer manholes, storm sewers, or catch basins.
- 6. Potable water mains shall not be located within 25 feet, horizontally, of a wastewater tile field or spray field.
- 7. Special Conditions: When it is impossible to obtain the distances specified above, SCDHEC may allow an alternative design. Any alternative design shall incorporate the following:
 - a. Maximize the distances between the water main and sewer line and the joints of each.
 - b. Use materials for the sewer line which meet the requirements specified herein for waterlines.
 - c. Allow enough distance to make repairs to one of the lines without damaging the other.

B. Creek or River Crossing:

- 1. The Owner will obtain the necessary construction permits from the governing authorities. The Contractor shall not begin work on any creek or river crossing until he receives a copy of the approved permit. The work shall be subject to any additional requirements of the governing authority.
- 2. Underwater Crossings:

- a. The pipe shall be buried with a minimum of 2 feet of cover.
 - b. Pipe and fittings shall be mechanical joint ductile iron pipe conforming to the Section 02515 - Ductile Iron Pipe.
 - c. For crossings exceeding 15 feet in width, an isolation valve shall be placed on each side of the crossing. The valve shall be easily accessible and not subject to flooding. A blow-off shall be provided on the sides opposite the supply. The blow-off shall be in accordance with the attached standard detail.
3. Above-water Crossings: The pipe shall be adequately supported and anchored, insulated to protect from damage and freezing, and accessible for repair and replacement.
 4. The Contractor shall control turbidity to within 50 NTU above normal at a distance greater than 100 feet from the point of work. The crossing shall include the necessary fittings, restraints, socket clamps, blocking and anchorage, riprap, and ground stabilization as shown in the drawings.
- C. Crossings Under Highways, Railroads, Pipelines and Other Rights-of-Way:
1. All pipe under City, County or State highways, railroads, pipelines and other public or private rights-of-way shall be installed in accordance with the highway department, railroad, agency or entity having jurisdiction, ownership, or governing authority.
 2. The entity involved will govern the method and materials of construction. The Owner shall obtain the necessary permits or agreements to enter said rights-of-way, and the Contractor shall be responsible for any and all expenses to protect the highway, utility, land, and other appurtenances within the rights-of-way involved. The Contractor shall secure any additional information as may be necessary to meet the conditions of the permit or agreement and shall perform the work accordingly.
 3. Where open cut or installation without casing is permissible in a crossing instead of jacking and boring, the Contractor shall make the necessary provisions for handling traffic or maintaining service as required.
 4. The steel pipe sleeve material and installation shall be in accordance with Section 02445 - Steel Pipe and Sleeves.
- D. Connection to Existing Mains:
1. Where connections are required between new work and existing water mains, the connections shall be made in a thorough and workmanlike manner, using proper specials and fittings to suit the actual conditions.
 2. In case a connection is made to an existing fitting in the line, the Contractor shall schedule his work so that digging and locating the existing fittings can be completed prior to starting trench work on the line. Cut-ins into lines shall be done at a time approved by the Owner's representative. The Contractor shall verify the dimensions of all pipe before ordering special fittings and couplings.
- E. Harnessing:
1. Where harnessing is shown on the drawings or approved by the Engineer, all harnessing rods, clamps, bolts, and nuts shall be coated after assembly. The coating shall be a coal tar or asphalt base bituminous coating approved by the Engineer and applied to at least a 4-mil dry thickness.

F. Pits, chambers or manholes containing valves, blow-offs, meters, air relief valves, or other such appurtenances shall not be connected directly to any storm drain or sanitary sewer.

G. Contaminated Areas

1. Waterlines shall not be located in areas of known contamination.

3.5 PRESSURE TESTING OF SYSTEM

A. Pressure test piping systems in accordance with Section 01669 – Testing Piping Systems.

3.6 DISINFECTION AND TESTS

A. Conduct disinfection procedures in accordance with Section 01656 – Disinfection of Potable Water Mains.

3.7 CROSS CONNECTION CONTROL

A. There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the water system.

B. No bypasses shall be allowed, unless the bypass is equipped with an equal, approved backflow prevention device.

C. High hazard category cross connections shall require an air gap separation or an approved reduced pressure backflow preventer.

D. Reduced pressure principle backflow prevention assemblies shall not be installed in any area or location subject to possible flooding. This includes pits or vaults which are not provided with a gravity drain to the ground's surface that is capable of exceeding the discharge rate of the relief valve. If the device is installed in a pit the drain shall be a minimum of two times the size of the line entering the backflow prevention device. The drain shall not discharge into any ditch, storm drain which could flood water back into the pit.

E. All inlet piping to the backflow prevention device shall be approved for potable water service, and must be AWWA or NSF approved.

F. Fire line sprinkler systems and dedicated fire lines, except those in high hazard category, shall be protected by an approved double check valve assembly.

END OF SECTION

SECTION 02502

VALVES AND ACCESSORIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of valves to be used is shown on the drawings, in schedules, and specified.
- B. Related Work Specified Elsewhere:
 - 1. Section 01656 - Disinfection of Potable Water Mains
 - 2. Section 02501 - Pressure Piping - General
- C. Valves wrenches, extensions, handles, operators, and handwheels shall be provided for each valve. The Contractor shall provide one T-handle valve wrench for all below grade valves with square operating nut.

1.2 SUBMITTALS

- A. Submit shop drawings or manufacturer's product data on all items in Part 2.
- B. Submit copies of report on hydrostatic and leakage tests conducted in accordance with AWWA C504, Section 12, to the Engineer for Butterfly Valves.
- C. Submit sworn affidavit from the manufacturer that all valves comply with all applicable provisions of ANSI/AWWA standards.

PART 2 - PRODUCTS

2.1 GATE VALVES

- A. Manufacturers:
 - 1. Mueller (A-2360 or A-2361)
 - 2. American Flow Control (Series 2500)
- B. Gate valves shall be used for all sizes 2 inches through 14 inches. Gate valves shall be cast iron bodied, bronze mounted, resilient wedge, O-ring type with non-rising stem and opening counterclockwise. Valves from 2 to 12 inches shall be manufactured in accordance with AWWA C509, latest revision, for resilient-seated gate valves and designed for 250 psi working pressure. Valves from 14 to 24 inches shall be manufactured in accordance with AWWA C515, latest revision, for resilient-seated gate valves and designed for 250 psi working pressure. Valves for buried service shall have mechanical joint ends in accordance with AWWA C111 and operating nut in accordance with AWWA C500. Two socket valve wrenches shall be provided with extensions as required. Valves for above ground shall be American Standard Flanged, with wheel operator.

2.2 AIR RELEASE/VACUUM VALVES

- A. Air release valves shall be provided in accordance with AWWA C512 and sound engineering practice at the high points along the pipeline where shown on the drawings. Valves shall be standard series combination air release valves as manufactured by APCO Valve and Primer Corporation, Crispin, Valmatic, or equal.
- B. Air valve shall be installed as shown on the drawings.
- C. Air valve shall be fitted with a vent pipe installed with appropriate pipe couplings for easy removal of the air valve and/or concrete box. Welded carbon steel vent pipe shall be installed through concrete box at a positive grade to the concrete valve marker. Vent pipe riser with U-shaped fitting shall be secured to concrete marker. Opening to be protected with stainless steel insert screen.
- D. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur. A manual air valve must be used in these situations.

2.3 BUTTERFLY VALVES

- A. Butterfly valves shall be used for all sizes 16 inches and larger. Butterfly valves shall conform to AWWA C504. Laying length of all classes shall be Table 2, short body. Butterfly valves 16 inches and greater shall be rated at 150 psig working pressure. Valves shall be bubble tight at rated pressure and shall be satisfactory for applications involving valve operation after long periods of inactivity. Valves shall have mechanical joint ends for buried service and flanged joints in the vaults and above grade.
- B. Valve body shall be ductile or cast iron per ASTM A 126, Class B, or ASTM A 48, Class 40, with integrally cast hubs for shaft bearing housing.
- C. The valve disc shall be of heat treated ductile iron, cast iron or of alloy cast iron per ASTM A 436, latest revision, Type I, Class I. The disc shall rotate 90° from full open to tight shut position.
- D. Valve shaft shall be of solid one-piece design or stub shaft. Shaft, taper pins, lockwashers and nuts shall be Type 304 stainless steel. A shaft seal and bronze gland follower, studs and nuts shall be provided in the valve body. Shaft seals shall be in accordance with Section 10 of AWWA C504.
- E. Valve seat shall be of molded natural or synthetic rubber, recess mounted, bonded and/or mechanically secured to the valve body or disc. Valves may be furnished with rubber seats clamped securely to the cast iron discs and mating against stainless steel seating surface in the valve body.
- F. Valves shall be fitted with sleeve type bearings of self-lubricating corrosion resistant material.

2.4 VALVE BOXES

- A. Valve boxes shall be an Opelika No. 107 Box provided for all buried valves. Valve boxes shall consist of cast iron base and adjustable top section with cover that shall be marked "Water." Extensions shall be provided as required to meet grade.

2.5 TAPPING SLEEVES

A. Manufacturers:

1. Mueller (H-304 and H-615)
2. Smith-Blair (622 and 662 Series)
3. Romac (FTS420 and SST-III)

- B. Tapping sleeves and valves shall be used to make "wet" taps into the existing water mains where shown on the drawings. Tapping sleeves 4 inches and larger shall be fabricated of carbon steel or stainless steel bodies, with Type 304 stainless steel bolts and nuts. Carbon steel-bodied sleeves will be furnished with a fusion-bonded epoxy coating, with an average thickness of 12 mils. Tapping sleeve shall have outlet flange counter bored to accept a mating tapping valve per MSS SP-60 for true alignment of tapping valve and tapping machine. Contractor shall verify type of existing main before ordering sleeve. The Engineer may deem it necessary to use a more substantial tapping sleeve of cast iron construction with MJ ends. The tapping valve shall have an inlet flange to match the sleeve and a mechanical joint outlet for connection to water main pipe. Tapping valve and tapping sleeve shall be rated for a minimum 150 psi working pressure, open counterclockwise with nonrising stem and have BUNA-N O-rings. Provide valve with box. Tapping sleeve and valve assembly shall be air tested at the rated pressure after installation and prior to tapping.

2.6 TAPPING SADDLES

- A. Tapping saddles shall be used to make "wet" taps into the existing water mains where shown on the drawings. Tapping saddle bodies shall be made of malleable iron conforming to ASTM A 47 Grade 32510, or ductile iron conforming to ASTM A 536. Straps shall be made of carbon steel conforming to ASTM A 307, electro-galvanized with Di-Chromate Seal. Nuts shall be cold formed, semi-finished, heavy hex steel electro-galvanized with Di-Chromate Seal. Gaskets shall be made of synthetic rubber and shall be suitable for service at maximum operating temperature of piping system, and as specified in individual piping specification sections.
- B. Tapping saddles shall be Rockwell 313 double strap iron service saddles or equal.

2.7 PRESSURE GAUGES

- A. Gauges shall be furnished as shown on the drawings. Gauges shall be bourdon tube type, with bronze movement, plexiglass covers and shall be 4-1/2 inches in diameter with not less than 90 percent glycerin filled cast phenolic cases. Each gauge shall have a range such that the normal operating pressure shall be approximately at half the range. The gauges shall be provided with diaphragm protectors and 1/4-inch NPT liquid flushing connection with brass lever handle blow-off petcock. The diaphragm and surfaces exposed to the liquid shall be of stainless steel. Gauges shall be calibrated in pounds per square inch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Valves, gates and accessories shall be installed as shown on the drawings and in accordance with applicable paragraphs of Section 02501 - Pressure Piping - General and individual piping specification sections.
- B. Valves, gates and accessories shall be installed plumb and true in a first class manner, consistent with the manufacturer's recommendations.
- C. Valves, gates and accessories shall be installed with care to prevent undue strain upon the valve, operators, or other associated pieces of equipment.

3.2 SETTING VALVES AND BOXES

- A. Valves and valve boxes as specified in the preceding paragraphs shall be installed where shown on the drawings unless otherwise directed. Valves shall be set plumb with the base of the valve box centered over the valve and resting on compacted backfill. The top section of the box shall be set to allow equal movement above and below finished grade. After being correctly positioned, fill shall be carefully tamped around the valve box for a distance of 4 feet on all sides of the box. In paved areas, top of the cover shall be flush with the finished paving. In off-street areas, the cover shall be set 1 inch above existing grade unless otherwise directed by the Engineer and a 4 inch thick precast concrete collar shall be placed around the top of the box as shown in the typical details.

END OF SECTION

SECTION 02515

DUCTILE IRON PIPE (DIP)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the ductile iron pipe (DIP) is shown on the drawings. Unless otherwise directed by the Engineer, all pipe 6 inches and larger in diameter shall be DIP. Pipe diameters less than 6 inches may be DIP as directed by the Engineer.
- B. Related Work Specified Elsewhere:
 - 1. Section 01656 – Disinfection of Potable Water Mains.
 - 2. Section 01669 – Testing Piping Systems.
 - 3. Section 02320 – Trenching, Backfilling and Compacting.
 - 4. Section 02501 – Pressure Piping – General.
 - 5. Section 02502 – Valves and Accessories.

1.2 SUBMITTALS

- A. Three certified copies of the tests made by the manufacturer or by a reliable commercial laboratory shall be submitted to the Engineer with each shipment of pipe. The manufacturer shall also submit a sworn affidavit that the pipe fittings and lining furnished comply with all applicable provisions of ANSI/AWWA standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. American Cast Iron Pipe Company.
- B. Griffin Pipe.
- C. U.S. Pipe.

2.2 PIPE AND FITTINGS

- A. Pipe:

1. Ductile iron pipe shall be designed in accordance with ANSI A21.50/AWWA C150, latest revision and manufactured in accordance with ANSI A21.51/AWWA C151, latest revision. Pipe with diameters 4 inches through 12 inches shall conform to pressure class 350; diameters 14 inches through 20 inches shall conform to pressure class 250; diameters 24 inches shall conform to pressure class 200; and diameters 30 inches shall conform to pressure class 150 unless otherwise noted on the Drawings. Earth loads to be taken from the standard tables in the manual based on a minimum 150 psi working pressure, trench condition 2, width $d + 2$ feet and minimum depth of cover over pipe of 36 inches.

B. Pipe Joints

1. Push-on joints for ductile iron pipe shall conform to ANSI A21.11/AWWA C111, latest revision.
2. Joint lubrication shall be as furnished by the manufacturer, and shall meet the requirements of NSF-61.
3. Flanged joints shall conform to ANSI A21.11/AWWA C115. Bolts and nuts shall conform to ANSI 21.10/AWWA C111, latest version.
4. Restrained joints shall be made using American Fast-Grip® Gaskets, Flex-Ring®, Field Flex-Ring®, Lok-Ring®, or approved equal. The restraint provided shall be a boltless, integral restraining system and shall be rated for 150 psi in accordance with the performance requirements of ANSI/AWWA C111/A21.11, unless noted otherwise on the Drawings.
5. Pipe ends (spigot end, bell, and socket) for all pipe shall be gauged with suitable gauges at sufficiently frequent intervals to ensure compliance to the standard dimensions of ANSI/AWWA C151/A1.5, latest addition. Manufacturer must have a recommended ovality tolerance for 18 inches and larger size pipe. Each end of each pipe 18 inches and larger shall be measured and approved by manufacturer's quality assurance inspector to meet such out of round tolerances. Manufacturer shall certify that ovality has been measured and controlled in accordance with manufacturer's standard.

C. Fittings

1. Belowground fittings for ductile iron pipe shall be mechanical joint type, manufactured of ductile iron and shall conform to the requirements of ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 latest revision. Fittings shall be compatible with the pipe and shall conform to the pressure classification at least equal to that pipe with which they are used, unless noted otherwise on the Drawings. The lining and coating of the fittings shall be as specified for the pipe.
2. Mechanical joint fittings through 16 inches in diameter shall be restrained using thrust blocks, or EBAA Iron, Inc., Megalug. Twist-off nuts shall be used to insure proper actuation of mechanical joint restraining devices.
3. Mechanical joint fittings larger than 16 inches shall be restrained using EBAA Iron, Inc., Megalug. Twist-off nuts shall be used to insure proper actuation of mechanical joint restraining devices.
4. Aboveground fittings for ductile iron pipe shall be flanged, manufactured of ductile iron and shall conform to the requirements of ANSI/AWWA C110/A21.10 latest revision. Fittings shall be compatible with the pipe and designed for 150 psi working pressure. The lining and coating of the fittings shall be as specified for the pipe.

5. Flanged fittings shall conform to ANSI/AWWA C110. Flanged fittings shall be faced and drilled to match AWWA C115 threaded on flanges which also match ANSI B16.1 class 125 flanges except where class 250 are specifically noted.

D. Lining:

1. The interior of ductile iron pipe and fittings shall have cement lining and seal coat in accordance with ANSI A21.4, latest revision (AWWA C104).

E. Exterior Finish:

1. For underground installation, pipe and fittings shall have the standard bituminous coat or epoxy coating conforming to the requirements of ANSI/AWWA C550 and C116/A21.116 on the exterior with a 6-8 mil nominal thickness fusion bonded.

2.3 GASKETS:

- A. Gaskets shall be made of synthetic rubber type and shall be suitable for service at maximum operating temperature of piping system as specified in piping system specification section. Natural rubber, or other material which will support microbiological growth, may not be used for any gaskets, O-rings, and other products used for jointing pipes, setting meters or valves, or other appurtenances which will expose the material to the water.

2.4 JOINT LUBRICANTS

- A. Joint lubrication shall be as furnished by the manufacturer of the pipe and shall meet the requirements of NSF 61.
- B. Lubricants which support microbiological growth, including vegetable shortening, shall not be used for pipe joints.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with AWWA C600, Section 02501 - Pressure Piping – General, and manufacturer's recommendations.
- B. Field cutting of pipe shall be accomplished per manufacturer's written recommendations. Pipe cuts for push joints shall be beveled per manufacturer's written recommendation. Use of chop saws will not be allowed for cutting pipe.

END OF SECTION

SECTION 02620

POLYVINYL CHLORIDE (PVC) PIPE

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. This Section covers PVC pipe for underground waterlines only. The PVC pipe specified in this Section shall not be used above grade. The extent of PVC pipe is shown on the drawings. Unless otherwise directed by the Engineer, all water mains 2 inches and 3 inches shall be PVC pipe. Pipe diameters of 4 inches may be PVC as directed by the Engineer.
- B. Related Work Specified Elsewhere:
 - 1. Section 01656 - Disinfection of Potable Water Mains
 - 2. Section 01669 - Testing Piping Systems
 - 3. Section 02320 - Trenching, Backfilling and Compacting
 - 4. Section 02501 - Pressure Piping - General

1.2 SUBMITTALS

- A. Submit three certified copies of all required test reports to the Engineer with each shipment of pipe. These shall include:
 - 1. Quick Burst Test, ASTM D 1599
 - 2. Drop Impact Test, ASTM D 2444
- B. Results of the pressure and leakage test specified in Section 01669 - Testing Piping Systems.
- C. Results of the bacteriological test specified in Section 01656 - Disinfection of Potable Water Mains.

1.3 DELIVERY AND STORAGE

- A. In storing pipe, units shall be protected by dunnage in the same way they were protected while loaded on the truck. Pipe shall be strung out or stored flat to protect against bending.

PART 2 - PRODUCTS

2.1 PVC PIPE (4 inches)

- A. PVC pipe shall be SDR-21, Class 200 and meet the requirements of ASTM D 2241, latest revision, ASTM D 1784, latest revision, having elastomeric gasket bell ends and

elastomeric seals meeting the requirements of ASTM D 2672, ASTM D 3139, and ASTM F 477 latest revisions. Pipe shall be furnished in standard 20 foot lengths. Pipe shall bear the National Sanitation Foundation seal for potable water pipe and shall be marked with SDR and Class Number.

- B. The joints for PVC water pipe shall be rubber ring type consisting of integral, thickened, solid wall bells which maintain the same D.R. as the pipe barrel. Joints shall be made in accordance with the manufacturer's instructions and recommendations.
- C. Where necessary, adaptor fittings shall be furnished and installed where plastic pipe is connected to pipes or fittings of other materials.
- D. In storing pipe, units shall be protected by dunnage in the same way they were protected while loaded on the truck. If pipe is to be stored outside longer than 15 days the pipe shall be covered with canvas or other opaque material to protect it from prolonged exposure to the sun.
- E. Fittings and Specials:
 - 1. Fittings and specials shall be ductile iron short body fittings conforming to the requirements of ANSI Standard A21.10, latest revision.
 - 2. Joints for ductile iron fittings shall be mechanical or push-on type designed in accordance with ANSI Standard A21.11, latest revision. Bolts and nuts shall be ductile iron conforming to ANSI Standard A21.11. Fittings shall be cement mortar lined and bituminous coated in accord with ANSI Standard A21.4, latest revision.

2.2 PVC PIPE (1-1/2 inches through 3 inches)

- A. PVC pipe shall be SDR-21, Class 200 and meet the requirements of ASTM D 2241, latest revision, ASTM D 1784, having elastomeric gasket bell ends and elastomeric seals meeting the requirements of ASTM D 2672, ASTM D 3139, and ASTM F 477.
 - 1. Pipe shall bear the National Sanitation Foundation seal for potable water pipe and marked with SDR and class number.
- B. The joints for PVC water pipe shall be rubber ring type consisting of integral, thickened, solid wall bells which maintain the same D.R. as the pipe barrel. Joint lubrication shall be as furnished by the manufacturer of the pipe and shall meet the requirements of NSF 61. Joints shall be made in accordance with the manufacture's instructions and recommendations.
- C. Fittings:
 - 1. Fittings shall be Class 200 and conform to requirements of DR 21. Fittings shall be manufactured in one piece of injection molded PVC meeting the requirements of ASTM D1784.
- D. Joints for fittings shall be rubber ring type consisting of integral, thickened, solid wall bells, which maintain the same D.R. as the pipe barrel. Joint lubrication shall be as furnished by the manufacturer of the pipe and shall meet the requirements of NSF 61.

Joints shall be made in accordance with the manufacture's instructions and recommendations.

2.3 PVC PIPE (Smaller than 1-1/2 inches)

- A. PVC pipe shall be Schedule 40 and meet the requirements of ASTM D 1785, latest revision.
 - 1. Pipe shall bear the National Sanitation Foundation seal for potable water pipe and marked with SDR and class number.
- B. The fittings for Schedule 40 PVC pipe shall meet the requirements of ASTM D 2466, latest revision, with ASTM D 2564, latest revision, solvent cement.

2.4 GASKETS

- A. Gaskets shall be made of synthetic rubber and shall be suitable for service at maximum operating temperature of piping system as specified in piping system specification section. Natural rubber, or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, setting meters or valves, or other appurtenances which will expose the material to the water.

2.5 JOINT LUBRICANTS

- A. Joint lubrication shall be as furnished by the manufacturer of the pipe and shall meet the requirements of NSF 61.
- B. Lubricants which support microbiological growth shall not be used for slip-on joints.
- C. The use of vegetable shortening is prohibited.

2.6 JOINT RESTRAINT

- A. Water lines 2.5 inches and larger shall be thrust blocked to prevent movement of lines under pressure. Concrete thrust blocks shall be furnished by the Contractor. Concrete shall be a minimum of 2,500 psi. Thrust or anchor blocks shall be installed at all bends, tees, crosses, wyes, plugs, and reducers as shown in details of typical thrust and anchor block placements on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with AWWA C605, Section 02501 - Pressure Piping - General, and manufacturer's recommendations.

- B. Tracer wire shall be installed within six (6) inches of the pipe, in a continuous fashion. The tracer wire shall be solid strand 14 gauge copper wire with insulation rated for underground service. The excess wire shall be brought to the surface in valve boxes and meter boxes to facilitate the location of the mains. Underground splice connections shall be minimized and shall be rated for buried service.
- C. PVC pipe shall not be used above grade.
- D. The use of solvent-weld PVC pipe and fittings in waterlines 1-1/2 inches and larger is prohibited.

END OF SECTION

SECTION 02623

COPPER PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of the copper piping is as shown on the drawings and as specified by the Engineer. Pipe 3 inches and smaller in diameter may be copper piping.
- B. Related Work Specified Elsewhere:
 - 1. Section 01656 - Disinfection of Potable Water Mains.
 - 2. Section 01669 - Testing Piping Systems
 - 3. Section 02501 - Pressure Piping - General.
 - 4. Section 02502 - Valves and Accessories.

1.2 SUBMITTALS

- A. Three certified copies of the tests made by the manufacturer or by a reliable commercial laboratory shall be submitted to the Engineer with each shipment of pipe. The manufacturer shall also submit a sworn affidavit that the pipe fittings and lining furnished comply with all applicable provisions of ANSI/AWWA standards.

PART 2 - PRODUCTS

2.1 COPPER PIPE OR TUBE

- A. Seamless copper pipe, designed for underground services, shall conform to the requirements of ASTM B 88, latest revision. Underground and concealed pipe shall be Type K. Pipe in exposed areas, unless otherwise specified, shall be Type L.
- B. Instrument tubing shall be Type L, hard-drawn, copper tubing conforming to Federal Specification WW-T-799F, Tube, Copper, Seamless, Water and Refrigeration (for use with solder-, flared-, or compression-type fittings).
- C. Compression fittings shall be used on soft pipe and sweat fittings shall be used on hard pipe. All fittings shall be solid cast brass or wrought copper. Solder used for sweat fittings shall be "lead free", containing less than 0.2 percent in the solder and flux. Soldering flux where used shall be non-corrosive type.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Installation shall be in accordance with Section 02501 - Pressure Piping - General and manufacturer's recommendations.

3.2 INSTALLATION – INSTRUMENT TUBING

- A. Vertical or horizontal runs in close proximity shall be bundled in an acceptable manner. Concealed runs shall be continuous and without joints. Installation of tubing to instruments shall be in accordance with the manufacturer's recommendation.

- B. Copper tubing shall be mounted to surfaces by means of copper or cadmium plated tubing racks securely mounted to the surface. Tubing entering and leaving concealed areas shall be identified by function in accordance with the identification number given in the instrument schedule. Identification tags shall be copper and secured to the tubing with copper sealing wires.

END OF SECTION

SECTION 02661

FIRE HYDRANT ASSEMBLIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. The extent of fire hydrant assemblies is shown on the drawings and specified. A fire hydrant assembly shall consist of fire hydrant, the pipe connecting the hydrant to the gate valve, the gate valve and box between the hydrant and the water main hydrant tee, accessories, and gravel.
- B. Related Work Specified Elsewhere:
 - 1. Section 02501 - Pressure Piping - General
 - 2. Section 02502 - Valves and Accessories

1.2 SUBMITTALS

- A. Submit manufacturer's literature marked to show compliance with specifications

PART 2 - PRODUCTS

2.1 FIRE HYDRANT

- A. Manufacturers:
 - 1. Mueller (A-421 Super Centurion 250)
 - 2. American Flow Control (Mark 73-2)
- B. Fire hydrant shall be of the dry barrel breakaway traffic type construction with a 6 inch pipe connection, 4½ inch main valve opening, two 2½ inch nozzle and one 4½ inch pumper nozzle connections. Hydrant shall be designed for 250 pounds working pressure and shall conform to AWWA Specification C502, latest revision. All working parts shall be bronze. All hose threads shall be National Standard threads. The Contractor shall verify that connections are as typically found in the system and are compatible with equipment of the local fire department. Design, material and workmanship shall be of the latest stock pattern ordinarily produced by the manufacturer. Hydrant shall be painted in accordance with the specifications of the City Fire Department.
- C. Fire hydrant shall be provided with a lubricant sealed bonnet assembly to assure lubrication of operating parts and to seal operating thread from water when the hydrant is opened.

2.2 FIRE HYDRANT CONNECTOR PIPE

- A. The connector pipe shall be ductile iron pipe positioned between the fire hydrant and gate valve.
- B. The connector pipe may be of the offset design so that the fire hydrant can be adjusted to ensure placement at the proper grade, with an anchoring feature at both ends so that when used with M.J. split glands, a restrained joint is provided, such as the Gradelock, manufactured by Assured Flow Sales, Inc.
- C. The connector pipe may be plain end ductile iron pipe with restrained joints provided by tie rods or by Megalug, manufactured by EBBA Iron, Inc.

2.3 WATER MAIN HYDRANT TEE

- A. The water main hydrant tee shall provide a 6 inch tee outlet to the hydrant.
- B. The 6 inch leg of the tee shall have an anchoring feature so that when used with an M.J. split gland, a restrained joint is provide between the tee and the gate valve

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Section 02501 - Pressure Piping - General, Part 3 for installation.

3.2 SETTING VALVES AND BOXES

- A. See Section 02502 - Valves and Accessories, Part 3 for setting valves and boxes

3.3 SETTING HYDRANTS

- A. Fire hydrant shall be connected to the mains with a mechanical joint hydrant tee, ductile iron connector pipe, and a gate valve, all part of the assembly. After connections are made, the hydrant bury shall be at such elevation that the "bury line" on the hydrant is at finished grade. The fire hydrant shall be backfilled with gravel as shown on the drawings and in such a manner as to insure complete drainage of the hydrant when closed. All backfill around the hydrant shall be thoroughly compacted to the surface of the ground. Before installing any hydrant or valve, care shall be taken to see that all foreign material is removed from the interior of the barrel. Stuffing boxes shall be tightened and the hydrant or valve opened and closed to see that all parts are in working condition.
- B. Where hydrants are being connected to an existing water main, Contractor shall check depth of bury and order barrel and shaft extensions as required for the measured bury.

END OF SECTION

SECTION 02743

ASPHALTIC CONCRETE PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Asphaltic concrete paving and patching, wearing binder or base course.
- B. Surface sealer.
- C. Aggregate base course.

1.2 RELATED SECTIONS

- A. Section 02320 - Trenching, Backfilling and Compacting.

1.3 REFERENCES

- A. ASTM D946 - Penetration-Graded Asphalt Cement for Use in Payment Construction.
- B. TAI - (The Asphalt Institute) - MS-2 Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.
- C. TAI - (The Asphalt Institute) - MS-3 Asphalt Plant Manual.
- D. TAI - (The Asphalt Institute) - MS-8 Asphalt Plant Manual.
- E. TAI - (The Asphalt Institute) - MS-19 Basic Asphalt Emulsion Manual.
- F. SCDOT - Standard Specifications For Highway Construction - 1986 Edition; Section 400 - Bituminous Pavements.

1.4 PERFORMANCE REQUIREMENTS

- A. Standard Paving: Designed for parking and light traffic.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with State of South Carolina Department of Transportation standard.
- B. Mixing Plant: Conform to State of South Carolina Department of Transportation standard.
- C. Obtain materials from same source throughout.

1.6 REGULATORY REQUIREMENTS

- A. Conform to applicable code for paving work on public property.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Apply prime and tack coats only when ambient temperature is above 50 degrees F, and when temperature has not been below 35 degrees F for 12 hours immediately prior to application. Do not apply when base is wet or contains excess moisture.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphalt Cement: In accordance with State of South Carolina Department of Transportation standards.
- B. Aggregate for Base Course Mix: Macadam Base Course or Stabilized Aggregate Base Course in accordance with South Carolina Department of Transportation standards.
- C. Aggregate for Binder Course Mix: In accordance with State of South Carolina Department of Transportation standards.
- D. Aggregate for Wearing Course Mix: In accordance with State of South Carolina Department of Transportation standards.
- E. Fine Aggregate: In accordance with State of South Carolina Department of Transportation standards.
- F. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- G. Primer: Homogeneous, medium curing, liquid asphalt. In accordance with State of South Carolina Department of Transportation standards.
- H. Tack Coat: Homogeneous, medium curing, liquid asphalt. In accordance with State of South Carolina Department of Transportation standards.

2.2 ASPHALT PAVING MIX

- A. Use dry material to avoid foaming. Mix uniformly.
- B. Wearing Course: 4.8 - 6.8 percent of asphalt cement by weight in mixture in accordance with State of South Carolina Department of Transportation standards.

2.3 SOURCE QUALITY CONTROL AND TESTS

- A. Submit proposed mix design for review prior to beginning of work.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that compacted granular base is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.2 SUBBASE

- A. Section 02320 - Trenching, Backfilling and Compacting form the base construction for work of this section.

3.3 PREPARATION - PRIMER

- A. Apply primer on aggregate base or subbase at uniform rate of 1/3 gal/sq yd.
- B. Apply primer to contact surfaces of curbs, gutters, and existing pavement.
- C. Use clean sand to blot excess primer.

3.4 PREPARATION - TACK COAT

- A. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/2 gal/sq yd.
- B. Apply tack coat to contact surfaces of curbs, gutters and existing pavement.
- C. Coat surfaces of catch basin frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.5 PLACING ASPHALT PAVEMENT

- A. Install Work in accordance with State of South Carolina Department of Transportation standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Install catch basin frames in correct position and elevation.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.6 TOLERANCES

- A. Thickness of all courses shall comply with those shown on the drawings.
- B. Flatness: Maximum variation of 1/8-inch measured with 10-foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4-inch.
- D. Variation from True Elevation: Within 1/4-inch.

3.7 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 3 days or until surface temperature is less than 140 degrees F.

END OF SECTION

SECTION 02920

GRASSING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes furnishing labor, material and equipment to establish grass as shown on the drawings and in all those areas where construction has damaged or destroyed the ground cover.
- B. Related Sections include the following:
 - 1. Section 02320 - Trenching, Backfilling and Compacting

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
- C. Planting Schedule: Indicating anticipated planting dates for each type of planting.

- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required maintenance periods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.6 MAINTENANCE

- A. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: **60** days from date of Substantial Completion.
 - a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.

PART 2 - PRODUCTS

2.1 SEED MIXTURE

- A. Seed Mixture:

<u>Schedule No.</u>	<u>Common Name of Seed</u>	<u>Lbs./1000 sq. ft.</u>	<u>Planting Dates</u>
1	Bermuda Common (hulled)	0.5	March 15 - August 14
	Kentucky 31 Fescue	0.75	
	Pensacola Bahia	0.5	
	Brown Top Millet	0.5	
	Lime	50	
	Fertilizer	20	
	Mulch	90	
2	Kentucky 31 Fescue	1.15	August 15 - March 14
	Bermuda Common (unhulled)	0.5	
	Pensacola Bahia	0.75	
	Annual Ryegrass	0.2	
	Rye Grain	0.5	
	Lime	50	
	Fertilizer	20	
Mulch	90		

2.2 SOIL MATERIALS

A. Topsoil:

1. Excavated and reused topsoil material generally occurring from the top of the ground to a depth of 6 – 18 inches.
2. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.

2.3 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic; free of plant-growth or germination inhibitors; with maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- D. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.4 LIME

- A. Lime shall be agricultural grade, ground limestone conforming to the requirements of the South Carolina Department of Agriculture.

2.5 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches long.
- B. Erosion-Control Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, a minimum of 0.92 pounds per square yard, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches long.

2.6 ACCESSORIES

- A. Fertilizer: FS O-F-241: Recommended for grass, with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil to the following proportions: Nitrogen 15 percent, phosphoric acid 10 percent, soluble potash 10 percent.
- B. Water: Clean, fresh and free of substances or matter, which could inhibit vigorous growth of grass.

- C. Herbicide: Pre-Immergent.
- D. Stakes: Softwood lumber, chisel pointed.
- E. String: Inorganic fiber.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches. Remove stones larger than 1 inch in dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- B. Fertilizing:
 - 1. Apply lime uniformly at a rate of 50 pounds per 1000 square feet.
 - 2. Apply fertilizer in accordance with manufacturer's instructions at a rate of 20 pounds per 1000 square feet.
 - 3. Apply after smooth raking of topsoil and prior to roller compaction.
 - 4. Do not apply fertilizer at the same time or with the same machine as will be used to apply seed. Mix thoroughly into upper 2 inches of topsoil.
- C. Finish Grading: After fertilizing, grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus ½ inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- D. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Restore areas if eroded or otherwise disturbed after finish grading and before planting.

3.3 SEEDING

- A. Apply seed at a rate consistent with Schedule 1 or 2, paragraph 2.1.A, evenly in two intersecting directions. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Planting Season: March 15 to August 14, Schedule 1; August 15 to March 14, Schedule 2.

- D. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- E. Roll seeded area with roller not exceeding 112 pounds.
- F. Immediately following seeding and compacting, apply mulch to a thickness of 1-1/2 inches. Maintain clear of shrubs and trees. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into topsoil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at the rate of 10 to 13 gallons per 1000 square feet. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.4 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with non-asphaltic tackifier.
 - 2. Apply slurry uniformly to all area to be seeded in a two-step process. Apply first slurry application at a minimum rate of 12 pounds per 1000 square feet dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 25 pounds per 1000 square feet.

3.5 SEED PROTECTION

- A. Identify seeded areas with stakes and string around area periphery. Set string height to 6 inches. Space stakes at 48 inches.
- B. Cover seeded slopes where grade is greater than 1:3 with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 12-inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- D. Secure outside edges and overlaps at 36-inch intervals with stakes.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.

3.6 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by lawn work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

- B. Erect barricades and warning signs as required to protect newly planted areas from traffic. Maintain barricades throughout maintenance period and remove after lawn is established.
- C. Remove erosion-control measures after grass establishment period.
- D. The Contractor shall, at his expense, maintain the planted areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include watering, filling, leveling, and repairing of any washed or eroded areas necessary to maintain and protect grades as established.
- E. The Contractor shall be responsible for permanently establishing grass cover over the entire site and shall take suitable measures as are necessary to maintain and protect grades as established.
- F. Final acceptance of the work shall be when the permanent stand of grass is established and erosion/washing is completely checked, to the satisfaction of the Engineer.

3.7 MAINTENANCE

- A. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which show bare spots.
- H. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Steel reinforcing bars, welded wire fabric and accessories for cast-in-place concrete.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-in-Place Concrete.
- B. Section 03470 - Precast Concrete Structures.

1.3 REFERENCES

- A. ACI 301 - Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements For Reinforced Concrete.
- C. ACI SP-66 - American Concrete Institute - Detailing Manual.
- D. ASTM A 82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- E. ASTM A 185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- F. ASTM A 615 - Deformed and Plain Billet Steel Bars for Concrete Reinforcement.
- G. AWS D1.4 - Structural Welding Code for Reinforcing Steel.
- H. AWS D12.1 - Welding Reinforcement Steel, Metal Inserts and Connections in Reinforced Concrete Construction.
- I. CRSI - Concrete Reinforcing Steel Institute - Manual of Practice.
- J. CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
- K. CRSI 65 - Recommended Practice For Placing Bar Supports, Specifications and Nomenclature.

1.4 SUBMITTALS FOR REVIEW

- A. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing bars and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with CRSI 63, 65 and Manual of Practice.
- B. Welders' Certificates: Submit under provisions of Section 01400 Manufacturer's Certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

- A. Steel Reinforcing Bars: ASTM A 615, 60 yield grade; deformed billet steel bars, unfinished finish.
- B. Steel Welded Wire Fabric: ASTM A 185 Plain Type in flat sheets, unfinished. Unless otherwise noted on drawings, welded wire fabric shall be 6x6-W2.9xW2.9.

2.2 ACCESSORIES

- A. Tie Wire: Minimum 16 gauge annealed type.
- 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 barrier puncture.
- C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Plastic coated steel type; size and shape as required.

2.3 FABRICATION

- A. Fabricate concrete reinforcing in accordance with ACI 318 and CRSI Manual of Practice.
- B. Locate reinforcing splices not indicated on drawings, at point of minimum stress. Review location of splices with Engineer.

PART 3 - EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.

- D. Conform to applicable code for concrete cover over reinforcement.
- E. Reinforcement shall be continuous through construction joints. Reinforcement may be spliced at construction joints provided entire splice is located within one pour.
- F. Reinforcing bars partially embedded in concrete shall not be field bent.
- G. Tack welding of reinforcing bars is prohibited.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide and install the cast-in-place concrete as shown on the drawings and as specified herein.
- B. The work consists of furnishing all plant, labor, equipment and materials for constructing concrete and reinforced concrete as shown on the drawings or as normally required in construction by standard practice of the trade.
- C. All materials shall be as specified, new and of current production.

1.2 QUALITY ASSURANCE

- A. Allowable tolerances for flatwork shall be true to the drawings $\pm 1/8$ inch in 10 feet.
- B. Work shall conform to all applicable standards of the American Concrete Institute and the Concrete Reinforcing Steel Institute with particular reference to ACI 301, ACI 318, and the CRSI Manual of Standard Practice.

1.3 SUBMITTALS

- A. Prior to the commencement of work, the Contractor shall provide the design of the concrete mixes intended for this work for the Engineer's approval. The design shall indicate the proportions of all the materials in the mix by weight; except that the aggregates shall be indicated by weights and also by dry compacted volumes.
- B. The water/cement ratio shall be indicated in gallons of water per sack of cement. Mix design shall be made by an approved testing laboratory subject to the requirements of this specification.
- C. The Owner shall employ a reliable testing laboratory to make and test three cylinders of the design concrete mixes. The cylinders shall be made, cured and tested in accordance with ASTM C 192. The Engineer shall be provided three copies of the testing laboratory's report for approval.
- D. The source from which concrete aggregates are to be obtained shall be selected by the Contractor well in advance of the time they will be required in the work. Suitable samples, as they are to be used in the concrete shall be furnished in advance of the time when the placing of the concrete is expected to begin. Test samples shall be supplied by the Contractor at his expense, and tests shall be made by an independent testing laboratory in accordance with ASTM Designations and at the Owner's expense.

- E. The Contractor shall provide for test purposes, and not less than once per day, one set of three cylinders taken from each day's pour or each 100 cubic yards placed, whichever is less, or as directed by the Engineer. Test samples shall be supplied by the Contractor at his expense and tests will be made by an independent testing laboratory at the Owner's expense. The standard age of test shall be 28 days but, when approved by the Engineer, 7-day tests may be used provided that the relation between the 7 and 28-day strengths of the concrete is established by test for materials and proportions used. If the test strength of the cylinders falls below the minimum allowable compressive strength, the Engineer shall have the right to order the Contractor to remove and renew that day's pour of concrete or the Contractor shall accept such deductions in the final payment as the Owner may deem reasonable.
- F. Submit shop drawings for reinforcement. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures." Show bar schedules, diagrams of bent bars, stirrup spacing, lateral ties and other arrangements and assemblies as required for fabrication and placement of reinforcement for unit masonry work.
- G. Submit manufacturer's literature for formwork on all concrete specialty items such as waterstops, control joints, expansion joints, keyway forms, splicing materials, etc.

PART 2 - PRODUCTS

2.1 CEMENT

- A. Cement shall conform to the Standard Specifications for Portland Cement, ASTM C 150-81 and shall be Type I or Type II.
- B. Cement for high-early-strength concrete may be used where approved by the Engineer, and shall be Type III conforming to the Standard Specifications for Portland Cement, ASTM C 150.

2.2 AGGREGATES

- A. Course aggregates shall consist of gravel, or crushed gravel, crushed stone, or a combination thereof, conforming to the requirements of ASTM C 33, Standard Specifications for Concrete Aggregates.
- B. Coarse aggregate shall be well-graded from fine to coarse so that concrete of the required workability, density, and strength can be made without the use of an excess amount of sand, water or cement.
- C. The maximum size mesh screen for the aggregate shall not be less than 3/4 inch or more than 1-1/2 inches. Where cover over reinforcing is less than 2 inches, maximum size shall be 3/4 inch.
- D. Within the 3/4 inch to 1-1/2 inch size limits, not less than 94 percent of the material shall be retained on a standard square mesh screen of the minimum size indicated, and not more than 5 percent shall be retained on a standard square mesh screen of the maximum size.

- E. The grading of the coarse aggregate in the mixed concrete shall fall within the following limits:
 - 1. Maximum size mesh screen (square mesh): 97-100 percent.
 - 2. 1/2 maximum size mesh screen (square mesh): 40-70 percent.
 - 3. No. 4 sieve: 0-6 percent.
- F. When warranted by local conditions, the percentage by weight passing the 1/2 maximum size mesh screen (square mesh) may be reduced from 40-70 to 40-60.

2.3 WATER

- A. The water used in mixing concrete shall be potable.

2.4 ADMIXTURES

- A. A water-reducing retarder may be used where approved by the Engineer. This admixture shall be one that acts as a cement-dispersing agent and retards the setting of the concrete in the early stages. Retarder shall conform to ASTM C 494 and shall be added to concrete according to the manufacturer's recommendations.
- B. Air-entraining agents may be used where approved by the Engineer and shall conform to ASTM C 260. Air-entrained concrete shall have an air content of 4.5 percent, plus or minus 1.5 percent of the volume of the concrete.
- C. Other admixtures may be used only with the written approval of the Engineer. Do not use fly ash.

2.5 HIGH-EARLY-STRENGTH CONCRETE

- A. Concrete made with high-early-strength Portland cement or other special cements shall be used only when specified or approved in writing by the Engineer. The 7-day compressive strength of the concrete, when made with high-early-strength cement, shall be at least equal to the specified minimum 28-day compressive strength. All provisions of the specifications, except for cement, shall be applicable to such concrete.

2.6 PROPORTIONING

- A. All concrete materials shall be proportioned to produce a workable mixture in which the water content does not exceed the maximum specified.
- B. The exact proportions of all materials in the concrete shall be approved by the Engineer. The Contractor shall provide all equipment necessary to positively determine and control the actual amounts of all materials entering into the concrete. The proportions shall be changed when, in the opinion of the Engineer, such changes become necessary to obtain the specified strength and the desired density, uniformity and workability, and the Contractor will not be compensated because of such changes.

- C. All materials shall be measured by weight except that water may be measured by volume. One bag of cement will be considered as 94 pounds in weight, and one gallon of water as 8.33 pounds.
- D. Maximum water/cement ratio shall be 0.45 for 4000 psi concrete and 0.52 for 3000 psi 28-day concrete.
- E. Use admixtures for water reducing and set-control in strict compliance with manufacturer's directions.
- F. Proportion and design mixes to result in concrete slump at point of placement as follows:
 - 1. Concrete: Not less than 1 inch or more than 4 inches.
 - 2. Concrete containing HRWR admixture (super-plasticizer): Not more than 8 inches after addition of HRWR to site-verified 2-3 inch slump concrete.

2.7 CONCRETE MIXING

- A. Ready-Mix concrete shall comply with requirements of ASTM C 94, and as herein specified.
- B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.

2.8 STRENGTH

- A. Concrete shall be designed to develop a minimum compressive strength of 4000 pounds per square inch at the age of 28 days, unless otherwise noted or specified. Miscellaneous or unreinforced concrete may be designed to develop a minimum compressive strength of 3000 psi at the age of 28 days.

2.9 FORMS

- A. Forms shall be of wood, steel or other approved materials. The sheeting for surfaces not normally visible shall be of lumber of uniform width not greater than 6 inches. The Contractor shall check the type, size, shape, quality and strength of all materials for forms before use.
- B. Wood forms shall be No. 2 common or better lumber.

2.10 REINFORCEMENT

- A. The Contractor shall furnish and install all reinforcements, including bars, fabric and structural shapes, as shown on the drawings or otherwise required. Immediately prior to placing concrete, all reinforcement shall be entirely free from rust, scale, grease or other coatings, which might destroy or reduce its bond with concrete. Bars for concrete reinforcement shall conform to the requirements of ASTM A 615, Grade 60 deformed. Wire mesh reinforcement which shall conform to ASTM A 185.

PART 3 - EXECUTION

3.1 MIXING AND PLACING

- A. Ready-mixed concrete shall be used. Ready-mixed concrete shall conform to ASTM C 94, using the materials specified. No water shall be added. Trip tickets shall be furnished to the Engineer.
- B. Mixing of the material may be accomplished by an approved weight batch-type mixing machine when approved by the Engineer. Adequate equipment and facilities shall be provided for accurate measurement and control of the materials entering into the concrete. The minimum time for mixing each batch after all materials are combined shall be 1-1/2 minutes. The mixer shall revolve a minimum of twelve revolutions after all materials have been placed within, and at a uniform speed. Neither speed nor volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive overmixing requiring additions of water to preserve the required consistency will not be permitted.
- C. No concrete shall be placed in the forms until all reinforcements have been placed and securely fastened, all anchors, fixtures and other materials to be built into the concrete are in place, forms cleaned of all debris and other foreign material, and placing of reinforcement and form work is inspected and approved by the Engineer. Concrete shall be placed in the dry except for tremie or seal concrete.
- D. Concrete shall be placed in daylight except where drawings call for continuous pours of such quantity to necessitate night placing. In such cases, the Contractor shall provide adequate lighting to carry on his operation to the satisfaction of the Engineer.
- E. Placing of the concrete shall be accomplished as rapidly as practicable after mixing and in no event shall it be placed after more than one hour. Concrete shall be conveyed from mixer to forms as rapidly as practicable by methods, which will prevent segregation or loss of ingredients. It shall be deposited as nearly as practicable in its final position. Chutes with a flatter slope than 1 on 3 or with a steeper slope of 1 on 2 will not be permitted. There shall be no free vertical drop greater than 3 feet except where tremies are used. Chutes shall be either metal or metal lined.
- F. Concrete shall be placed on clean, damp surfaces free from running water and not upon soft mud, dry porous earth or upon fills that have not been subjected to approved compaction so that ultimate settlement has occurred.
- G. Concrete shall be deposited in approximately horizontal layers not to exceed 24 inches in thickness and the concreting shall be carried on as a continuous operation, as far as practicable, until the placing in the course, section, panel or monolith is completed.
- H. Except for thrust blocks, concrete shall be placed with the aid of mechanical vibrating equipment. Vibration shall be transmitted directly to the concrete and in no case shall it be transmitted through the forms. The frequency of vibration shall not be less than 4,500 cycles per minute. The intensity of vibration shall be sufficient to cause flow or settlement of the concrete into place. The vibration shall be of sufficient duration to accomplish thorough compaction. Vibration shall be supplemented by forking or spading by hand adjacent to the forms on exposed faces in order to secure smooth, dense, even surfaces. The concrete shall be compacted and worked in an approved

manner into all corners and angles of the forms and around reinforcement and embedded fixtures. Light hammer tapping will be allowed at lift lines to prevent air bubbles.

- I. In pouring concrete through reinforcement, care shall be taken so that no segregation of coarse aggregate occurs. On flat surfaces where the congestion of steel near the forms makes placing difficult, a mortar of the same cement-sand ratio used in the concrete shall first be deposited to cover the forms.
- J. The Contractor shall plan his concrete work in such a manner that, once started, the work can be continuous until a section, panel or unit is completed. Construction joints, other than the ones shown on the drawings, must be approved by the Engineer prior to pouring concrete.
- K. Rock surfaces shall be approximately horizontal, clean and spread with a layer of mortar before placing concrete.
- L. Concrete placed during cold weather shall comply with ACI 306. Concrete shall not be placed when the surrounding air temperature is below 35 degrees F., or when the concrete is likely to be subjected to freezing temperatures before final set has occurred, unless specifically authorized by the Engineer in writing. When authorized, the materials shall be heated in order that the temperature of the concrete when deposited shall be not less than 50 degrees F or more than 90 degrees F. Salt and other chemicals shall not be admitted into the mixture to prevent freezing. All methods and equipment for heating shall be subject to approval by the Engineer before use.
- M. Concrete placed during hot weather shall be in accordance with ACI 305.
- N. Concrete shall be handled in accordance with the applicable provisions of ACI 304, "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".

3.2 CONCRETE FINISHES

- A. Concrete slabs shall be finished in accordance with the following requirements. The dusting of wearing surfaces with dry materials will not be permitted. In preparation for finishing, slabs shall be struck off true to the required level as shown on the drawings. Finished surfaces shall be within a tolerance of 1/8 inch measured as the departure from the testing edge of an approved 10-foot straight edge held parallel to, and in contact with, the surface.
- B. Rough Slab Finish: Unexposed slabs under earth shall be finished by tamping the concrete with special tools to force the aggregate away from the surface, then screeding with straight edges and floating to produce a true and uniform surface.
- C. Wood-Float Finish: While the concrete is still green but hardened sufficiently to bear the cement finisher's weight, the surface shall be floated with a wood float to a true and uniform plane with no coarse aggregate visible.
- D. Monolithic Finish: Exposed interior concrete slabs shall be finished by tamping the concrete with special tools to force the coarse aggregate away from the surface, then screeding and floating with straight edges to bring the surface to the required finish level shown on the drawings. While the concrete is still green but sufficiently hardened

to bear a man's weight, is shall be wood floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. The concrete shall then be hand steel troweled to produce a smooth impervious surface free from trowel marks. An additional steel trowelling shall be given to the surface for the purpose of burnishing to match adjacent concrete pavement.

- E. Power-Machine Finishing: In lieu of hand finishing, the Contractor may use a power machine approved by the Engineer for finishing concrete floors or slabs in accordance with the directions of the machine manufacturer. The preparation of concrete surfaces for finishing by machine shall, in general, be as required for hand finishing.
- F. Nonslip Broom Finish: Immediately after trowel finishing, slightly roughen exterior concrete and sidewalk surfaces by brooming with a fiber bristle broom perpendicular to the main traffic route. Coordinate required final finish with the Engineer before application.

3.3 PATCHING

- A. Any concrete which is not formed as shown on the drawings or is out of alignment or level or shows a defective surface, shall be considered as not conforming with the intent of these specifications and shall be removed by the Contractor at his expense, unless the Engineer grants permission to patch the defective area. This shall be done in accordance with the procedures above. Honeycomb consisting of 3/4 inch diameter holes or greater shall be considered a defective surface. Permission to patch any such area shall not be considered a waiver of the Engineer's right to require complete removal of the defective work if the patching does not, in his opinion, satisfactorily restore the quality of the concrete and appearance of the surface.

3.4 CURING

- A. All concrete shall be adequately protected from injurious action by the sun, heavy rains, flowing water and mechanical injury. All concrete shall be kept wet for a period of not less than 14 consecutive days by covering with water or with an approved water-saturated covering, or by a system of perforated pipes, mechanical sprinklers, or any other approved method which will keep all surfaces continuously (not periodically) wet. Where wood forms are left in place for curing, they shall be kept wet at all times to prevent opening at the joints and drying out of the concrete. Water for curing shall be generally clean and free from any elements which might cause staining or discoloration of the concrete.
- B. Concrete placed during cold weather shall be kept moist and provided with adequate protection so that the surfaces of the concrete will be maintained at temperatures between 50 degrees F and 70 degrees F for at least the first five (5) days of the curing period.

3.5 FORM CONSTRUCTION

- A. Forms shall be built true to line and grade and shall be mortar-tight and sufficiently rigid to prevent displacement or sagging between supports. Responsibility for their

adequacy shall rest with the Contractor. Their surfaces shall be smooth and free from irregularities, dents, sags or holes when used for permanently exposed faces. Bolts and rods used for internal ties shall be arranged so when the forms are removed metal will be not less than 2 inches from any concrete surface. Wire ties will not be permitted where the concrete surface will be exposed to weathering and where discoloration will be objectionable. All forms shall be constructed so they can be removed without hammering or prying against the concrete. Unless otherwise indicated, suitable moldings shall be placed to bevel or round exposed edges, expansion joints and/or other areas that may be required.

- B. Forms for exposed surfaces shall be coated with a nonstaining mineral oil applied shortly before the reinforcement is placed. Forms for unexposed surfaces shall be oiled before reinforcement is placed with any suitable oil sufficient to facilitate their prompt removal.
- C. Formwork shall be in accordance with ACI 347, "Recommended Practice for Concrete Formwork".

3.6 PLACEMENT OF REINFORCEMENT

- A. The spacing of reinforcing bars, protective covering and splicing shall be in accordance with Chapter 7, Details of Reinforcement in ACI 318, "Building Code Requirements for Reinforced Concrete."
- B. Adjacent sheets of mesh reinforcement shall be spliced so that the overlap measured between the outermost cross wires of each fabric sheet are not less than the spacing of the cross wires plus 2 inches. The lapped ends shall be securely wired together.
- C. All reinforcement shall be secured in place true to lines and grades indicated by the use of plastic tipped supports or spacers and metal ties. Such supports shall be sufficient in strength to maintain the reinforcement in place throughout the concreting operation and shall be used in such a manner that no metal will be exposed on the face or in any way discolor or be noticeable in the surface of the finished concrete. The cost of furnishing and placing all supports, spacers, ties and/or other devices required in the Contract prices for reinforcing.

3.7 EMBEDDED ITEMS

- A. Care shall be taken to determine that all embedded metal or wood parts are firmly and securely fastened in place as indicated before placing concrete. The parts shall be thoroughly clean and free from coating, rust, scale, oil or other foreign matter. The embedding of wood in concrete shall be avoided whenever possible, metal being used instead. If wood is allowed, it shall be thoroughly wetted before the concrete is placed.

3.8 EXPANSION AND CONTRACTION JOINTS

- A. Expansion and contraction joints shall be constructed at the locations shown and be of such dimensions indicated on the drawings, or as approved by the Engineer and as required by good construction practices. The method and materials used shall be

subject to the approval of the Engineer and the materials shall conform to the ASTM standards, where applicable.

3.9 TOLERANCES

- A. Tolerances for concrete work shall be in accordance with ACI 347.

END OF SECTION

SECTION 03470

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Furnish and install the precast concrete structures as shown on the drawings and as specified herein.
- B. The work generally consists of manholes, catch basins and vaults.
- C. All products shall be the sizes shown, new and of current manufacture and complete with all accessories.

1.2 RELATED WORK

- A. Section 02320 - Trenching, Backfilling and Compacting
- B. Section 02501 - Pressure Piping - General
- C. Section 02515 - Ductile Iron Pipe (DIP)
- D. Section 03600 - Grouting

1.3 QUALITY ASSURANCE

- A. Structures and accessories shall be free of fractures, cracks and undue roughness. Concrete shall be free of defects which indicate improper mixing or placing, and surface defects such as honeycomb or spalling. Cracks or broken ends due to improper handling will not be acceptable. The Owner reserves the right to inspect structures and accessories at the factory prior to shipment.
- B. Lift holes will be allowed to penetrate the entire wall thickness to facilitate handling of the structures safely. All lift holes shall be plugged with a nonshrink leak-proof grout.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Concrete: 4000 psi. See Section 03300, Cast-in-Place Concrete for materials and reinforcing.
- B. Flexible Plastic Gaskets: Rope Form.

- C. Manhole Brick: ASTM C 32, Grade MA.
- D. Masonry Mortar: ASTM C 270, Type M.
- E. Manhole Steps: Copolymer polypropylene plastic encapsulating 1/2 inch grade 60 steel rod or aluminum alloy, 6061-T6 minimum tensile strength 38,000 psi. Either type to resist pull out force of 1500 pounds. Stepping surface non-skid design with end lugs or drop front, 10 inch long minimum.
- F. Water Stops: See Section 03300 - Cast-in-Place Concrete.
- G. Frames, Covers and Grates: Traffic type, conforming to ASTM A 48, 30,000 psi tensile strength.
- H. Access Hatches: Aluminum, channel or trough frame,, stainless steel hinges, hold open arm, padlock hasp or stable as manufactured by Bilco Company, or equal.

2.2 CONSTRUCTION

- A. Structures shall be constructed of precast reinforced concrete with reinforcing as specified in ASTM C 478. Reinforcing shall extend into the tongue and groove of the joints and there shall be a #4 continuous rebar hoop around pipe openings. The base of manholes and vaults shall be monolithic with the first wall section.
- B. Joints shall be the tongue and groove type suitable for flexible plastic gaskets.
- C. Lifting hooks may be set in structure bases for ease of installation. Lift holes will be allowed only in rise and cone sections and shall be completely plugged with a nonshrink leak-proof grout.
- D. Cone sections shall be eccentric.
- E. Standard manholes for sanitary sewers shall be 4 feet in diameter, except as otherwise noted on the drawings.

2.3 FRAMES, COVERS AND GRATES

- A. Frames, covers and grates shall be as shown on the drawings and the quality and composition of the metal of the castings shall be strong, tough and of even grain. They shall be smooth, free from scale, lumps, blisters and sand holes. No plugging or filling will be allowed. The words "Water" shall be cast in manhole covers to be plainly visible. Frames, covers and grates shall be set so the top of the item will be flush with the finished grade, unless shown otherwise on the drawings. All items shall have the bearing surfaces machined to prevent rocking and shall have a protective coating of black paint. All covers shall have a nonpenetrating or concealed type pick hole.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Structures shall be set on firm compacted gravel or crushed stone foundations and plumb in the locations shown on the drawings. Manhole steps shall be in true alignment. Joints between sections shall be cleaned and primed and the gasket applied as recommended by the manufacturer. Voids remaining in the joint shall be caulked with anhydrous cement grout on the inside and outside to make smooth watertight joint seals.
- B. The method for joining pipe to structures (except catch basins) shall be by a rubber boot. The boot shall be composed of ethylene propylene rubber and shall meet the requirements of ASTM C 923. The rubber boot shall protrude at least 3-1/2 inches outside the structure wall. After the pipe has been installed inside the rubber boot, the boot shall be secured over the pipe by a nonmagnetic stainless steel clamp to provide watertightness. Other proposed alternative methods of connecting pipe to structures shall be submitted to the Engineer for approval.
- C. Connection to catch basins and electrical manholes shall be made with cementitious grout in accordance with the manufacturer's recommendations.
- D. Steep slopes outside invert channels shall be avoided. Changes in size and grade shall be made gradually and evenly. Changes in the direction of the sewer and entering branch or branches shall have a true curve, with a radius as large as the structure size will permit.
- E. For manholes built over existing lines and miscellaneous piping in vaults, the diameter of the pipe opening shall be 4 inches larger than the outside diameter of the pipe. After the manhole is set, space shall be filled with cement mortar and approved grout mix. The base slab thickness and inverts shall be as shown on the drawings.
- F. Set frames concentric with the top of the masonry and in a full bed of mortar so that the space between the top of the masonry and the bottom flange of the frame shall be completely filled with mortar and made watertight. Place a thick ring of mortar extending to the outer edge of the masonry all around the bottom flange. Finish the mortar flush with the top of the flange and with a slight slope to shed water away from the frame.

END OF SECTION

SECTION 03600

GROUTING

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide and install grouting as shown on the drawings and as specified herein.
- B. All materials shall be as specified, new and of current production.
- C. Types of grouting include the following:
 - 1. Epoxy Grout
 - 2. Portland Cement Grout
 - 3. Nonshrink Grout (Metallic)
 - 4. Nonshrink, Nonexpanding Grout (Nonmetallic)

1.2 RELATED WORK

- A. Section 03300 - Cast-in-place Concrete
- B. Section 03470 - Precast Concrete Structures

1.3 QUALITY ASSURANCE

- A. Grouting materials and procedures shall be in accordance with the Grouting Handbook published by the United States Grout Corporation (latest edition).

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pre-mixed Epoxy Grout
 - 1. Epoxy grout shall be an all-resinous grout mixed and installed according to the manufacturer's recommendations.
 - 2. The grout shall be nonshrink when tested according to ASTM C 827.
 - 3. The effective bearing area shall be no less than 95 percent when tested according to ASTM C 827.
- B. Portland Cement Grout
 - 1. Portland Cement: ASTM C 150, Type I.
 - 2. Sand: ASTM C 33, fine aggregate.
 - 3. Water: Potable.

4. Pea Gravel: ASTM C 33, coarse aggregate, graded so at least 90 percent passes a 3/8 inch sieve and 90 percent is retained by a No. 4 sieve.

C. Pre-Mixed Nonshrink Grout (Metallic)

1. Nonshrink grout shall be a packaged mix requiring only water and mixing to form a plastic, workable grout. The specific type used shall be based on the recommendations of the grout manufacturer.

D. Pre-Mixed Nonshrink, Nonexpanding Grout (Nonmetallic)

1. Nonshrink grout shall be a mixture of sand, cement, wetting and polymer agents. Grout shall be nonmetallic and nonshrink in accordance with ASTM C 827, ASTM C 191 and ASTM C 109. The water-grout ratio shall be approximately 8 to 10 quarts of water per cubic foot of grout adjustable for varying job conditions. Grout shall not contain calcium chloride or other salts, aluminum or other metals, chemical additives, gypsum or expansive cements. Grout shall not expand after set and shall be used and applied in accordance with the manufacturer's written instructions.

E. Nonshrink grout shall conform to the following requirements:

1. Shall be manufactured under rigid quality control specifically for grout used in transferring heavy loads.
2. Shall contain nonmetallic aggregates especially graded to minimize bleeding.
3. Shall contain metallic aggregate that is especially graded to minimize bleeding and is ductile and capable of withstanding impact without fracturing.
4. Shall have an initial setting time of approximately one hour at 70 degrees F.
5. Shall produce no settlement or drying shrinkage at 3 days or after.
6. Shall have higher strength at all ages than plain cement grout of the same flowability.
7. Shall resist attack by oil and water and have lower absorption than plain cement grout of the same flowability.

2.2 MIXES

- A. For less than a 2 inch clearance, or where the size or shape of spaces makes grouting difficult, the grout mix shall consist of grout material and water.
- B. Mix nonshrink grouting materials and water in a mechanical mixer for no less than three (3) minutes.
- C. For greater than 2 inch clearances where coarse aggregate will not obstruct free passage of the grout, extend the grout by adding 50 pounds of pea gravel per 100 lbs. grout material.
- D. Use the minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding.
- E. Portland cement mortar for raked-out edges of nonshrink grout shall be one part Portland cement, two parts sand and 0.50 parts water by weight.

- F. Mix grout as close to the work area as possible and transport the mixture quickly and in a manner that does not permit segregation of materials.
- G. After the grout has been mixed, do not add additional water.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation methods and procedures shall be approved by the Engineer before work commences.
- B. Formwork
 - 1. Build leak-proof forms that are strong and securely anchored and shored to withstand grout pressures.
 - 2. Provide enough clearance between the formwork and the area to be grouted to permit proper placement of grout.
- C. Surface Preparation
 - 1. Remove all defective concrete, laitance, dirt, oil, grease and other foreign material from concrete surfaces by bush-hammering, chipping or other similar means until a sound, clean concrete surface is achieved.
 - 2. Lightly roughen the concrete, but not enough to interfere with the proper placement of grout. Cover concrete areas with waterproof membrane until ready to grout.
 - 3. Remove foreign materials from all steel surfaces in contact with the grout.
 - 4. Align, level and maintain final positioning of all components to be grouted.
 - 5. Take special precautions during extreme weather conditions according to the grout manufacturer's written instructions.
 - 6. Immediately before grouting, remove waterproof membranes and clean any contaminated surfaces.
 - 7. Saturate all concrete surfaces with clean water. Remove excess water and leave none standing.
- D. Placing
 - 1. Place grouting material quickly and continuously by the most practical means permissible, either by pouring, pumping or under gravity pressure.
 - 2. Do not use either pneumatic-pressure or dry packing methods without the written permission of the Engineer.
 - 3. Apply grout from one side only to avoid entrapping air.
 - 4. Final installation shall be thoroughly compacted and free from air pockets.
 - 5. Do not vibrate the placed grout mixture or allow it to be placed if the area is being vibrated by nearby equipment.
 - 6. Do not remove leveling shims for at least 48 hours after the grout has been placed.
 - 7. After shims have been removed, fill voids with plain cement-sand grout.
 - 8. After the grout has reached initial set, rake out all exposed edges approximately 1 inch into the grouted area and paint with Portland cement mortar.

E. Curing

1. Cure grout for 3 days after placing by keeping wet and covering with curing paper or by another method approved by the Engineer.

END OF SECTION

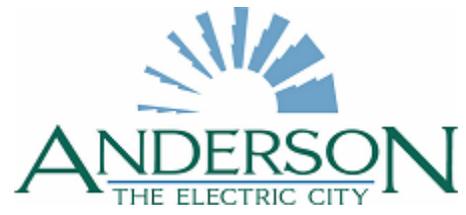
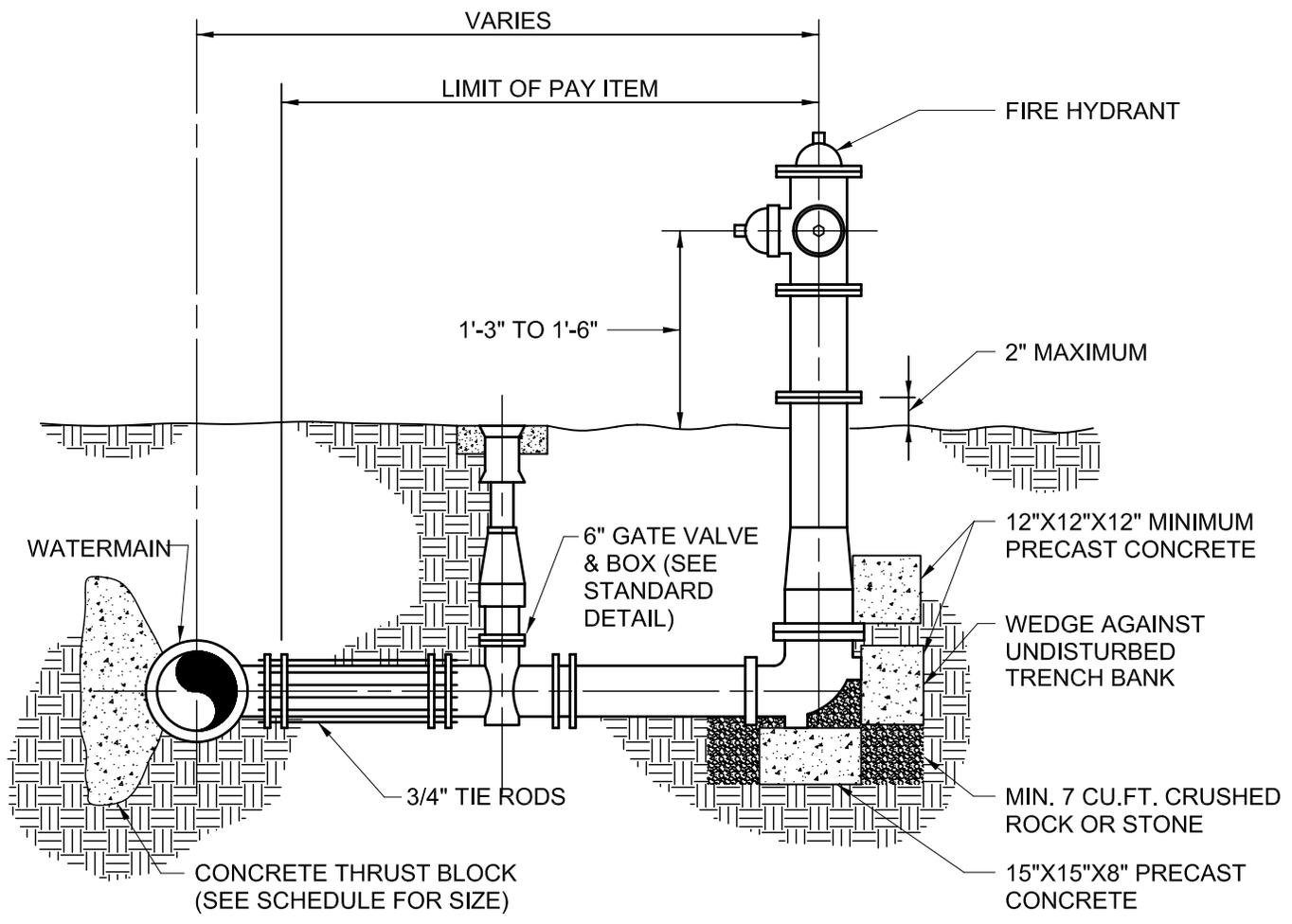
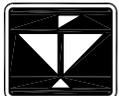


EXHIBIT A

STANDARD DETAILS



NOTE: HYDRANT DRAINS SHALL NOT BE CONNECTED TO OR LOCATED WITHIN 10 FEET OF SEWER SYSTEMS.



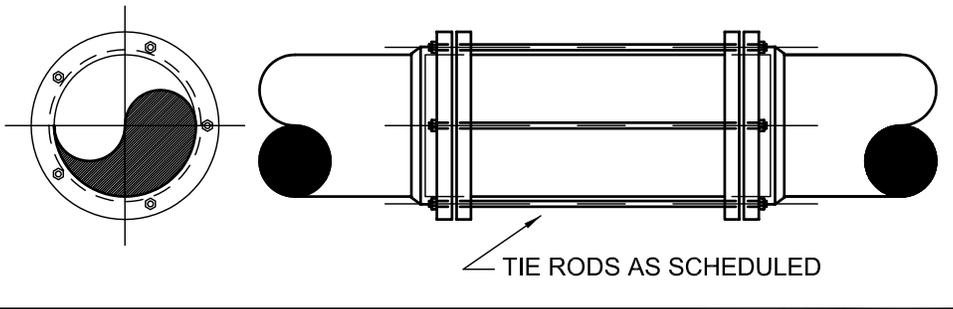
DESIGN SOUTH
PROFESSIONALS, INC.
 engineers architects planners

ELECTRIC CITY UTILITIES
 FIRE HYDRANT
 DETAIL

3/4" = 1'
 11/22/94
 r-CDET-005

THRUST RESTRAINT TIE ROD SCHEDULE

(BASED ON A36 STEEL THREADED RODS
AND 200 P.S.I. PIPE PRESSURE)



PIPE SIZE (IN.)	NO. OF RODS	DIA. OF RODS	PIPE SIZE (IN.)	NO. OF RODS	DIA. OF RODS
4"	2	3/4"	18"	6	3/4"
6"	2	3/4"	20"	8	3/4"
8"	2	3/4"	24"	12	3/4"
10"	2	3/4"	30"	10	1"
12"	4	3/4"	36"	16	1"
14"	5	3/4"	42"	14	1 1/4"
16"	6	3/4"	48"	16	1 1/4"



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ELECTRIC CITY UTILITIES
THRUST RESTRAINT TIE
ROD SCHEDULE

1:1
11/23/94
r-CDET-006

3" GALV. IRON
VENT PIPE W/ SCREENED AND
DOWNWARD FACING ELBOW
(FASTEN TO MARKER)

TRAFFIC TYPE
COVER

GRADE

VENT PIPE

3" AIR VALVE

3' X 3' CONC. METER BOX
MODEL NO. REA 333-C
AS MANUFACTURED BY
DEKALB CONCRETE PRODUCTS,
DECATUR, GA. OR APPROVED
EQUAL.

WATER MAIN

GRAVEL

TAPPING SADDLE
& VALVE

6"X6"X4'-0"
CONCRETE AIR
VALVE MARKER

24"

6"
MIN.

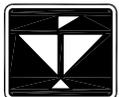
48" MIN.

VARIES

4"

NOTE:

1. AIR VALVES TO BE INSTALLED ON HIGH POINTS OF WATER MAINS. ALL PIPE AND FITTINGS SHALL HAVE MIN. 200 PSI WORKING PRESSURE RATING.
2. VALVE SHALL BE APCO COMBINATION AIR RELEASE VALVE (BULLETIN 623), OR APPROVED EQUAL.

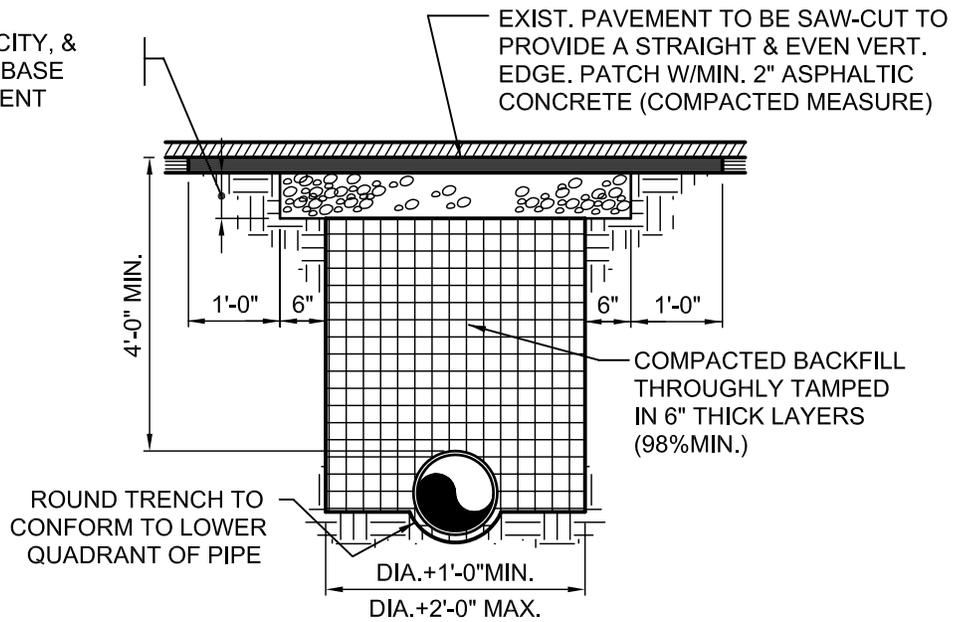


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ELECTRIC CITY UTILITIES
TYPICAL AUTOMATIC AIR
VALVE ASSEMBLY, TYPE 1

N.T.S.
2/2/95
r-CDET-098

TYPE "B": STATE SECONDARY, CITY, & COUNTY ROADS - 8" MACADAM BASE COURSE W/5% PORTLAND CEMENT

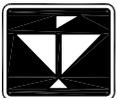


NOTES:

1. PIPELINE CONSTRUCTION & PAVEMENT REPLACEMENT SHALL BE IN STRICT ACCORDANCE W/REQUIREMENTS OF THE ENCROACHMENT PERMIT & APPLICABLE PART OF THE S.C. STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION.
2. COMPACTION OF FILL & BASE MAT'LS. SHALL BE ACCOMPLISHED WITH HAND HELD MECHANICAL TAMPERS. THE USE OF GRADING & EXCAVATION EQUIPMENT FOR COMPACTION WILL NOT BE PERMITTED.
3. COMPACTIONS ARE AS DETERMINED BY STANDARD PROCTOR TEST.

TYPICAL STATE & COUNTY ROADWAY PAVEMENT REPLACEMENT & OVERLAY

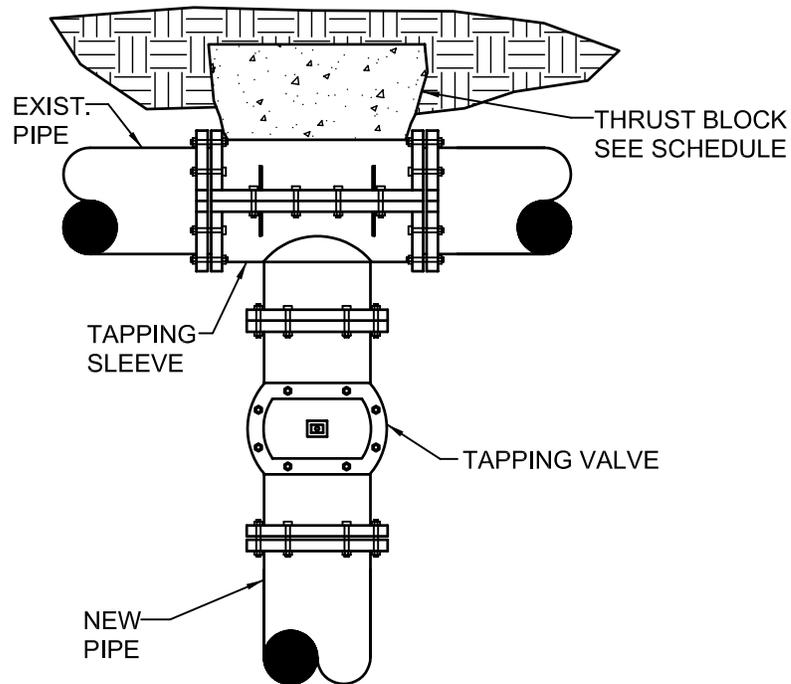
N.T.S.



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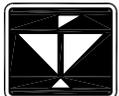
ELECTRIC CITY UTILITIES
STATE & COUNTY PAVEMENT
REPLACEMENT & OVERLAY

N.T.S.
2/17/95
r-CDET-078



TYP. TAPPING SLEEVE & VALVE

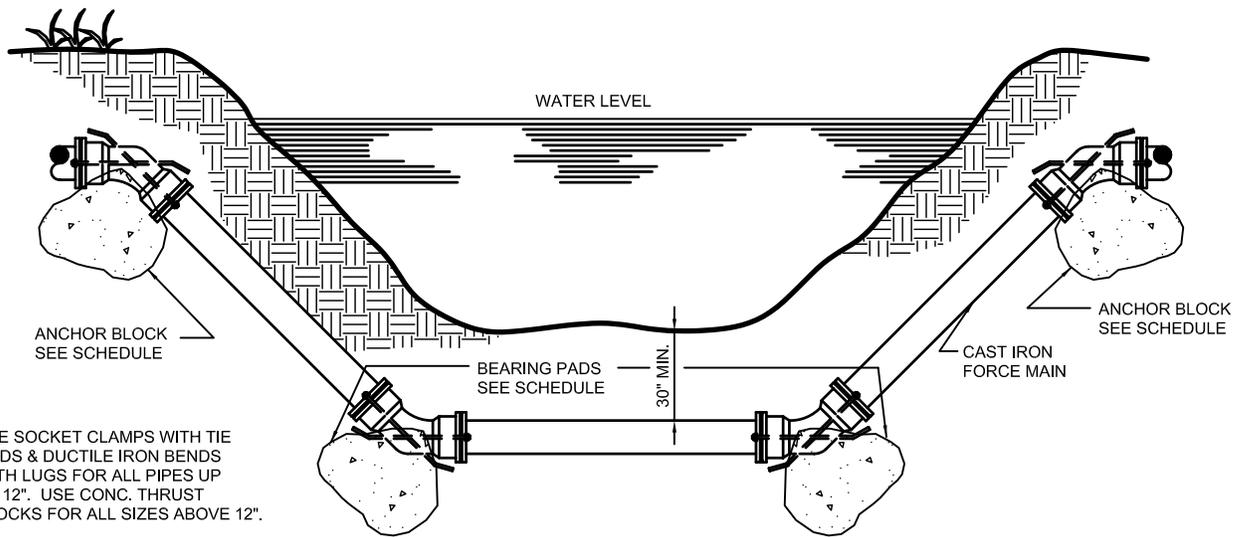
N.T.S.



DESIGN SOUTH
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ELECTRIC CITY UTILITIES
TYPICAL TAPPING SLEEVE
& VALVE

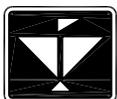
1/2" = 1'
11/23/94
r-CDET-010



USE SOCKET CLAMPS WITH TIE RODS & DUCTILE IRON BENDS WITH LUGS FOR ALL PIPES UP TO 12". USE CONC. THRUST BLOCKS FOR ALL SIZES ABOVE 12".

**TYPICAL UNDERWATER
STREAM CROSSING**

N.T.S.



DESIGN SOUTH
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engineers architects planners

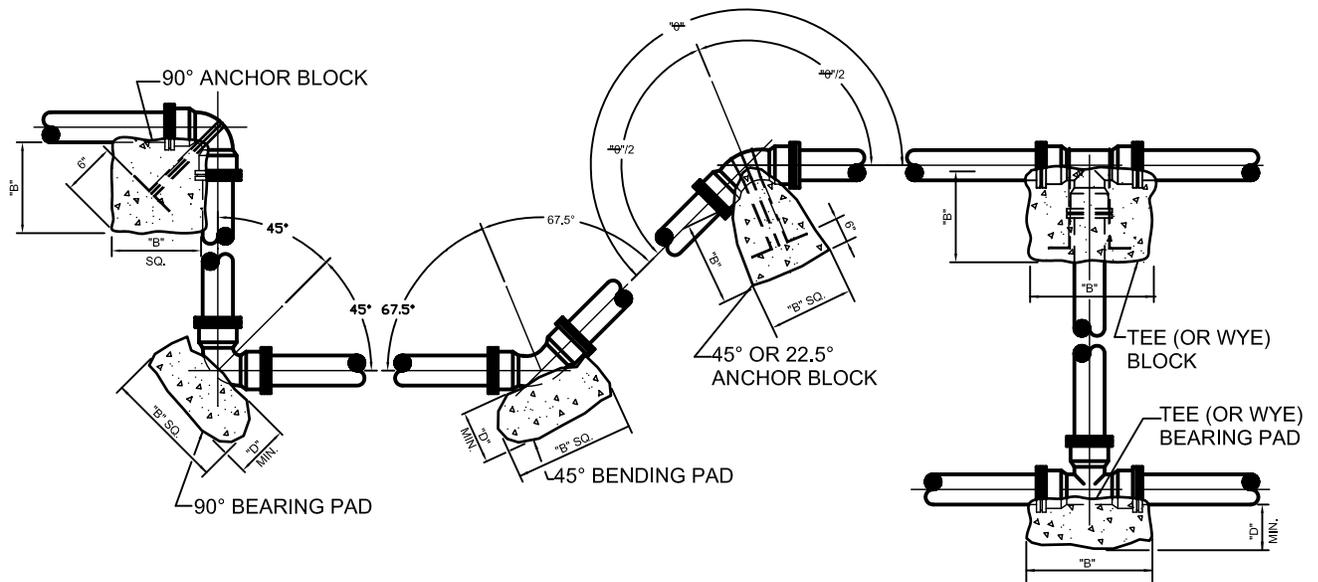
ELECTRIC CITY UTILITIES

TYPICAL UNDERWATER
STREAM CROSSING

N.T.S.
7/9/02
r-CDET-011

WATERMAIN ANCHORAGE SYSTEM

PIPE SIZE (IN.)	ANCHOR BLOCKS												BEARING PADS														
	90° BENDS			45° BENDS			22 1/2° BENDS			WYES & TEES			90° BENDS			45° BENDS			22 1/2° BENDS			TEE					
	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)	B	D	REINF. (EA. WAY)
2	1.3'	-	-	1.0'	-	-	1.0'	0.7	-	1.8'	-	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-
3	1.7'	-	-	1.4'	-	-	1.0'	0.7	-	2.4'	-	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-
4	2.1'	-	-	1.7'	-	-	1.3'	0.7	-	2.9'	-	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-
6	2.7'	-	-	2.2'	-	-	1.7'	0.7	-	3.8'	-	-	1.2'	0.7'	-	1.0'	0.7'	-	1.0'	0.7'	-	1.4'	0.7'	-	1.4'	0.7'	-
8	3.3'	-	-	2.6'	-	-	2.1'	0.7	-	4.6'	-	-	1.6'	0.8'	-	1.2'	0.7'	-	1.0'	0.7'	-	1.9'	0.8'	-	1.9'	0.8'	-
10	3.8'	-	-	3.1'	-	-	2.5'	0.7	-	5.3'	-	-	2.0'	0.8'	-	1.5'	0.7'	-	1.0'	0.7'	-	2.4'	1.0'	-	2.4'	1.0'	-
12	4.3'	-	-	3.5'	-	-	2.8'	0.7	-	6.0'	-	-	2.4'	1.0'	-	1.7'	0.8'	-	1.2'	0.7'	-	2.8'	1.0'	-	2.8'	1.0'	-
14	4.7'	-	5-#5'S	3.9'	-	3-#4'S	3.1'	0.7	3-#4'S	6.7'	-	6-#5'S	2.8'	1.0'	4-#5'S	2.0'	0.8'	2-#5'S	1.4'	0.7'	-	3.3'	1.0'	4-#5'S	3.3'	1.0'	4-#5'S
16	5.2'	-	5-#5'S	4.2'	-	3-#4'S	3.4'	0.8	3-#4'S	7.3'	-	6-#6'S	3.2'	1.0'	4-#5'S	2.3'	1.0'	2-#5'S	1.7'	0.8'	-	3.9'	1.0'	4-#5'S	3.9'	1.0'	4-#5'S
18	5.6'	-	6-#5'S	4.6'	-	4-#4'S	3.6'	1.0	4-#4'S	7.9'	-	7-#6'S	3.6'	1.0'	4-#5'S	2.6'	1.0'	3-#5'S	1.9'	0.8'	-	4.2'	1.2'	5-#5'S	4.2'	1.2'	5-#5'S
20	6.0'	-	6-#5'S	4.9'	-	4-#4'S	3.9'	1.0	4-#4'S	8.5'	-	7-#6'S	4.0'	1.2'	5-#5'S	2.9'	1.0'	4-#5'S	2.1'	0.8'	2-#5'S	4.7'	1.2'	5-#5'S	4.7'	1.2'	5-#5'S
24	6.8'	-	7-#6'S	5.5'	-	5-#5'S	4.4'	1.0	5-#5'S	9.6'	-	8-#6'S	4.7'	1.2'	5-#5'S	3.5'	1.0'	4-#5'S	2.5'	1.0'	3-#5'S	5.6'	1.3'	6-#5'S	5.6'	1.3'	6-#5'S
30	7.8'	-	7-#7'S	6.4'	-	5-#5'S	5.1'	1.0	5-#5'S	11.1'	-	8-#7'S	5.9'	1.3'	7-#5'S	4.4'	1.2'	5-#5'S	3.1'	1.0'	4-#5'S	7.0'	1.5'	8-#5'S	7.0'	1.5'	8-#5'S
36	8.9'	-	8-#7'S	7.2'	-	6-#5'S	5.8'	1.2	6-#5'S	12.5'	-	12-#7'S	7.1'	1.5'	8-#5'S	5.2'	1.3'	6-#5'S	3.7'	1.0'	5-#5'S	8.4'	1.7'	9-#5'S	8.4'	1.7'	9-#5'S
42	9.8'	-	10-#7'S	8.1'	-	7-#5'S	6.4'	1.2	7-#5'S	14.0'	-	14-#7'S	8.3'	1.7'	9-#5'S	6.1'	1.3'	7-#5'S	4.3'	1.2'	5-#5'S	10.0'	1.8'	10-#5'S	10.0'	1.8'	10-#5'S



GENERAL NOTES:

1. BLOCK AND PAD SIZES INDICATED IN SCHEDULE ARE TO BE USED IN SOILS WITH A MINIMUM BEARING CAPACITY ON 2500 P.S.F.. WHERE BAD SOILS ARE ENCOUNTERED THEY ARE TO BE REMOVED OR THE CONTRACTOR MAY SUBMIT REVISED ANCHORAGE BLOCKS TO ENGINEER FOR APPROVAL.

2. FOR DETAILS COVERING CONDITIONS NOT SHOWN SEE DETAILS ELSEWHERE IN THESE DRAWINGS OR SUBMIT DETAILS TO ENGINEER FOR APPROVAL.

NOTE 1:

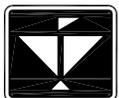
ANCHOR BARS:
 2" THRU 6" PIPE 2#5'S
 8" THRU 16" PIPE 2#6'S
 18" THRU 24" PIPE 3#8'S
 30" THRU 42" PIPE 3#10'S

AFTER FABRICATION COMPLETELY COAT EXPOSED BARS AFTER INSTALLATION WITH TWO COATS OF BITUMINOUS MASTIC.

NOTE 2:

ANCHOR BARS:
 2" THRU 6" PIPE 2#5'S
 8" THRU 16" PIPE 2#6'S
 18" THRU 24" PIPE 4#8'S
 30" THRU 42" PIPE 4#10'S

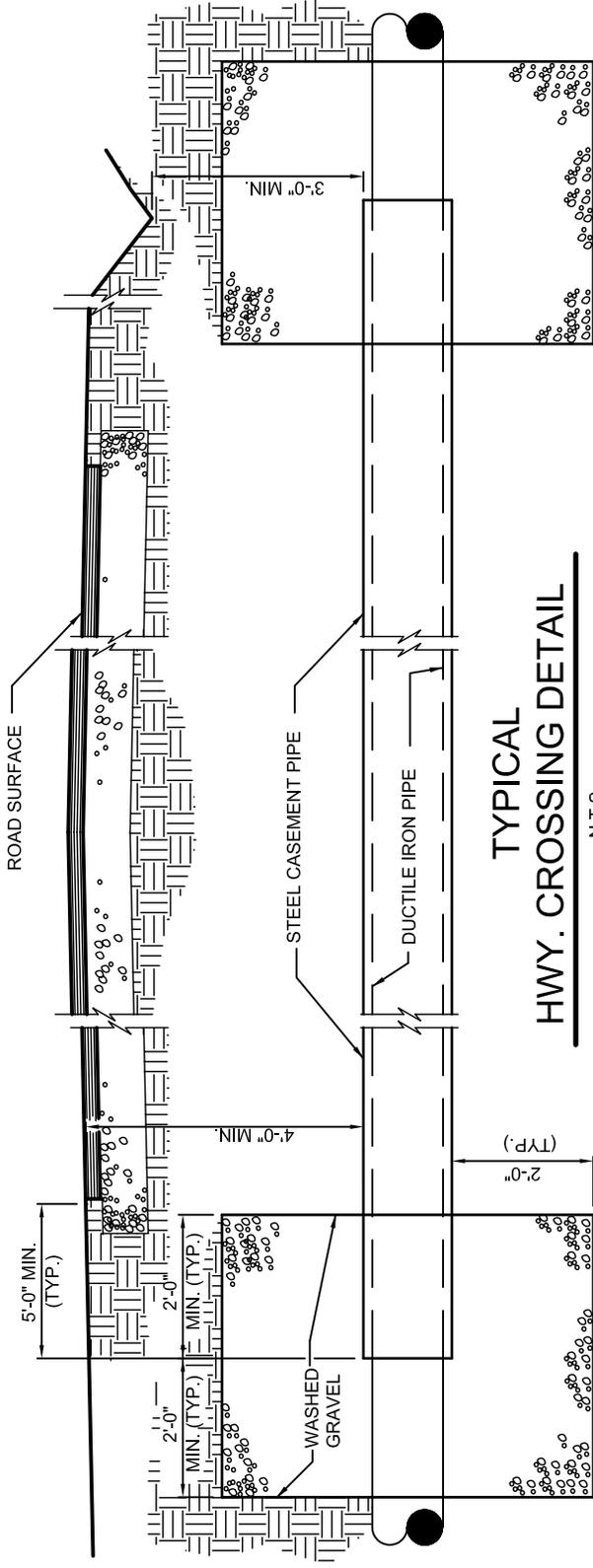
AFTER FABRICATION COMPLETELY COAT EXPOSED BARS AFTER INSTALLATION WITH TWO COATS OF BITUMINOUS MASTIC.



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ELECTRIC CITY UTILITIES
 ANCHOR BLOCKS
 & BEARING PADS

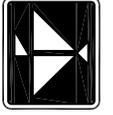
N.T.S.
 1/10/95
 r-CDET-019



TYPICAL
HWY. CROSSING DETAIL

N.T.S.

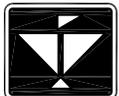
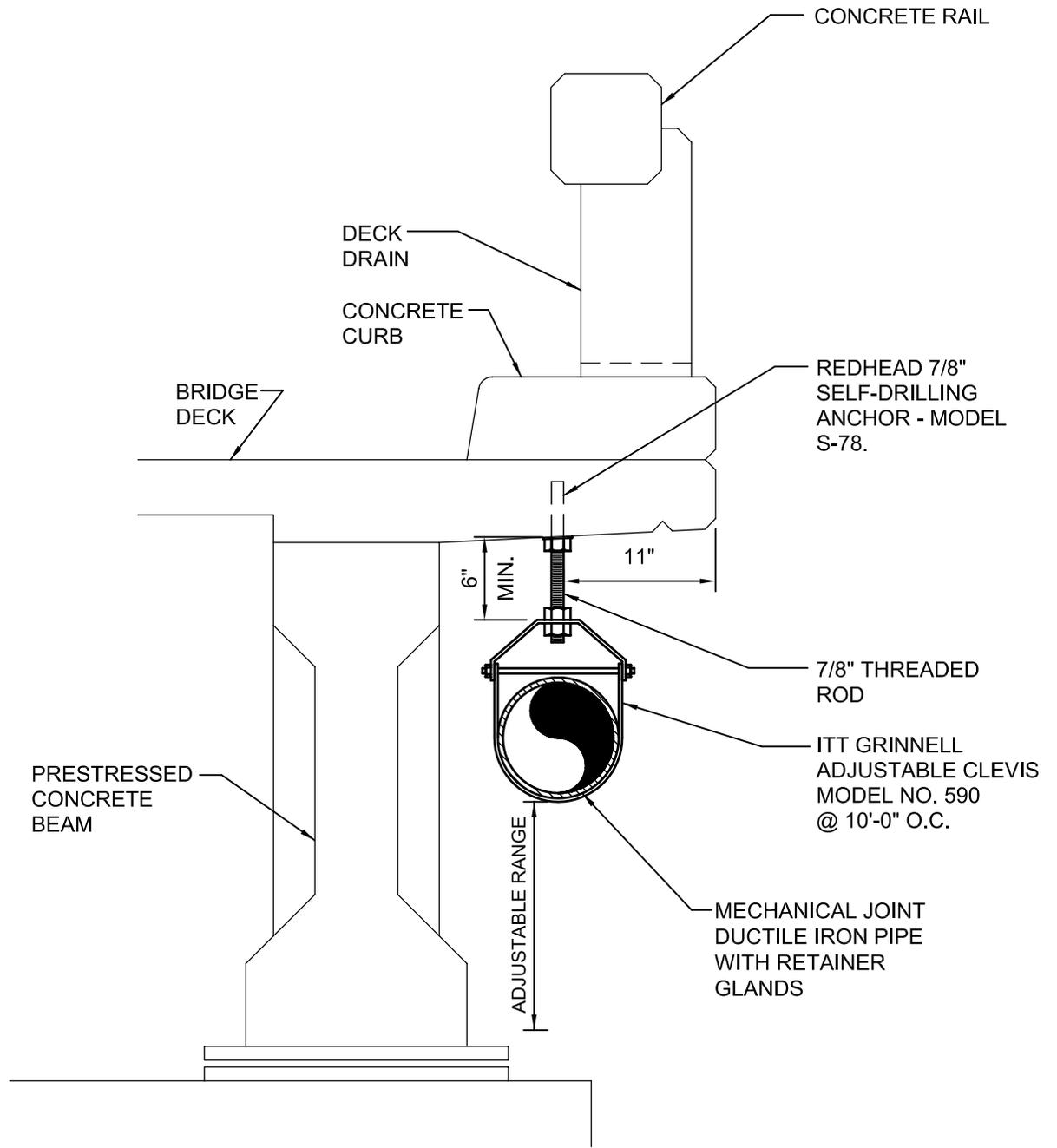
DUCTILE IRON CARRIER PIPE		STEEL CASEMENT PIPE SIZE	
2"	8"		
3"	9"		
4"	11"		
6"	13"		
8"	15"		
10"	17"		
12"	20"		
14"	22"		
16"	24"		
18"	26"		
20"	29"		
24"	33"		
30"	41"		
36"	48"		
48"	55"		
	62"		



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ELECTRIC CITY UTILITIES
TYPICAL HIGHWAY CROSSING

N.T.S.
1/10/95
r-CDET-022



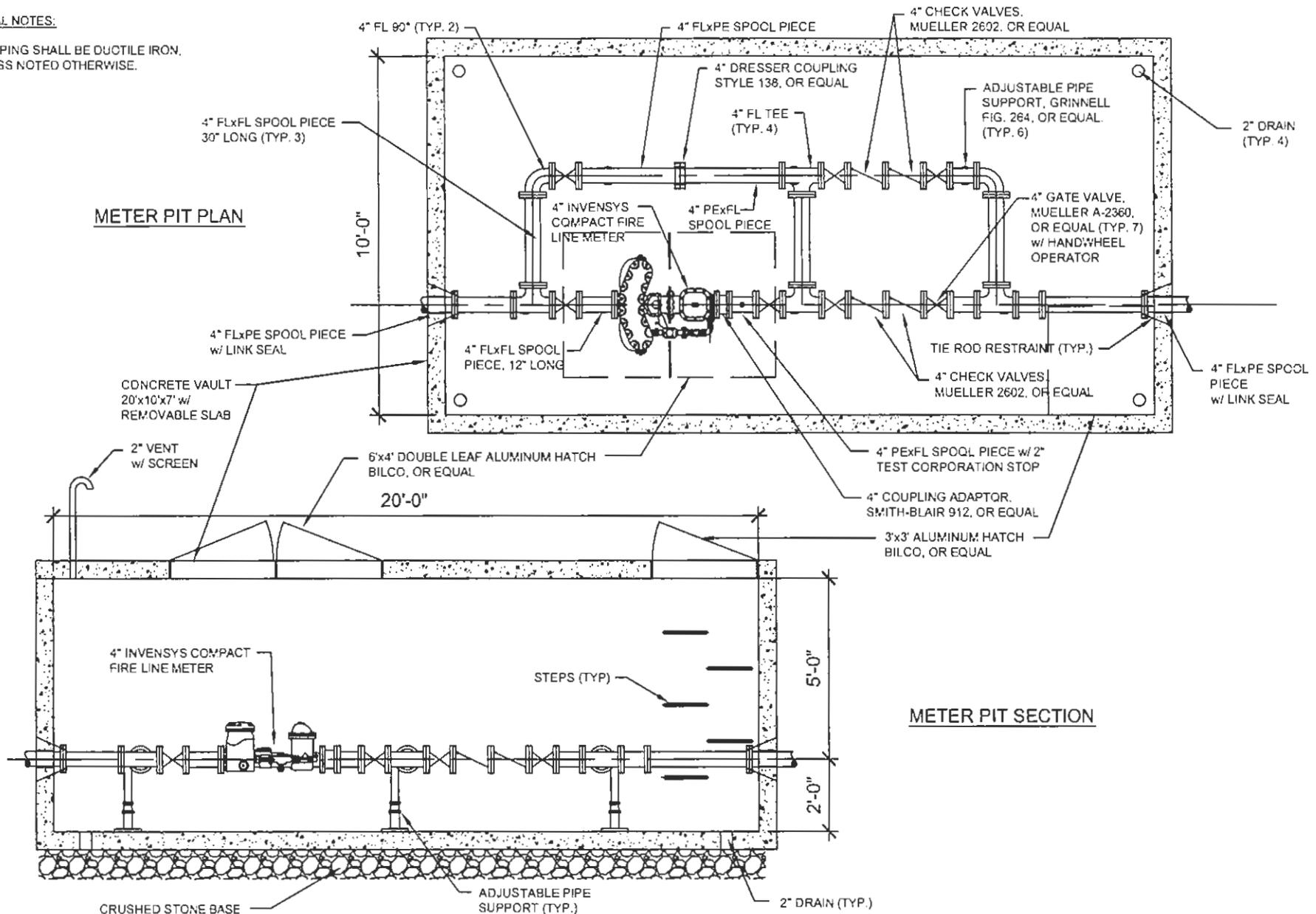
DESIGN SOUTH
PROFESSIONALS, INC.
 engineers architects planners

ELECTRIC CITY UTILITIES
 BRIDGE CROSSING
 PIPE HANGER 4"-12" DIA.

N.T.S.
 1/11/95
 r-CDET-023

GENERAL NOTES:

1. ALL PIPING SHALL BE DUCTILE IRON, UNLESS NOTED OTHERWISE.



METER PIT PLAN

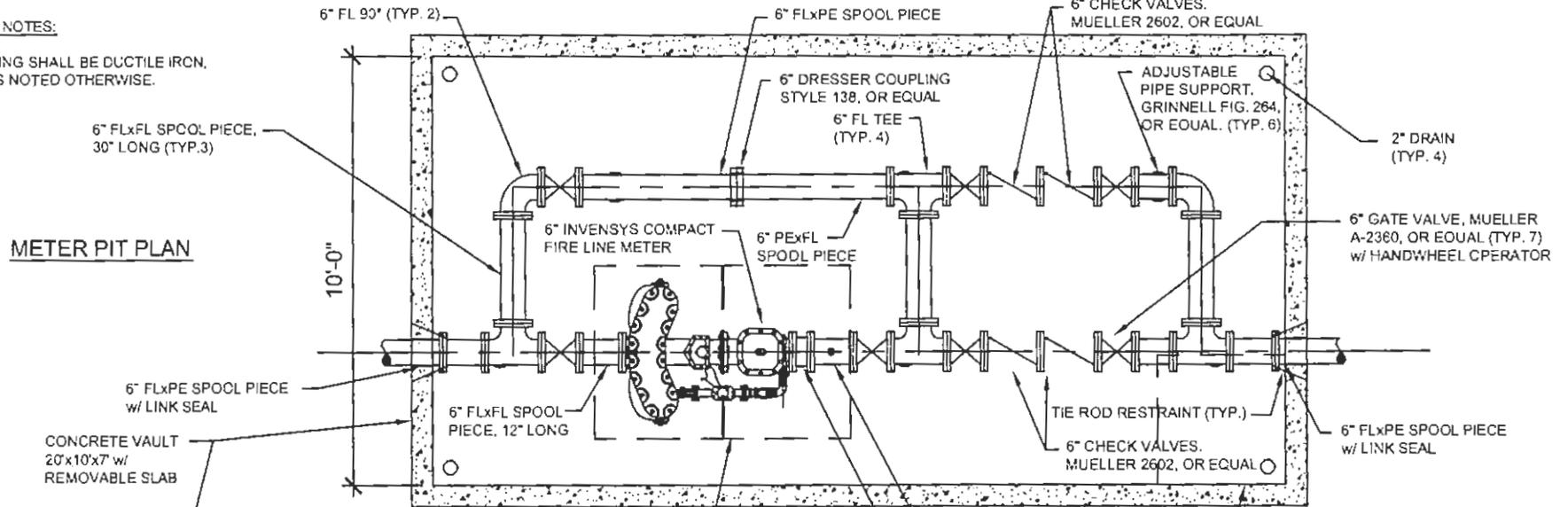
METER PIT SECTION

A1	TYPICAL 4" METER PIT DETAIL		STANDARD SPECS
1/4" = 1'-0"			C.1
 DESIGN SOUTH PROFESSIONALS, INC. <small>engineers architects planners</small>	CITY OF ANDERSON ELECTRIC CITY UTILITIES WATERWORKS ASSEMBLY METER PIT DETAIL		DATE: MAY 2005

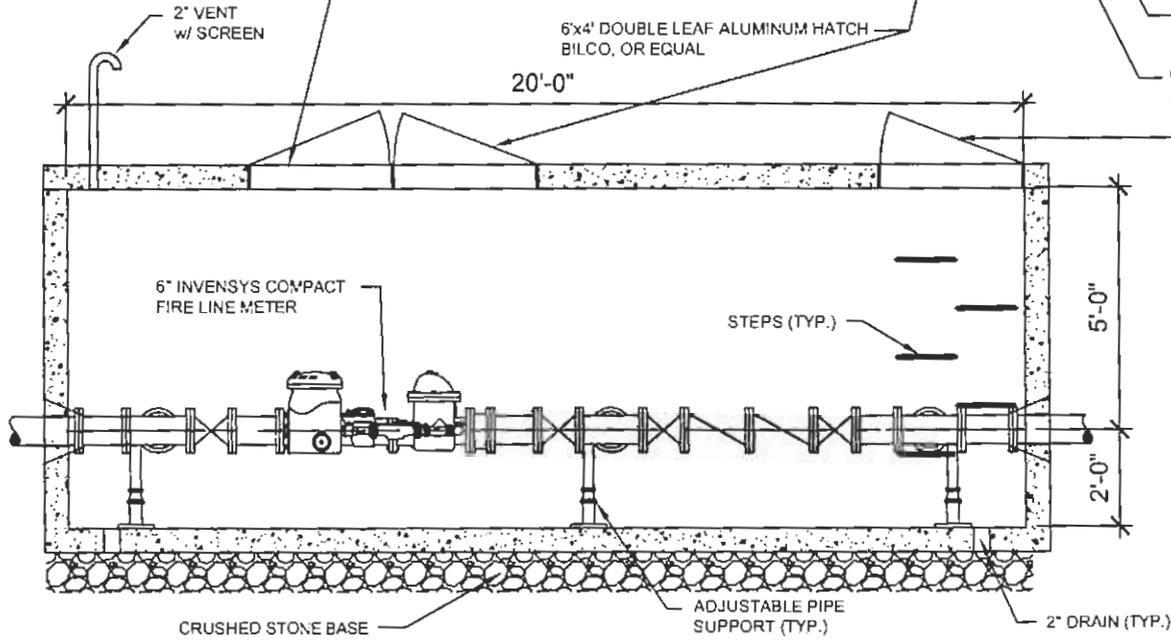
GENERAL NOTES:

1. ALL PIPING SHALL BE DUCTILE IRON, UNLESS NOTED OTHERWISE.

METER PIT PLAN



METER PIT SECTION

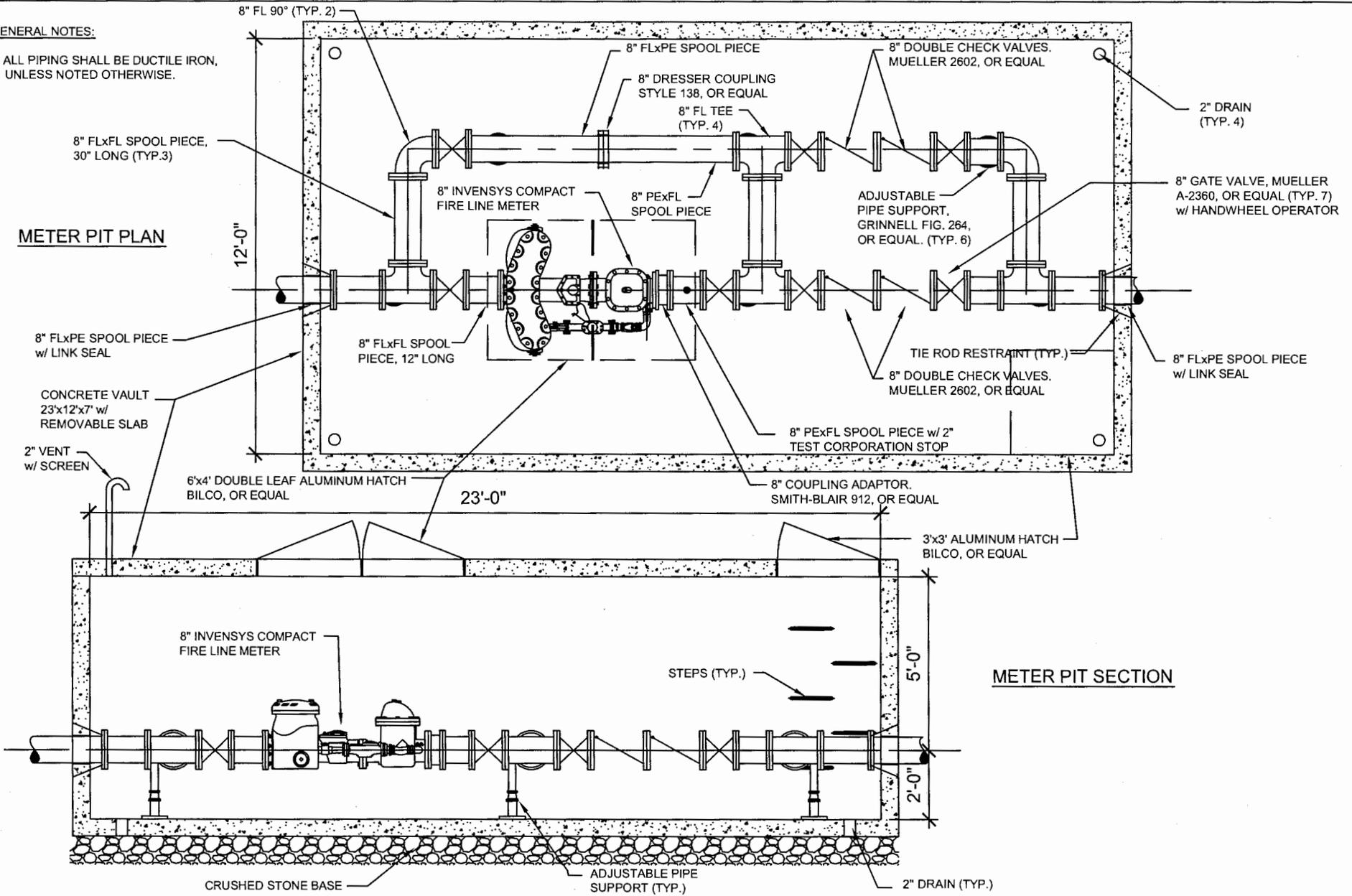


A1	TYPICAL 6" METER PIT DETAIL		STANDARD SPECS
1/4" = 1'-0"			C.2
 DESIGN SOUTH PROFESSIONALS, INC. <small>engineers architects planners</small>	CITY OF ANDERSON ELECTRIC CITY UTILITIES WATERWORKS ASSEMBLY METER PIT DETAIL		DATE: MAY 2005

GENERAL NOTES:

1. ALL PIPING SHALL BE DUCTILE IRON, UNLESS NOTED OTHERWISE.

METER PIT PLAN



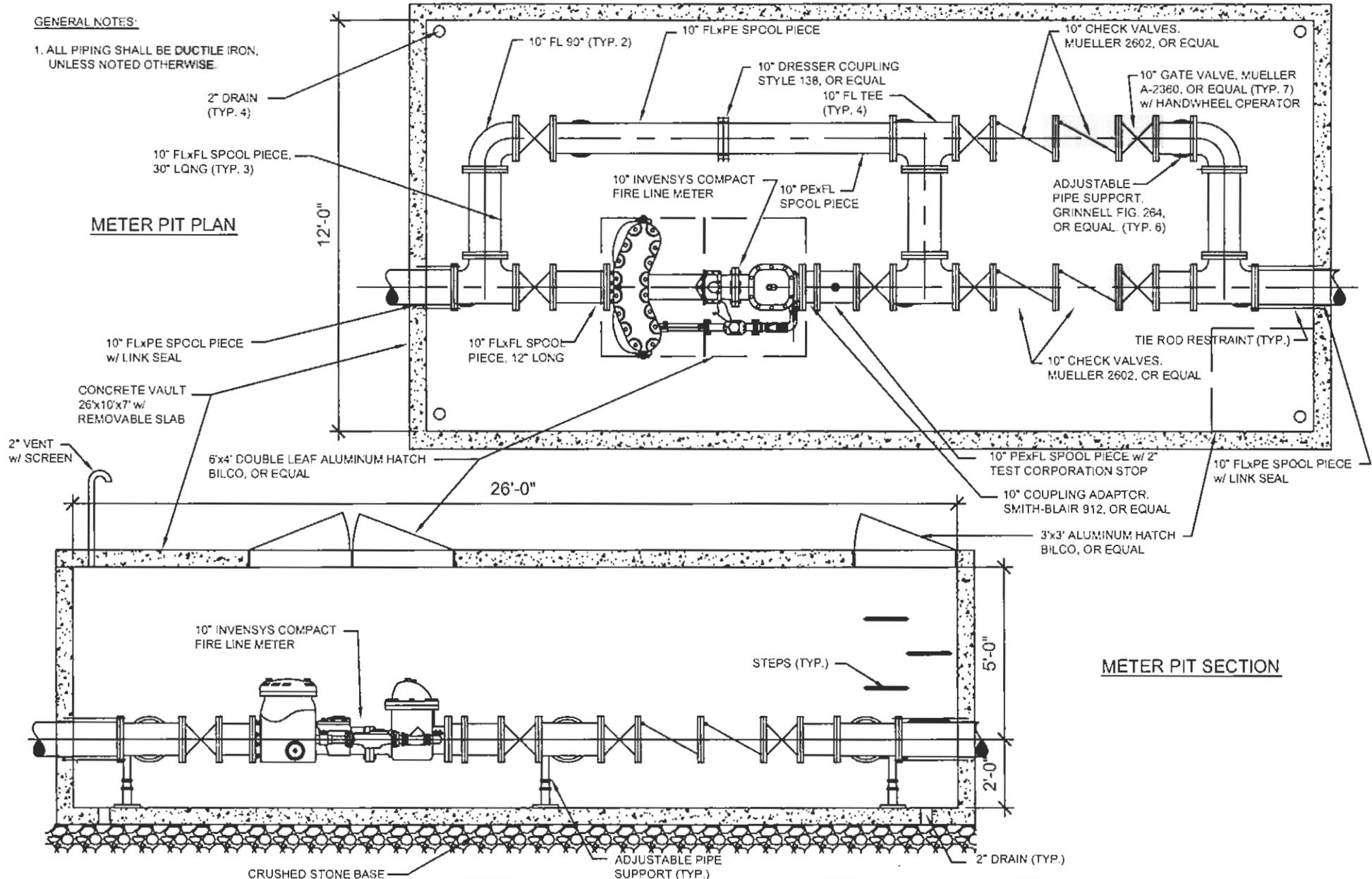
METER PIT SECTION

A1	TYPICAL 8" METER PIT DETAIL		
1/4" = 1'-0"			
 <p>DESIGN SOUTH PROFESSIONALS, INC. engineers architects planners</p>	CITY OF ANDERSON ELECTRIC CITY UTILITIES WATERWORKS ASSEMBLY METER PIT DETAIL		
			STANDARD SPECS
			C.3
			DATE: MAY 2005

GENERAL NOTES:

1. ALL PIPING SHALL BE DUCTILE IRON, UNLESS NOTED OTHERWISE.

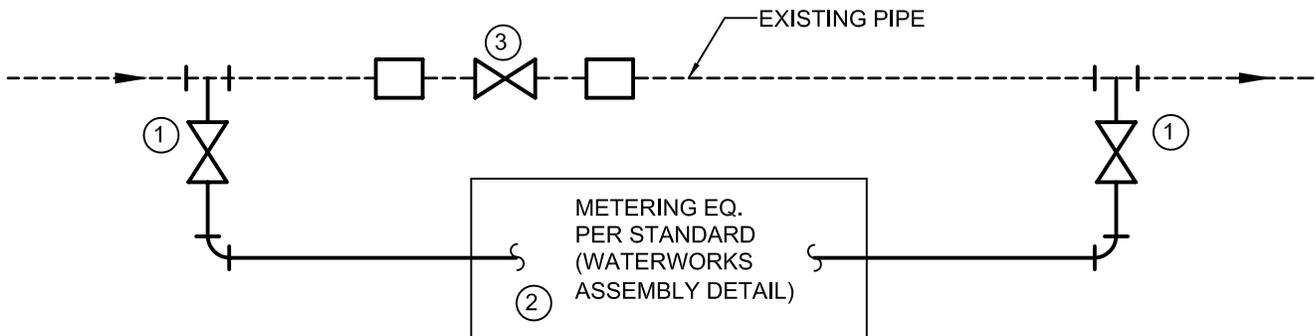
METER PIT PLAN



METER PIT SECTION

A1	TYPICAL 10" METER PIT DETAIL		
1/4" = 1'-0"			
	DESIGN SOUTH PROFESSIONALS, INC. engineers architects planners	CITY OF ANDERSON ELECTRIC CITY UTILITIES WATERWORKS ASSEMBLY METER PIT DETAIL	STANDARD SPECS C.4 DATE: MAY 2006

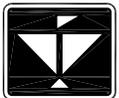
TAPPING INSTRUCTIONS



Where meters are to be installed on existing mains, the Customer shall follow the following procedures:

- ① Using tapping saddles and valves, tap the existing main for meter size or larger branch. This work shall be performed under inspection of the City's representative.
- ② Construct the meter pit in accordance with the standard shown on Waterworks Assembly detail, except:
 - a. Omit the bypass from the pit.
 - b. Tapping valves are shutoff valves for the meter.
- ③ Make up an assembly including spool pieces, mainline size gate valve and solid couplings for cast iron pipe. During a scheduled shutdown of service on the main, and under the inspection of the City's representative, cut out a pre-determined length of main, install the make-up piping and place the system back in service with a minimum of shut-down time.

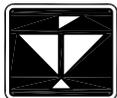
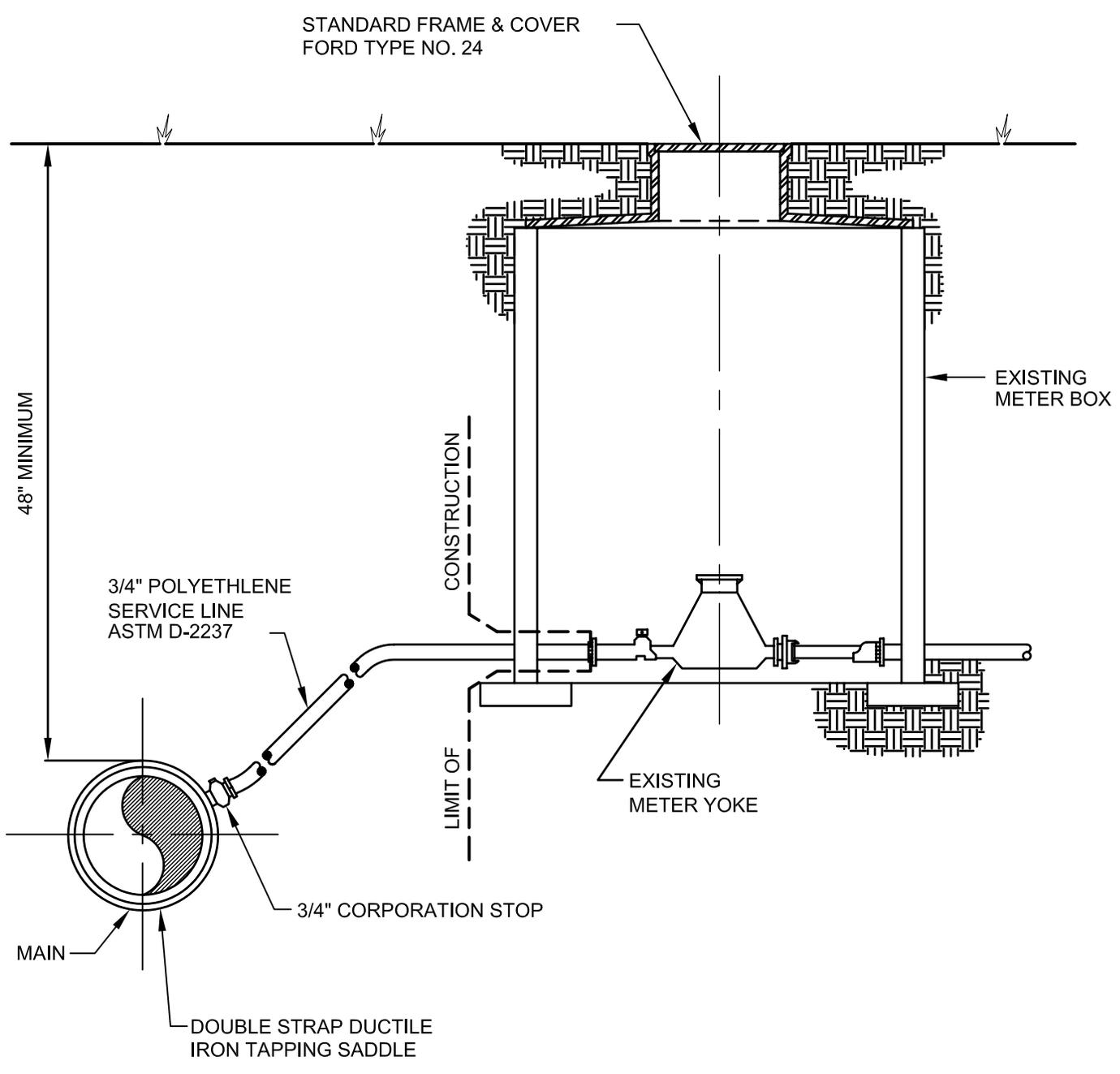
All other connections to the City's system shall be made by the Customer, with tapping saddle and valve, under inspection by the City's representative.



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ELECTRIC CITY UTILITIES
TAPPING INSTRUCTIONS

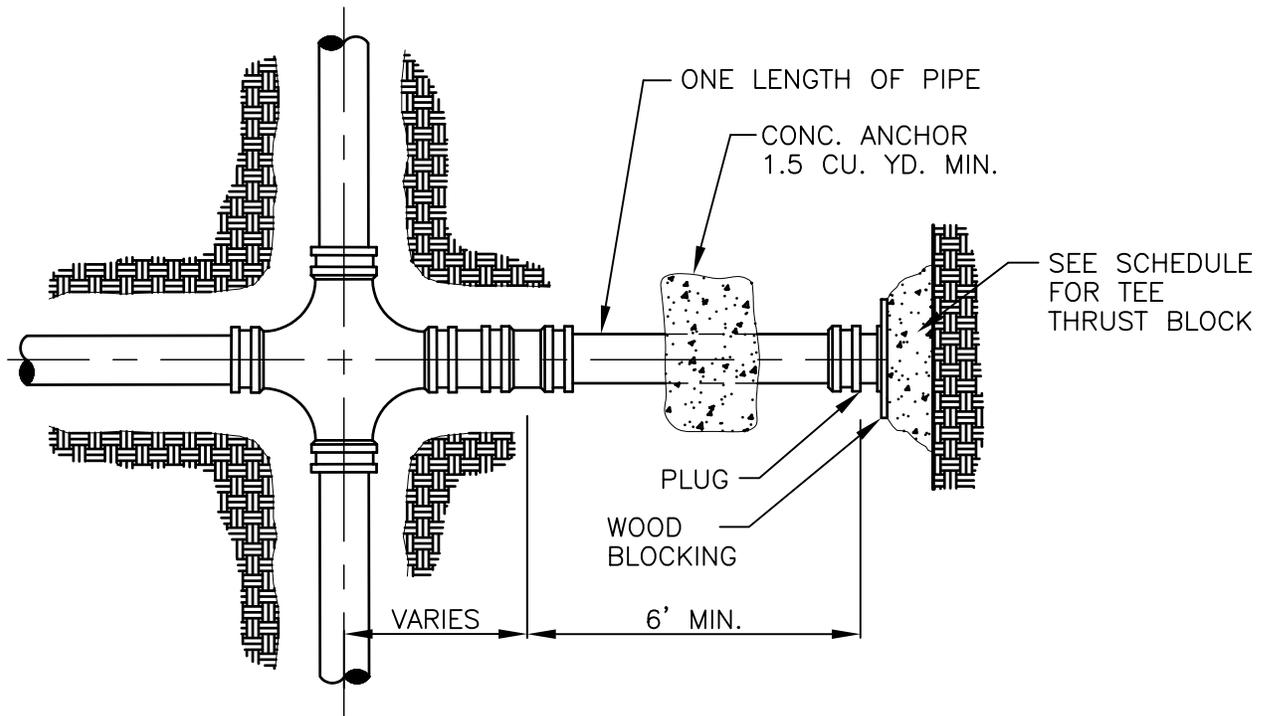
N.T.S.
9/28/94
r-CDET-025



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PROFESSIONALS, INC.
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ELECTRIC CITY UTILITIES
 2 SERVICE CONNECTION

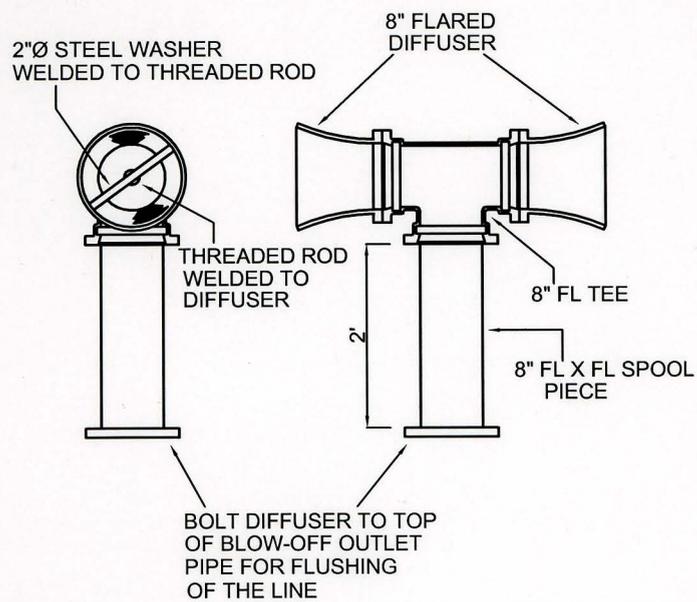
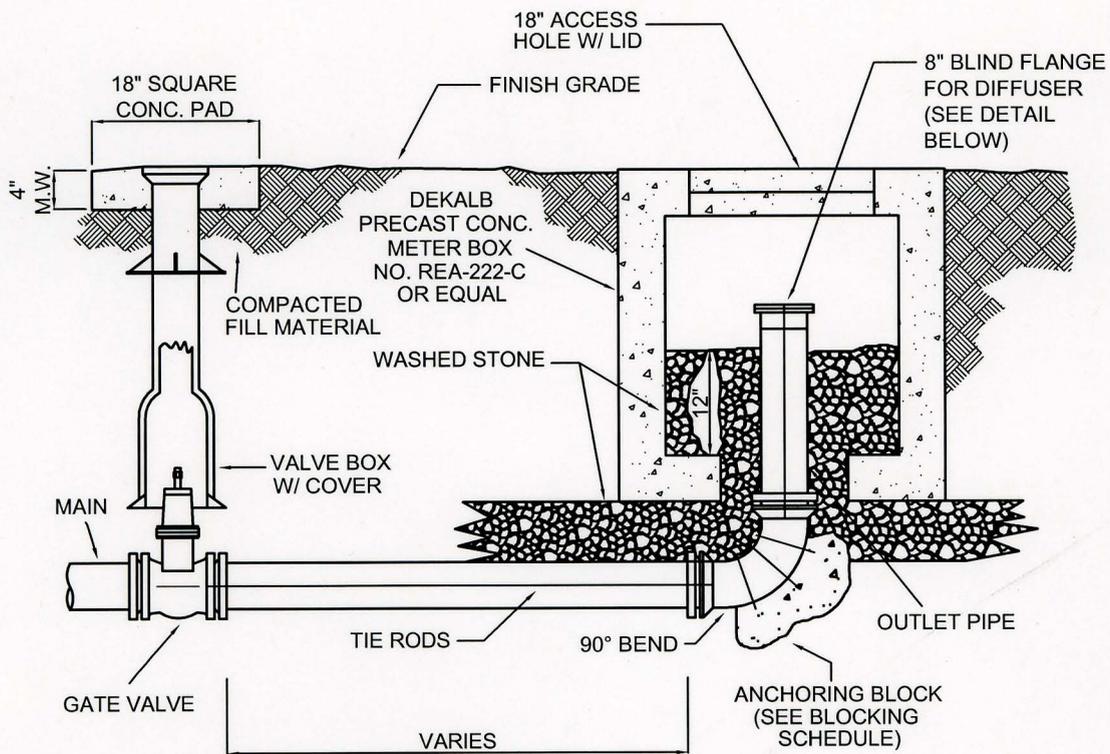
N.T.S.
 2/13/95
 r-CDET-062



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PROFESSIONALS, INC.
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ELECTRIC CITY UTILITIES
 MAIN WITH PLUG
 AND STUB-OUT

N.T.S.
 11/22/94
 r-CDET-043

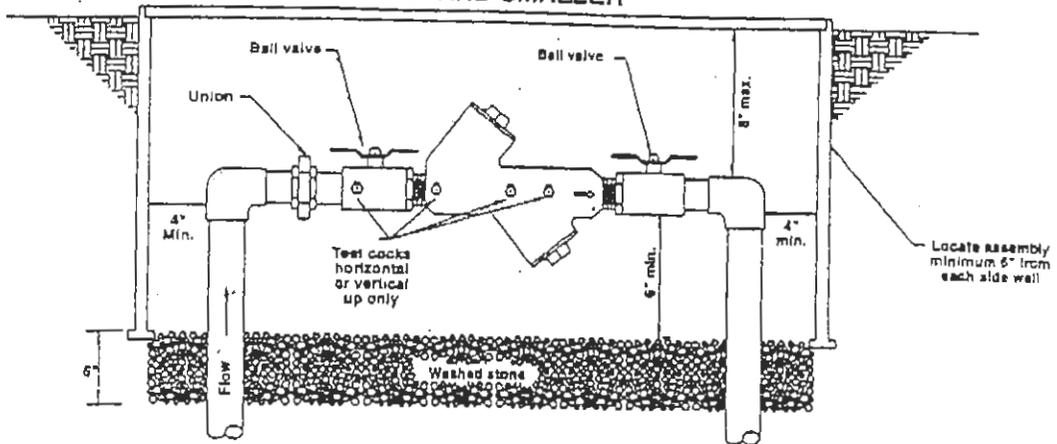


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ELECTRIC CITY UTILITIES
 BLOW OFF ASSEMBLY DETAIL
 WITH FLARED DIFFUSER

N.T.S.
 6/17/00
 r-CDET-101

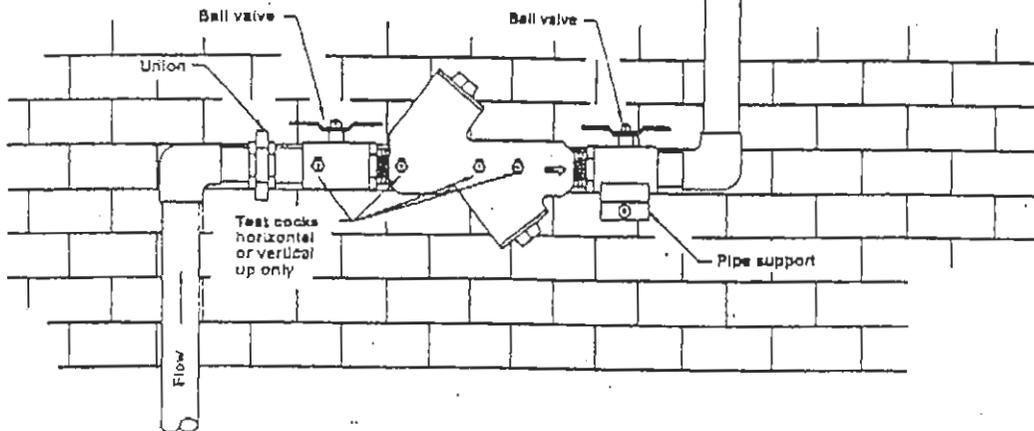
**DOUBLE CHECK VALVE ASSEMBLY
BELOW GROUND VAULT
2" AND SMALLER**



Notes:
Box shall be constructed at owners discretion of suitable material with removable access cover capable of handling traffic load that it may be subject. Also it shall be vandal resistant and provide protection from weather elements.

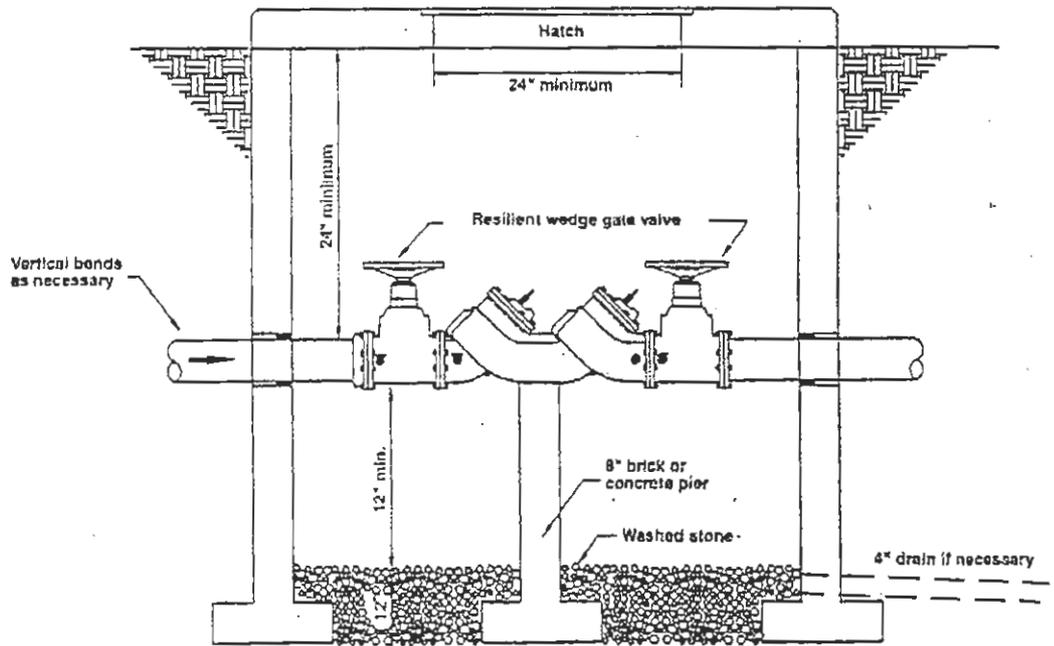
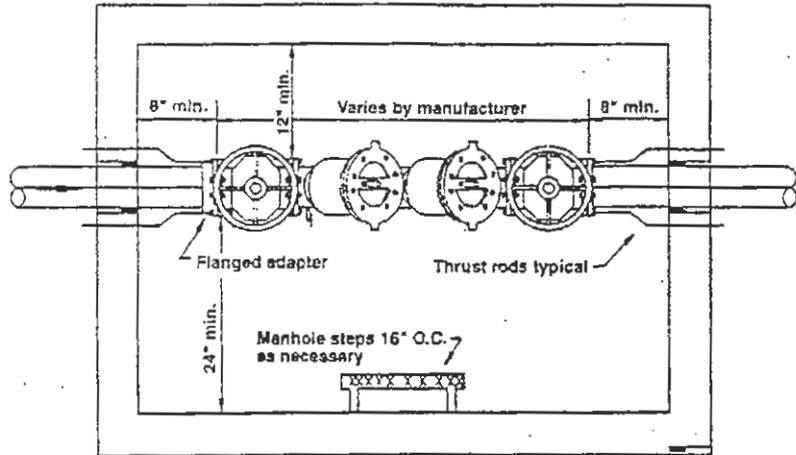
This picture shows how the device has to be installed and be at least 6" off the ground with pea-gravel in the bottom. This picture does not show it but the device must be installed with the test cock's looking straight up. The No. 1 and No. 2 cut-offs will be on the side.

**DOUBLE CHECK VALVE ASSEMBLY
INSIDE BUILDING
2" AND SMALLER**



Note:
Assembly to be a minimum of 6" from wall and 12" (min.) off floor.

DOUBLE CHECK VALVE ASSEMBLY UNDERGROUND INSTALLATION LARGER THAN 2"



- Notes:
- * Walls may be precast concrete, reinforced poured in place concrete, filled block or brick.
 - * Top may be reinforced concrete, reinforced board in place concrete, steel plate with epoxy coating, or aluminum plate.
 - * Hatch shall be manufactured steel or aluminum door, cast iron manhole ring and cover equal to sumter machine MF-11 frame and MF-18 cover, or fabricated steel or aluminum opening suitable to owner.
 - * Wall sleeves P.V.C., cast iron, steel or core drilled concrete.