

SECTION 331113
SANITARY UTILITY GRAVITY SEWER

PART 1 - GENERAL

1.1 SCOPE

- A. This section of the Specifications describes products and appurtenances to be incorporated into the gravity sanitary sewer lines and requirements for the installation and use of these items. The Contractor shall furnish all products and perform all labor necessary to fulfill the requirements of these Specifications. The Scope includes but is not limited to construction of the following items.
 - 1. Sewer Pipes
 - 2. Manholes
 - 3. Connection to Existing System
 - 4. All necessary appurtenances to collect the wastewater and deliver it to the existing system.
- B. Bypassing of raw wastewater onto the ground or into a receiving stream is prohibited.

1.2 REFERENCE STANDARDS

- A. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
- B. ASTM C14 - Standard Specification for Non-Reinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
- C. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- D. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- E. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- F. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- G. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
- H. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- I. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

- J. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- K. ASTM D2466 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- L. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
- M. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- N. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- O. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- P. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- Q. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- R. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- S. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
- T. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
- U. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.

1.3 OPTIONS

- A. The specifications describe several materials. Where manufacturers and models of equipment are named in the specification, it is intended that these are to describe the quality and function required. The Contractor may use equipment or materials of other manufacturers provided they are received and accepted by the Engineer and the Owner as meeting the specifications.

1.4 QUALITY ASSURANCE

- A. Material and Equipment shall be the standard product of a manufacturer who has manufactured them for a minimum of 2 years and who provides published data on the quality performance of the project.
- B. A Subcontractor for any part of the Work must have experience on similar work and if required, furnish the Engineer with a list of projects and the Owners or Engineers who are familiar with his competence.

- C. Devices, equipment, structures, and systems not designated by the Engineer that the Contractor wished to furnish shall be designed either by a registered Professional Engineer or by someone the Engineer approved as qualified. If required, complete design calculations and assumptions shall be furnished to the Engineer or the Owner before acceptance.
- D. All testing of the piping shall be made by the Contractor with equipment qualified by the Owner, Engineer, or utility company and in the presence of the Engineer, Owner, and utility company. The Engineer or his representative reserves the right to accept or reject testing equipment.
- E. Soil testing shall be performed by a testing laboratory regularly engaged in soil testing and shall be provided by the Owner. Mill certificates of tests on materials made by manufacturers will be accepted provided the manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests that are spot checked by an outside laboratory and furnished satisfactory certificates with the date, time, and name of the one making the test.

1.5 PRODUCT DELIVERY, STORAGE & HANDLING

A. General

- 1. Shall be as described in Section 1600 – Product Requirements.
- 2. Equipment, products, and materials shall be shipped, handled, stored, and installed in ways which will prevent damage to the items. Damaged items will not be permitted as part of the work except in cases of minor damage that have been satisfactorily repaired and are acceptable to the Engineer.

B. Pipe

- 1. Pipe: Pipe and appurtenances shall be handled, stored, and installed as recommended by the manufacturer. Pipes with paint, tape coatings, linings, or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.

C. Equipment

- 1. Package and Marking
 - a. All equipment shall be protected against damage from moisture, dust, handling or other cause during transport from manufacturer's premises to site. Each item or package shall be marked with the number unique to the specification reference covering the item.
 - b. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub assembled units where possible.
- 2. Shipping
 - a. Unload ductile iron pipe, fittings, and accessories with hoists or by skidding. Under no circumstances are pipe to be dropped. Do not skid or roll pipe handled

on skid ways against pipe already on the ground. Do not damage casting and linings; but, in the event should damage occur, make repairs or replacement to satisfaction of the Engineer/Inspector.

- b. Use proper, suitable tools and appliances for the safe and convenient handling and laying of the pipe and fittings. Take care to prevent the pipe coating from being damaged, particularly on the inside of the pipe and fittings.
 - c. Pipe may not be "strung" along the job within highway right-of- ways without the approval of the Engineer/Inspector.
 - d. Carefully examine all pipe and fittings for defects just before laying and lay no pipe or fitting which is known to be defective. In the event that defective pipe is discovered after having been laid, remove and replace with a sound pipe or fitting in a satisfactory manner at Contractor's expense.
 - e. Thoroughly clean all pipe and fittings before being laid. Plug open ends of pipe with an approved plug during construction.
3. Storage
- a. During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust, and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.
 - b. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture and condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture and condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.
4. Factory Applied Coatings
- a. Unless otherwise specified, each item of equipment shall be shipped to the site of the work with the manufacturer's shop applied epoxy prime coating. The prime coating shall be applied over clean dry surfaces in accordance with the coating manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats. Electrical equipment and materials shall be painted by the manufacturer.
5. Protection of Equipment after Installation
- a. After installation, all equipment shall be protected from damage from, including but not limited to, dust, abrasive particles, debris and dirt generated by the placement, chipping, sandblasting, cutting, finishing, and grinding of new or existing concrete, terrazzo and metal; and from the fumes, particulate matter and splatter from welding, brazing and painting of new or existing piping and equipment. As a minimum, vacuum cleaning, blowers with filters, protective shielding and other dust suppression methods will be required at all times to adequately protect all equipment. During concreting, including finishing, all equipment that may be affected by cement dust must be completely covered. During painting operations, all grease fittings and similar openings shall be

covered to prevent the entry of paint. Electrical switchgear, unit substation, and motor load centers shall not be installed until after all concrete and sandblasting in those areas have been completed and accepted and the ventilations systems installed.

1.6 GUARANTEE

- A. The Contractor shall guarantee the quality of the materials, equipment and workmanship for 12 months after acceptance of the completed project. Defects discovered during that period shall be repaired by the Contractor, at no cost to the owner. The Performance Bond shall reflect this guarantee.

1.7 EXISTING UTILITIES

- A. The Contractor is responsible for locating all existing utilities in accordance with Georgia Law.
- B. All known utility facilities are shown schematically on the plans and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown on plans will not relieve the Contractor of his responsibility under this requirement. "Existing Utility Facilities" means any utility that exists on the project in its original, relocated or newly installed position. The Contractor will be held responsible for the cost of repairs to damaged underground facilities even when such facilities are not shown on the plans. The Contractor shall contact all utility companies prior to beginning the work and request an accurate field location of their respective utility lines.
- C. Damage to any part of the existing system and facilities by the Contractor or Subcontractors, that is required by the User's and Owner's forces, shall be charged to the Contractor on the basis of time and material, plus 30% for overhead and administration.

1.8 REQUIREMENTS OF REGULATORY AGENCIES

- A. All pipes, manholes, and appurtenant structures shall meet the requirements of Georgia Environmental Protection Division.

1.9 SEQUENCING AND SCHEDULING

- A. The Contractor shall arrange his work so that sections of sewers between manholes are backfilled and tested, lateral sewers connected, pavement replaced, and the section placed in service as soon as reasonable after it is installed.

1.10 ACCEPTANCE OF PORTIONS OF WORK

- A. The Owner reserves the right to accept and use any portion of the work whenever it is considered in the public interest to do so.

1.11 RECORD DATA

- A. The Contractor is required to keep accurate, legible records of the location of any deviations from the construction drawings, any additional items or structures to the construction drawings and all utilities encountered which are not shown on the construction drawings. These records will be made available to the Engineer before his inspection for incorporation into the Engineer's record drawings.
- B. An As-Built Survey of the sanitary sewer and pump station shall be performed by a Georgia Registered Land Surveyor. The Engineer or Owner may require as-built information on each segment of the sewer installed during each pay request or application period prior to approving each periodic pay request. The drawings shall provide the state plane coordinates and depth of each manhole, beginning and end of casings, pipeline and grade, and connection to other pipelines. The drawings shall provide the state plane coordinates and depth of the pipeline at each as built survey marker. The As-Built Survey drawing shall show the as constructed arrangement of parts and fittings. The As-Built drawings shall be submitted as one paper copy and two CD copies. The CDs shall have both AutoCAD, and PDF file formats.

1.12 ENVIRONMENTAL PROTECTION

- A. The bypassing of raw wastewater onto the ground or into a receiving stream is prohibited. Direct discharging trench water into a receiving stream is prohibited. Contractor shall comply with all Environmental Protection Division Regulations during the construction of the work.

1.13 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 PIPE

- A. All pipe shall be manufactured in the United States.
- B. Ductile iron pipe shall conform to AWWA C 151 (ANSI A21.51) and shall be of a minimum pressure class as specified or shown on the plans. For a pipe with a deeper bury depth, higher pressure class pipe may be required. Final pipe class shall be determined based on specific structural calculations as they relate to conditioned encountered during design.
- C. All pipes shall be furnished in nominal lengths of 18 to 20 feet.
- D. All pipe shall be tested to a minimum of 500 psi. Pipe 18-in and larger shall be subjected to a factory hydrostatic test of at least 500 psi for a period of not less than 10 seconds after which

time the pressure is to be elevated to a peak pressure that induces a stress in the pipe wall equivalent to 75% of the minimum specified yield of the ductile iron (42,000 psi).

- E. Pipe shall be furnished with a bituminous outside coating overlaying a zinc coating per Paragraph G. and an interior per Paragraph H. Where pipe has been manufactured with a high speed cement lining, an interior seal coat shall not be required.
- F. Where pipe has been manufactured with a high speed cement lining, an interior sealcoat shall not be required. All manufacturers shall demonstrate the ability to produce a high performance lining.
- G. Ductile iron pipe shall be coated with a layer of Zinc to a mass of 200 g/m². The Zinc shall be factory applied prior to the black asphaltic coating. The coating system shall conform to ISO 81791. The mean dry film thickness of the finishing bituminous coating layer shall not be less than 3 mils with a local minimum not less than 2 mils. All pipe with zinc basecoat shall be manufactured and coated in the United States at the pipe manufacturer's facility.
- H. Pipe Interior Lining
 - 1. Unless otherwise specified, interior surfaces of pipe and fittings shall be first lined with cement mortar lining in accordance with AWWA C104 followed by asphaltic material as specified in AWWA C151. Cement shall be ASTM C150, Type II or V, low alkali, containing less than 0.60 percent alkalis.
 - 2. Where fusion-bonded epoxy coating and lining is specified, ductile iron pipe and fittings shall be coated and lined with fusion-bonded epoxy not less than 6 mils. Surface preparation and fusion-bonded epoxy application shall be per AWWA C116, with coating application by the fluidized bed process. Finished product shall be holiday tested in accordance with ASTM G62 method A or method B. Holes or voids shall be repaired per the coating manufacturer's recommended process.
 - 3. Where ceramic epoxy lining is specified, ductile iron pipe shall be lined with not less than 40 mils of ceramic epoxy. Epoxy lining shall be PROTECTO 401™ Cerami Epoxy by Induron® or Engineer's approved equal. The material shall be an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. Surface preparation and lining application shall be as recommended by the manufacturer. The lining shall be applied by a competent firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
 - 4. Any request for substitution must be accompanied by a successful history of lining pipe and fittings for sewer service, a test report verifying the material properties, and a certification of the test results.
 - 5. The pipe manufacturer must supply a certificate attesting to the fact that the applicator met the requirements of this specification, and that the material used was as specified.

2.2 JOINTS

- A. Joints shall be push-on-type for pipe and standard mechanical joints for fittings unless shown otherwise on the Drawings.

- B. Restrained mechanical joints for fittings including bends shall be mechanical joint with retainer glands.
- C. Restrained joint pipe shall be the positive restraint type. Mechanical joint pipe with retainer glands is not acceptable.
- D. Pipe in a bore casing shall be restrained joint unless shown otherwise on the Drawings.
- E. Unrestrained joints shall be the Fastite Joint as manufactured by American Cast Iron Pipe Company, the Tyton Joint as manufactured by U.S. Pipe, or equal.
- F. Restrained Joints for Ductile Iron Pipe, valves and fittings shall be mechanical joints with ductile iron retainer gland or push-on type joints equivalent to ACIPCO “Flex Ring” or “Lok Ring”, U.S. Pipe “TR Flex” or equal and shall have a minimum rated working pressure of 250 psi. Restrained joints 16-in in diameter and smaller may be ACIPCO “Fast-Grip”, U.S. Pipe “Field Lock”, McWane “TR Flex” or equal. The joints shall be in accordance with AWWA C111. If a pigmented gasket is not used, the manufacturer’s restrained joint shall be provided.
- G. Provide and install the appropriate gaskets, nuts, and bolts for restrained joints. Nuts shall be steel with American Standard Regular hexagonal dimensions, all as specified in ANSI B 17.2.
- H. All bolts and all nuts shall be threaded in accordance with ANSI B 1.1, Coarse Threaded Series, Class 2A, and 2B fit. Mechanical joint glands shall be ductile iron.
- I. Restrained joint gaskets shall be ACIPCO “Amarillo Fast-Grip” or U.S. Pipe ‘Barracuda” or McWane “Sure Stop” or equal. Restrained gaskets shall be consistent throughout the entire cross section of the gasket. The color shall not be attained by surface coating; it shall be inherent within the rubber. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11 and shall be ANSI/NSF Standard 61 certified. Restrained gaskets shall be manufactured in the United States.

2.3 FITTINGS

- A. All fittings shall be manufactured in the United States.
- B. Mechanical joint fittings for Ductile Iron Pipe shall be compact and conform to AWWA C153 with rated working pressure of 350 psi or AWWA C110 with rated working pressure of 250 psi.
- C. Fittings shall be furnished with a bituminous outside coating and an interior seal coat.
- D. Fittings shall be ductile iron and have a coating consisting of Tnemec Series 94H2O Hydro-Zinc Primer and Tnemec Series 22 Epoxoline Finish Coat Polyamine Epoxy or approved equal. Both primer and finish coat shall be ANSI/NSF Std. 61 Certified. The coating system as applied shall have a zinc level of at least 200g/m².
- E. All fittings shall have a cement mortar lining with an asphaltic seal coat and an asphaltic coating on the interior. Fittings shall be cement lined in accordance with AWWA C104.

- F. All fittings shall be lined with Induron’s Protecto 401 Ceramic Epoxy or approved equal. Where Protecto 401 is used, the lining is to be applied at a nominal 40-mil thickness.
- G. Fittings may be furnished with a 6-mil minimum nominal thickness fusion bonded epoxy coating conforming to ANSI/AWWA C550 and C116/A21.16 in lieu of bituminous coating.

2.4 PIPE & FITTINGS

- A. Both pipe and fittings shall be furnished by the same manufacturer. The Contractor may request mixed manufacturers if approved by the Engineer and Owner.

2.5 CASING PIPE

- A. The steel casing pipe shall be manufactured from steel conforming to ASTM A 139, Grade B and be new and un-used. Minimum size and thickness shall be as follows:

Pipe Diameter (inches)	Casing Diameter (inches)	Wall Thickness (inches)
6	12	0.375
8	16	0.375
10	16	0.375
12	18	0.375
14	22	0.500
16	24	0.500
18	30	0.500
20	30	0.500
24	36	0.500
30	42	0.500

- B. The materials for casing under State Highways shall be in accordance with the Georgia Department of Transportation Standard Specifications for the Construction of Roads and Bridges, latest edition. It shall be the Contractor’s responsibility to determine the exact requirements of the Georgia Department of Transportation. If there is a conflict between these Specifications and the Georgia Department of Transportation Specifications the latter shall take precedent.
- C. Steel pipe used as casing shall not require a coating or lining unless otherwise indicated on the Drawings.

- D. Stainless Steel Casing Spacers shall be bolt on style with a two-piece shell made from T-304 stainless steel of a minimum 14-gauge thickness. The shell shall be lined with a ribbed PVC sheet of a .090-inch thickness that overlaps the edges. Runners, made from UHMW polymer, shall be attached to risers at appropriate positions to properly locate the carrier within the casing and to ease installation. Risers shall be made from T-304 stainless steel of a minimum 14-gauge thickness and shall be attached to the shell by MIG welding. All fasteners shall be made from T-304 stainless steel.

2.6 CORROSION-PROTECTION PIPING ENCASEMENT

- A. Where shown on the drawings, when in proximity to cathodic protected utilities or as indicated by the FCDWS Engineer, ductile iron pipe and fittings shall be wrapped entirely with polyethylene wrap, overlapped where necessary, and secured with polyethylene tape.
- B. Encasement for Underground Metal Piping shall comply with AWWA C105, "Polyethylene Encasement for Ductile Iron Pipe Systems," and shall be in sleeve form. Materials shall be LLDPE film of 8-mil minimum thickness and colored identical to the pipe.

2.7 IDENTIFICATION

- A. The Contractor shall install Mylar marking tape or detection wire one foot above all non-ferrous pipe and properly connect it to fittings and valves.
- B. Ductile Iron Pipe and fittings supplied with black asphaltic paint shall be required to be color-coded during installation as per the general color codes requirements listed in the Utility Location and Coordination Council's Uniform Color Code. The paint shall cover what corresponds to 60% of the circumferential area of the assembled pipe. The dry film thickness of the coating shall be a minimum of 1 mil and shall substantially cover the black asphaltic coating. Any distinguishing marks as to the plant of manufacture or product information should be positioned such that this area is not included in the area to be coated. The painted area shall be installed facing up toward the top of the trench. The area to be painted shall be dry and free of any contamination that may cause the coating to disbond or discolor. Manufacturers shall be Induron Corporation or equivalent.
- C. Detection Tape: marking tape shall be buried a minimum of 12" and a maximum of 18" below finish grade. The tape shall be placed during backfill.
- D. Tracing Wire: Tracer wire will be installed on top of the pipe and looped up to surface level in all valve boxes and at all service laterals. Tracer wire shall be taped to the top of the pipelines at a minimum of 5-foot intervals in a uniform, continuous manner. This tracing wire system shall be checked and tested by the Contractor, in the presence of the Engineer or Owner, prior to acceptance of the water main installation. All equipment, meters, detectors, etc., needed for testing shall be furnished by the Contractor.
- E. Locator Posts: Posts shall be installed in a true vertical plane directly over the pipe. Post should be driven at a uniform anchoring depth of 18 to 24 inches. The tracing wire shall be brought to the surface and attached to the locator post with non-corrosive hardware. Not applicable to gravity sewers.

PART 3 - EXECUTION

3.1 ON-SITE OBSERVATION

- A. The Engineer shall have the right to require that any portion of the work be done in his presence and if any work is covered up after such instruction, it shall be exposed by the Contractor for observation. However, if the Contractor notifies the Engineer that such work is scheduled and the Engineer fails to appear within 48 hours, the Contractor may proceed without him.
- B. All work done and materials furnished shall be subject to review by the Engineer or Project Representative. All improper work shall be reconstructed and all materials which do not conform to the requirements of the specifications shall be removed from the work upon notice being received from the Engineer for the rejection of such work or materials. The Engineer shall have the right to mark rejected materials so as to distinguish them as such.
- C. The Contractor shall give the Project Engineer or project representative a minimum of 48 hours' notice for all required observation or tests.
- D. The Contractor is required to keep accurate, legible records of the location of all sewer lines, laterals, manholes, fittings, and appurtenances. These records will be prepared in accordance with the paragraph on "Record Data" in the Supplementary Conditions. Final payment to the Contractor will be withheld until all such information is received and accepted.

3.2 HANDLING MATERIALS

- A. In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench and shall be laid on high ground so that it will not be in the drainage way.
- B. Pipe shall be placed on the site of the work parallel with the trench alignment and with the bell ends facing the direction in which the work will proceed, unless otherwise directed by the Engineer.
- C. Unload ductile iron pipe, fittings, and accessories with hoists or by skidding. Under no circumstances are pipes to be dropped. Do not skid or roll pipe handled on skid ways against pipe already on the ground. Do not damage casting and linings; but, in the event should damage occur, make repairs or replacement to satisfaction of the Engineer/Inspector.
- D. Carefully examine all pipe and fittings for defects just before laying and lay no pipe or fitting which is known to be defective. In the event that defective pipe is discovered after having been laid, remove and replace with a sound pipe or fitting in a satisfactory manner at Contractor's expense.
- E. Use proper, suitable tools and appliances for the safe and convenient handling and laying of the pipe and fittings. Take care to prevent the pipe coating from being damaged, particularly on the inside of the pipe and fittings.
- F. Pipe may not be "strung" along the job within highway right-of- ways without the approval of the Engineer/Inspector.

- G. The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times.

3.3 CONSTRUCTION ALONG HIGHWAYS, STREETS, AND ROADWAYS

Install pipelines and accessories along highways, streets, and roadways in accordance with the applicable regulations of the County, City, and/or the Department of Transportation with reference to construction operations, safety, traffic control, road maintenance, and repair.

- A. Protection of Traffic: Provide and maintain suitable signs, barricades, and lights for protection of traffic.

Replace all highway signs removed for construction as soon as possible. Do not close or block any highway, street, or roadway without first obtaining permission from the proper authorities.

Provide flagmen to direct or expedite the flow of traffic.

- B. Construction Operations: The Contractor shall construct all work along highways, streets and roadways using the following sequence of construction operations, so as to least interfere with traffic.

- 1. Stripping: Where pipeline is laid along the road shoulders, sod, topsoil, and other material suitable for shoulder restoration shall be stripped and stockpiled for replacement.

- 2. Trenching, Laying and Backfilling: Do not open the trench any further ahead of pipe laying operations than is necessary. Backfill and remove excess material immediately behind laying operations. Complete excavation and backfill for any portion of the trench in the same day.

- 3. Shaping: Reshape damaged slopes, side ditches and ditch lines immediately after completing backfilling operations. Replace topsoil, sod and any other materials removed from shoulders.

- C. Excavated Material: Excavated material shall not be placed along highways, streets, and roadways in such a manner as to obstruct traffic. Roadways and pavement will be maintained free of earth material and debris.

- D. Drainage Structures: All side ditches, culverts, cross drains and other drainage structures shall be kept clear of excavated material and be free to drain at all times.

- E. Maintaining Highways, Streets, Roadways and Driveways

- 1. The Contractor shall furnish a road grader which shall be available for use at all times for maintaining highways, streets, and roadways.

- 2. All such streets, highways, and roadways shall be maintained in suitable condition for the movement of traffic until completion and final acceptance of work.

- 3. Repair all driveways that are cut or damaged. Maintain them in suitable condition until completion and final acceptance of work.

4. Use steel running plate to maintain traffic until pavement replacement is completed.

NOTE: Traffic must be maintained at all times. When one lane is closed, flagmen must be utilized to maintain traffic flow.

Repair all driveways that are cut or damaged immediately. Maintain them in a suitable condition for use until completion and final acceptance of the work.

3.4 EXISTING UNDERGROUND UTILITIES AND CONSTRUCTION

- A. The Contractor is responsible for locating all existing utilities along the path of his construction. The drawings shall indicate underground utilities or obstructions that are known to exist. Where these or unforeseen underground utilities are encountered, the location and alignment of the pipe may be changed, upon written approval of the Engineer and Owner, to avoid interferences.

3.5 CONNECTIONS TO EXISTING PIPELINES

- A. Before laying pipe, the Contractor shall locate the points of connection to existing pipelines and uncover as necessary for the Engineer and Owner to confirm the nature of the connections to be made. The Contractor shall furnish materials and make the connection to all existing pipelines. The Contractor will be observed during construction of tie-ins by the Owner and the Engineer. The Contractor shall use all available practices and resources to minimize the time the customers are without sanitary sewer services. The Contractor shall notify the affected customers of a sanitary sewer service outage at least 24 hours in advance.

3.6 PIPE DISTRIBUTION

- A. Pipe shall be distributed and placed in a manner that will not interfere with traffic.
- B. No pipe shall be strung further along the route than 1000 feet beyond the area in which the Contractor is actually working without written permission from the Owner and Engineer. The Owner and or Engineer reserves the right to reduce this to a maximum distance of 200 feet in residential and commercial areas based on the effects of the distribution to the adjacent property owners.
- C. No street or roadway may be closed for unloading pipe without first obtaining permission from the proper authorities. The Contractor shall furnish and maintain proper warning signs and obstruction lights for the protection of traffic along highways, streets and roadways upon which pipe is distributed.
- D. No distributed pipe shall be placed inside drainage ditches.
- E. Distributed pipe shall be placed as far as possible from the roadway pavement, but no closer than 5 feet from the roadway pavement, as measured edge to edge.
- F. Contractor shall not excavate sanitary sewer trenches more than 300 feet in advance of pipe laying.

3.7 LOCATION AND GRADE

- A. The drawings show the location and grade of the gravity sewer and the position of the manholes and other appurtenances. The slope shown on the gravity sewer profile and/or called for in the Specifications is the slope of the invert of the pipe.
- B. After the contractor located and marks the manhole centerlines or baselines of the gravity sewer, the Contractor shall perform clearing and grubbing.

3.8 PIPE INSTALLATION

- A. General – Ductile iron pipe shall be laid in accordance with AWWA C-60 and the pipe manufacturer’s recommendations
- B. Construction Methods:
 - 1. Install piping by trenches unless horizontal directional drilling or jack and boring are shown on the Drawings.
 - 2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
 - 3. Install manholes and reducers at locations as shown on the Drawings.
 - 4. Casing shall be installed in conformance with FCDWS Standard Specifications Division IV, Section 5.07.
 - 5. Install gravity-flow, non-pressure piping according to the following:
 - a. Install piping pitched down in direction of flow at the slope indicated on Drawings.
 - b. Install ductile-iron, gravity sewer piping according to ASTM A 746.
 - c. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
 - 6. Alignment and Grade:
 - a. All pipe shall be laid and maintained in the required lines and grades, with fittings at the required locations and with joints centered.
 - b. Where pipe is laid in roadways and parkways of streets, the top of the barrel of the pipe shall have a minimum cover of 48” below the curb line of the street or where no curb line has been established, below the existing ground line. Where the pipe is laid in open, unsubdivided areas, a minimum of 48” of cover is required. A greater depth of cover is required in certain sections of the main, such as railroad crossings, valve locations and other sections of special construction and within State and Federal highway rights-of-way.
 - c. Prior to excavation, investigation shall be made to the extent necessary to determine the location of existing underground structures and conflicts. Care shall be exercised by the Contractor during excavation to avoid damage to existing

- structures. The pipe manufacturer's recommendations shall be used when the water main being installed is adjacent to a facility that is catholically protected.
- d. Unforeseen Obstructions - When obstructions that are not shown on the plans are encountered during the progress of work and interfere so that an alteration of the plan is required, the Engineer will alter the plans or order a deviation in line or grade, or arrange for removal, relocation or reconstruction of the obstructions.
7. Excavation and Preparation of Trench: See Section 312316.13 Trenching
 8. Laying of Pipe: the spigot shall be centered in the bell, the pipe forced "home" and brought into true alignment; it shall be secured there by earth, carefully tamped under on each side of it, excepting at all bell holes. Care shall be taken to prevent dirt from entering the joint space. No "blocking up" of pipe joints will be permitted. The joint shall be made as hereinafter described.
 - a. Trench Water Entering Pipe: At times when pipe laying is not in progress, the open ends of the pipe shall be closed by approved means and no trench water shall be permitted to enter pipe.
 - b. Cutting Pipe: Cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat workmanlike manner without damage to the pipe.
 - c. Bell Ends Face Direction of Laying: unless otherwise directed, pipe shall be laid with bell ends facing in the direction of laying; and for lines on an appreciable slope, bells shall, at the direction of the Engineer, face up-grade.
 - d. Permissible Deflection of Joints: Wherever necessary to deflect pipe for a straight line, either in the vertical or horizontal plane to avoid obstructions, the degree of deflection shall be according to the manufacturer's recommendations.
 - e. Unsuitable Conditions for Laying Pipe: No pipe shall be laid in water, or when trench conditions or the weather is unsuitable for such work.
 9. Jointing Pipe – Mechanical Joints: the following steps shall be taken in the making of mechanical joints.
 - a. All lumps, blisters, and excess coal-tar enamel shall be removed from socket and spigot of the pipe.
 - b. Wash socket and plain end with soapy water containing chloride solution: then slip gland and gasket over the plain end. The small site of the gasket and lip gland shall face bell.
 - c. Paint gasket with soapy solution.
 - d. Push gasket into position, being sure it is evenly seated in socket.
 - e. Slide gland into position; insert bolts and run nuts up finger tight.
 - f. Tighten bolts to uniform tightness with correct ratchet wrench. The first bolt tightened shall be the bottom bolt, then top. All other bolts shall be tightened in sequence at 180 degrees apart.
 10. Backfilling, Clean Up and Maintaining Surfaces - See Section 312316.13 Trenching

3.9 CONNECTION TO AN EXISTING MANHOLE

- A. Connection to an existing manhole shall be made by replacing the base section of the existing manhole with a new precast base section that has inverts pre-constructed to match the proposed sewer alignment.

3.10 CONNECTION AND REPAIR TO EXISTING SEWER MAIN

- A. Where connections and repairs are required, Contractor shall only use solid sleeves, provide all materials, and labor necessary to make the connection or repair to the existing pipeline.

3.11 PROTECTION AND RESTORATION OF WORK AREA

- A. General: Return all items and all areas disturbed, directly or indirectly by work under these Specifications, to their original condition or better, as quickly as possible after work is started.
 - 1. The Contractor shall plan, coordinate, and prosecute the work such that disruption to personal property and business is held to a practical minimum.
 - 2. All construction areas abutting lawns and yards of residential or commercial property shall be restored promptly. Backfilling of underground facilities, ditches, and disturbed areas shall be accomplished on a daily basis as work is completed. Finishing, dressing and grassing shall be accomplished immediately thereafter, as a continuous operation within each area being constructed and with emphasis places on completing each individual yard or business frontage. Care shall be taken to provide positive drainage to avoid ponding or concentration of runoff.
 - 3. Handwork, including raking and smoothing, shall be required to ensure that roots, sticks, rocks and other debris are removed in order to provide a neat and pleasing appearance.
- B. Man-Made Improvements: Protect or remove and replace with the Owner and or Engineer's approval, all fences, walkways, mail boxes, pipelines, drain culverts, power and telephone lines and cables, property pins and other improvements that may be encountered in the work.
- C. Cultivated Growth: Do not disturb cultivated trees and shrubbery unless approved by Owner and or Engineer. Any such trees or shrubbery which must be removed shall be heeled and replanted under the direction of an experienced nurseryman.
- D. Cutting of Trees: Do not cut for the performance of the work except as absolutely necessary. Protect trees that remain in the vicinity of the work from damage and equipment. Do not store spoil from excavation against the trunks. Remove excavated material stored over the root system of trees within 30 days to allow proper natural watering of the root system. Repair any damaged tree over 3-inches in diameter, not to be removed, under the direction of an experienced nurseryman. All trees and brush that require removal shall be promptly and completely removed from the work area and disposed of by the Contractor. No stumps, wood piles, or trash piles will be permitted on the work site.

- E. Disposal of Rubbish: Dispose of materials cleared and grubbed during the construction of the project in accordance with the applicable codes and rules of appropriate city and or county, state and federal regulatory agencies.

- F. Swamps and other Wetlands:
 - 1. The contractor shall not construct permanent roadbeds, berms, drainage structures or any other structures which alter the original topographic features within the easement.
 - 2. All temporary construction or alterations to the original topography will incorporate measures to prevent erosion into the surrounding swamp or wetland. All areas within the easement shall be returned to their original topographic condition as soon as possible after work is completed in the area. All materials of construction and other non-native materials shall be disposed of by the Contractor.
 - 3. The Contractor shall provide temporary culverts or other drainage structures, as necessary, to permit the free migration of water between portions of a swamp, wetland or stream which may be temporarily divided by construction.
 - 4. The Contractor shall not spread, discharge or dump any fuel, oil, gasoline, pesticide, or any other pollutant to adjacent swamps or wetlands.

PART 4 - TESTING

4.1 GENERAL

- A. The following tests shall be performed by the Contractor.
- B. Sanitary sewer systems failing the required tests shall be repaired at the expense of the Contractor.

4.2 TELEVISIONING

- A. Sanitary sewers shall be televised to ensure integrity by the Contractor.
- B. Pipe shall be free of dirt and debris. Pipe shall be jetted, flushed, and vacuumed prior to test.
- C. Televising cable attached to a video monitor shall be directed through pipe to view for the following deficiencies.
 - 1. Cracks in pipe and liner material.
 - 2. Rolled gaskets.
 - 3. Leaking joints.
 - 4. Deviations from line and grade.
 - 5. Other deficiencies.

- D. Contractor shall repair all deficiencies noted by FCDWS. Method must be approved by FCDWS Engineer.
- E. Test shall be considered acceptable when the televised pipe does not reveal the deficiencies indicated in Item C.
- F. Test shall be recorded on F.C. T.V. Test form Appendix G in Forsyth County Department of Water and Sewer Construction Standards.

4.3 AIR PRESSURE

- A. All gravity sewer pipes, including service laterals, shall be subjected to a low air pressure test in accordance with Uni-bell UNI-B-6-98. Testing shall be done when the temperature at the site is at least 36 degrees (F) and rising.
- B. Pipe shall be free of dirt and debris.
- C. During testing, personnel shall not be permitted in manholes connected to pipe being testing.
- D. The internal air pressure of the pipe shall be raised to four (4.0) psi greater than the average backpressure of groundwater around the sewer (add 0.43 psi to test pressure for each vertical foot that the groundwater is above the top of pipe). Test pressure shall not exceed 9.0 psi.
- E. The test shall begin when the stabilized pressure is at a minimum of 4 psi greater than the average backpressure of groundwater around the sewer.
- F. If the time shown in the following table for the designated pipe size and length elapses before the air pressure drops 1.0 psi; the section undergoing test shall be considered acceptable.
- G. If there has been no leakage (zero psig drop) after one hour of testing, the test section shall be considered acceptable and the test complete.

AIR TEST - BASED ON FORMULAS FROM UNI-N-6-98

SPECIFICATION TIME (MIN:SEC) REQUIRED FOR PRESSURE DROP FROM 3 1/2 TO 2 1/2 PSIG WHEN TESTING ONE PIPE DIAMETER ONLY

Length	PIPE DIAMETER IN INCHES												
	4	6	10	12	15	18	21	24	27	30	33	36	42
25	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:40	25:30	28:20	31:10	34:00
50	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:40	25:30	28:20	31:10	34:00
75	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:40	25:30	28:20	32:19	38:28
100	3:47	5:40	7:33	9:27	11:20	14:10	17:00	19:50	22:48	28:51	35:37	43:06	51:17
125	3:47	5:40	7:33	9:27	11:20	14:10	17:00	21:49	28:30	36:04	44:31	53:52	64:06
150	3:47	5:40	7:33	9:27	11:20	14:10	19:14	26:11	34:11	43:16	53:25	64:38	76:56
175	3:47	5:40	7:33	9:27	11:20	15:35	22:26	30:32	39:53	50:29	62:20	75:25	89:45
200	3:47	5:40	7:33	9:27	11:24	17:48	25:39	34:54	45:35	57:42	71:14	86:11	102:34
225	3:47	5:40	7:33	9:27	12:49	20:02	28:51	39:16	51:17	64:55	80:08	96:58	115:24
250	3:47	5:40	7:33	9:54	14:15	22:16	32:03	43:38	56:59	72:07	89:02	107:44	128:13
275	3:47	5:40	7:33	10:53	15:40	24:29	35:16	47:59	62:41	79:20	97:56	118:31	141:02
300	3:47	5:40	7:36	11:52	18:00	26:43	38:28	52:21	68:23	86:33	106:51	129:17	153:51
350	3:47	5:40	8:52	13:51	19:57	31:10	44:52	61:05	79:47	100:58	124:39	150:50	179:30
400	3:47	5:42	10:08	15:50	22:48	35:37	51:17	69:48	91:10	115:24	142:28	172:23	205:09
450	3:47	6:25	11:24	17:48	25:39	40:04	57:42	78:32	102:34	129:42	160:16	193:55	230:47

Table based on allowable air loss of .0015 cu ft / min per square foot of internal pipe surface and a maximum air loss per test section of 1 cu foot / min

4.4 VACUUM TESTING FOR MANHOLES

- A. Vacuum testing of manholes for water tightness is required to demonstrate the integrity of the installed materials and the construction procedure. Vacuum testing shall be performed by the Contractor and witnessed by the Engineer or the Owner.
- B. Testing shall be in accordance with ASTM C 1244.
- C. If the manhole fails the initial test, the Contractor shall make all necessary repairs, then retest until a satisfactory test is obtained.
- D. All manholes shall pass the vacuum test prior to the final payment.

END OF SECTION 331113