



WASTEWATER DEPARTMENT
STANDARD SPECIFICATIONS

SECTION 400

WASTEWATER COLLECTION AND TRANSMISSION SYSTEMS

JANUARY 1, 2018

Table of Contents

400.01	SCOPE	1
400.02	SANITARY SEWER MAINS – GRAVITY AND PRESSURE (FORCE).....	1
400.03	SANITARY SEWER SERVICE CONNECTIONS (LATERALS).....	19
400.04	SANITARY SEWER MANHOLES.....	21
400.05	INSTALLATION	31
400.06	INSPECTION AND TESTING.....	44

400.01 SCOPE

- A. These general and detailed Specifications shall govern the construction of sanitary sewer gravity mains, force mains, service laterals (may also be referred to as service connections), manholes, and other related sanitary sewer facilities, and shall also govern the connection to existing sanitary sewer mains and manholes. These Specifications are to provide minimum design and construction criteria for the construction of sanitary sewer collection systems and transmission systems for the City of Foley (City), including The Utilities Board of the City of Foley, Alabama doing business as Riviera Utilities, and applicable jurisdictional boundaries that apply. Riviera Utilities may herein be referred to as "OWNER", unless distinctions otherwise are made.
- B. These minimum standards may be superseded in circumstances where the OWNER or ENGINEER OF RECORD (ENGINEER) determines that conditions specific to a particular project or location warrant additional measures beyond the scope of these Specifications. These conditions shall be limited to extraordinary circumstances such as soils, laying conditions, geography, etc., that, in the opinion of the ENGINEER of Record, could adversely affect the life, operation, or maintenance of the installed systems or the practical application of the methods described herein. All exceptions to these Specifications, other than exceptions that exceed these Specifications, shall be submitted to Riviera Utilities for review and approval. For all new construction, approval of these exceptions to the Specifications by Riviera Utilities is required prior to Riviera Utilities' approval of a preliminary plat, ground disturbance permit(s), and/or building permit(s) where any exceptions to the Specifications are included in the project. Under no circumstances will economic feasibility be an acceptable justification for an exception to these Specifications.

400.02 SANITARY SEWER MAINS – GRAVITY AND PRESSURE (FORCE)

- A. General Design Requirements
 1. Location of Gravity Mains and Force Mains
 - a. All public sanitary sewer gravity mains and force mains shall be installed within a dedicated street right-of-way or within a dedicated utility easement. In general, gravity mains installed within right-of-ways shall be routed along the centerline of the roadway's pavement. Gravity mains and force mains installed within easements shall be

centered within the easement. All mains located with State of Alabama right-of-ways shall be routed and installed in accordance with the requirements of the Alabama Department of Transportation (ALDOT).

- b. All private collection systems that discharge to, or are planned to discharge to, the OWNER'S wastewater collection system are required to comply with all design criteria and installation requirements described herein. The owner of the private collection system shall meet all local and state design requirements and obtain all applicable permits.
- c. Normally, easements for an individual public sanitary sewer gravity main or force main shall be a minimum of fifteen (15) feet in width and easements that contain both a gravity main and force main shall be a minimum of twenty (20) feet in width. Additional easement width may be required by the OWNER to better facilitate obstructions within the easement and access/maintenance of mains, particularly for mains installed at larger depths. Additional easement width may also be required if the main(s) cannot be centered along the easement. In general, sanitary sewer easements shall not contain other utilities or storm drains without prior approval from Riviera Utilities. Dedicated easements for sanitary sewer mains and appurtenances shall be recorded as "City of Foley/Riviera Utilities Sanitary Sewer Easement" or "City of Foley/Riviera Utilities Utility Easement".
- d. No developer, contractor or property owner shall place any part of a structure, any permanent equipment, permanent retaining wall or impoundment within sanitary sewer easements or utility easements dedicated to the City of Foley and/or Riviera Utilities. Fences may be allowed across easements provided that appropriate access gates have been installed to allow utility maintenance. Fill or cut slopes are not allowed to extend into sanitary sewer easements except by specific approval by Riviera Utilities.
- e. Sanitary sewer easements shall be graded smooth and be free from felled trees and limbs, roots, stumps, and other debris. Easements shall be seeded and mulched immediately upon the completion of construction. For final acceptance of sanitary sewer mains and appurtenances by the City and by Riviera Utilities, it is required that all areas within easements have a stand of grass sufficient to control erosion.

- f. Sanitary sewer gravity mains that parallel a creek, drainage pipeline, drainage ditch or other obstruction shall be of sufficient depth to allow sanitary sewer lateral connections to be extended under the obstruction. Under no circumstances shall the top of a sanitary sewer main or lateral have less than eighteen (18) inches of cover below a stream bed or drainage ditch. Concrete encasement and ductile iron pipe shall be required when the cover from the top of the pipe to the stream bed or ditch bed is less than 30 inches.
- g. Sanitary sewer mains shall not be installed under or within 10 feet horizontally of any water impoundments, including ornamental water features, retention ponds, or fountains.
- h. In accordance with Riviera Utilities' policies, sanitary sewer gravity mains shall be of sufficient depths to serve adjoining properties while allowing greater-than-minimum slopes for laterals. Where directed by Riviera Utilities, stub-outs of sanitary sewer gravity mains, force mains, or laterals shall be provided to serve adjoining properties.
- i. The minimum cover from the top of the pipe of all sanitary sewer mains shall be four (4) feet to finished subgrade under roadways and three (3) feet to finished grades elsewhere. Cover of mains to less than minimum depths shall require written approval by Riviera Utilities.
- j. Sanitary sewer mains shall have a minimum vertical separation of twelve (12) inches between storm sewer pipes when the horizontal separation is three (3) feet or less. Where sanitary and storm sewers cross with a vertical separation of less than eighteen (18) inches, a minimum of one (1) full joint of ductile iron pipe shall be centered at the crossing and backfilled with 3000 psi concrete or excavatable flowable fill that meets or exceeds ALDOT requirements.
- k. There shall be a minimum of five (5) feet of horizontal separation between parallel gravity mains and/or force mains.
- l. Sanitary sewer mains shall have a minimum horizontal separation of ten (10) feet from all water mains, unless the sanitary sewer main is more than eighteen (18) inches below the bottom of the water main and there is a horizontal separation of at least 36 inches from the closest pipe joints.

m. Where sanitary sewer mains cross beneath water mains with a vertical separation of eighteen (18) inches or less, or where water mains cross under sanitary sewer mains, a minimum of one (1) full joint of ductile iron pipe shall be centered at the crossing and the annular space between the crossing shall be backfilled with an excavatable flowable fill that meets or exceeds ALDOT requirements. The water main shall be centered at the point of crossing, which shall be at an approximate 90 degree angle.

2. Gravity Main Size, Slope and Design Criteria

- a. All public sanitary sewer gravity mains shall have a minimum nominal diameter of eight (8) inches.
- b. The capacities of sanitary sewer collection and transmission system expansions shall be designed based on the proposed land use unless directed otherwise by the OWNER or if the design criterion for the specific project dictates the need for additional capacity. Estimates of wastewater flow shall be based on the estimated daily flows per unit shown in Table 400.1 below unless data is available that supports higher estimated daily flows per unit. At a minimum, all sanitary sewer gravity mains shall be designed and sized to serve the ultimate buildout of the potential upstream portions of the drainage basin, including other basins that may be pumped by force main into said basin.

<u>Land Use</u>	<u>Estimated Flow Factor</u> <u>(gpd – gallons per day)</u>
Single Residential	280 gpd per dwelling unit
Multi-Family Residential	100 gpd per bedroom
Office or Institutional	0.09 gpd per square foot of building space
Commercial	0.12 gpd per square foot of building space
Industrial	0.20 gpd per square foot of building space

*Table 400.1 – Land Use Flow Factors for
Estimating Average Daily Wastewater Flows*

- c. For estimating ultimate flows for design purposes, the ratio of peak hourly flow (PHF) to average daily flow (ADF), also known as the “peaking factor”, shall be at least 3.5.
- d. All sanitary sewer gravity mains shall be designed to carry the projected peak flow at no more than 2/3 full and to have a mean velocity when flowing full of no less than 2.0 feet per second as based on Manning’s Equations with a roughness coefficient (“n”) of 0.013 or

greater. The recommended minimum grades for gravity mains shall be as shown in Table 400.2. Under limited circumstances, grades may be used that are less than those shown in Table 400.2 with written approval from the OWNER.

- e. The minimum grade for the uppermost reach of a gravity sewer line shall be 1.00% regardless of sewer main size. The maximum grade for gravity mains is 10%.
- f. Sewer extensions shall be designed to accommodate projected flows, even when the diameter of a receiving gravity main is less than the diameter of the proposed extension.

Nom. Pipe Diameter (inches)	Grade (feet per 100 feet or %)
4	1.00 (2.00 recommended)
6	0.60 (1.00 recommended)
8	0.40
10	0.28
12	0.22
14	0.17
15	0.15
16	0.14
18	0.12

Table 400.2 - Minimum Recommended Grades for Sanitary Sewer Gravity Mains ($V_{min} > 2.0$ Feet Per Second When Flowing Full)

- g. Changes in pipe diameter shall only occur in manholes, with the invert of the larger pipe lowered sufficiently to maintain the same energy gradient. An approximate method of obtaining this result is to place the point of 80% of full depth for both pipes at the same elevation. As an alternative, the crown of the incoming pipes may be designed for an elevation at or above the crown of the outgoing pipe.

3. Force Main Size and Design Criteria

- a. Force mains shall discharge at the invert of the receiving manhole and shall be as close as possible to 180 degrees from the outlet pipe. Drop connections or free fall discharges for force mains will not be allowed without approval by the OWNER. Force main discharges shall not create excessive turbulence within the receiving manhole. The receiving manhole's invert shall be designed to smoothly transition the flow from the force main to the outgoing pipe.

- b. As is appropriate for the particular installation, sewage air release valves, sewage air/vacuum valves and/or sewage combination air valves shall be installed in accordance with the recommendations of the ENGINEER or the valve manufacturer at strategic locations on the force main such as high points, long uphill runs, runs exceeding 3,000 feet, etc. to ensure that the efficiency of flow in the force main. At a minimum, sewage air release valves shall be installed on force main at all high points. All sewage air valves shall be inside a pit or vault with a vented cast iron cover as specified herein and/or shown on the Plans to allow routine access and maintenance.
 - c. An isolation gate valve or plug valve with a cast iron valve box lettered "SEWER" shall be installed at least every 2,000 feet of force main length. Additional isolation valves shall be installed where directed by the OWNER to accommodate future connections and extensions.
 - d. An isolation gate valve or plug valve shall be installed on the upstream side of each force main branch at locations where one force main is connected to another force main, unless directed otherwise by the OWNER. If a tapping valve and sleeve is used for connecting a new force main to an existing force main, it is not necessary to provide an isolation valve on the existing force main.
4. Infiltration Criteria for Gravity Mains
- a. Infiltration into newly constructed sanitary sewer gravity mains shall not exceed 100 gallons per mile of pipe per inch of inside diameter of the pipe per 24 hours in any section between successive manholes. At the discretion of the ENGINEER or the OWNER, the amount of leakage shall be measured by a suitable weir or other device at the cost of the Contractor.
 - b. If the infiltration exceeds the above specified amount, the Contractor shall make the necessary corrections to bring it within the acceptable limits. All visible leaks or points of infiltration shall be repaired regardless if the infiltration is below the minimum allowable amount.

B. Materials**1. Ductile Iron Pipe and Fittings for Sanitary Sewer Gravity Mains and Force Mains**

a. Where specifically designated on the Plans, the Specifications, or at locations determined in the field, ductile iron pipe shall be used for sanitary sewer gravity mains and/or force mains as hereinafter specified. Ductile iron pipe shall be manufactured in accordance with the latest revisions of ANSI/AWWA C151/A21.51 and ANSI/AWWA C151/A21.51. Pipe for gravity mains and force mains shall have a standard asphaltic coating on the exterior as required by ANSI/AWWA C151/A21.51, latest revision, and the interior shall have a cement-mortar lining with an asphaltic seal coat in accordance with ANSI/AWWA C104/A21.4, latest revision, unless indicated otherwise on the Plans or Specifications. At the discretion of the ENGINEER or the OWNER, ductile iron pipe for gravity mains in severe service areas or force mains shall be supplied with a manufacturer-applied ceramic epoxy interior lining in lieu of a cement mortar lining. Cutting of ductile iron pipe shall be by a saw, cutter, abrasive wheel or other approved means. In no case shall ductile iron pipe be cut by burning. Markings on all ductile iron pipe shall include the pressure rating, class or nominal thickness, net weight of pipe without lining, length of pipe, manufacturer's mark, casting period, year and country of production, and the letters "DI" or "DUCTILE". All gaskets shall be furnished with the pipe.

b. Ductile Iron Pipe for Gravity Mains

i. Ductile iron pipe for gravity mains and force mains shall be furnished with push-on (PO) type joints (i.e. Tyton, Fastite, etc.). Joints shall be in accordance with ANSI/AWWA C111/A21.11, latest revision, and shall be furnished complete with all necessary accessories. For certain installations, the ENGINEER or the OWNER may require ductile iron pipe having restrained joints (RJ). The allowable methods of joint restraint specified herein shall be utilized where required.

ii. The minimum wall thickness for gravity main pipe shall be as specified in ASTM A746 for Thickness Class 52. Pipe with a larger wall thickness shall be employed where required for extreme installation depths in accordance with ASTM A746, Table 12, for a Type 2 laying condition.

- iii. Unless otherwise specified, gasket material shall be standard styrene butadiene copolymer. Joint deflection for all joints shall not exceed the manufacturer's standard allowable joint deflection.
 - iv. With written approval from the OWNER, pressure class ductile iron pipe may be used in lieu of thickness class pipe for gravity mains. Pressure class pipe shall be designed and manufactured in accordance with AWWA C150 and AWWA C151 for a Type 2 laying condition. All pressure class pipes shall be rated for a 350 psi working pressure.
 - v. All gravity mains having less than three (3) feet of cover shall be ductile iron.
- c. Ductile Iron Pipe for Force Mains
- i. Ductile iron pipe for force mains shall be furnished with push-on (PO) type joints (i.e. Tyton, Fastite, etc.). Joints shall be in accordance with ANSI/AWWA C111/A21.11, latest revision, and shall be furnished complete with all necessary accessories. For certain installations, the ENGINEER or the OWNER may require ductile iron pipe having restrained joints (RJ). The allowable methods of joint restraint specified herein shall be utilized where required.
 - ii. Ductile iron pipe for force mains shall be Thickness Class 52 as specified in ASTM A746 or pressure class pipe rated for a 350 psi working pressure. Pressure class pipe shall be designed and manufactured in accordance with AWWA C150 and AWWA C151 for a Type 2 laying condition.
- d. Ductile Iron Fittings – All fittings shall be ductile iron and shall be designed for a minimum pressure rating of 250 psi. Fittings shall conform to the latest revision of either ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. Fittings and accessories shall be furnished with mechanical joints in accordance with ANSI/AWWA C111/A21.11, latest revision, unless noted otherwise on the Plans or Specifications. All fittings shall have a cement mortar lining conforming to ANSI/AWWA C104/A21.4.

- e. Positive Restrained Joint Pipe and Fittings – Positive RJ pipe and fittings suitable for a working pressure in excess of 150 psi may be used in lieu of friction restrained fittings. Positive restrained joint pipe and fittings shall be either mechanical joint or push-on joint and shall be the manufacturer's proprietary restrained joint system. The pipe and fittings shall achieve restraint by means of a positive factory-made, metal-to-metal contact and shall allow full deflection of the joint when made up.
- f. Friction Restrained Joint Fittings – The following types of friction-restrained fittings may be used in lieu of positive restraint:
 - i. Locked mechanical joint retainer glands of adequate strength to prevent movement may be used to supplement concrete backing. Locked mechanical joint retainer glands shall be ductile iron retainer glands equipped with either hardened cupped end set screws of a type which utilizes a multiple wedging action and twist-off nut to insure proper actuating of the restrained devices.
 - ii. Friction mechanical joint restraint may be used in lieu of locked mechanical joint retainer glands. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Flexibility of the joint shall be maintained after burial. Glands shall be manufactured of ductile iron conforming to ASTM A536. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21 and ANSI/AWWA C153/A21, latest revision. Twist-off nuts shall be used to insure proper actuating of restraining devices. The mechanical joint restraint device shall have working pressure of at least 250 psi with a minimum safety of 2:1.
 - iii. A gasket system utilizing stainless steel locking segments molded into the gasket may be used in lieu of mechanical joint retainer glands to achieve joint restraint for pipe diameters of 4 inches through 12 inches.

g. Polyethylene Sheath for Ductile Iron Pipe

- i. Where directed by the ENGINEER or the OWNER, a polyethylene sheath shall be installed on all ductile iron pipe and fittings used for sanitary sewer gravity mains and force mains unless the local native soils have been analyzed and evaluated by a Registered Professional Engineer in accordance with AWWA Specification C105 to confirm that the soils will not be corrosive to the pipe and fittings. The sealed polyethylene sheath shall be installed to cover all ductile iron in accordance with AWWA Specification C105.
- ii. Any polyethylene sheathing which is damaged shall be replaced or repaired by the Contractor at no additional expense to the OWNER. The thickness of ductile pipe may be increased by one class thickness in lieu of providing a soil survey.

2. PVC Pipe and Fittings for Sanitary Sewer Gravity Mains and Force Mains

- a. Where specifically designated on the Plans, the Specifications, or at locations determined in the field, polyvinyl chloride (PVC) pipe shall be used for sanitary sewer mains and/or force mains. PVC pipe shall be retained in shipping cradles until the pipe is ready to be installed. Under no circumstances shall PVC pipe for gravity mains be removed from shipping cradles more than twenty four (24) hours in advance of placing in the trench.

b. PVC Pipe and Fittings for Gravity Mains

- i. Unplasticized PVC pipe and fittings for gravity mains shall meet or exceed ASTM D3034, latest revision, and shall have a maximum Standard Dimension Ratio (SDR) of 35. Where laying conditions so warrant, and in accordance with manufacturer's recommendations, lower SDR values with higher wall thicknesses shall be required. At the discretion of the ENGINEER or the OWNER, the installation of SDR 26 PVC pipe or SDR 21 PVC pipe may be required.
- ii. Pipe lengths shall not exceed twenty (20) feet and provisions shall be made at each joint to accommodate expansion and contraction.
- iii. All PVC pipe and fittings shall be joined by means of an integral wall bell and spigot and sealed with a rubber gasket. This joint

shall be capable of withstanding an internal hydrostatic pressure of twenty-five (25) psi for one (1) hour without any detectable leakage.

- iv. PVC pipe for gravity mains shall be installed in accordance with ASTM D2321, latest edition. If there is a conflict between the provisions of ASTM D2321 and these Specifications, these Specifications shall govern as to this conflict.
 - v. Diametric deflection of PVC gravity mains after installation and backfill shall not exceed five percent (5 %) when tested at least 90 days after the pipe has been completely backfilled. PVC pipe found to be deflected more than five percent (5 %) shall be replaced. Refer to Section 400.5 for specific requirements for testing of pipe deflection.
 - vi. The color of PVC pipe used for gravity mains shall be green. With prior approval from the OWNER, white pipe may be substituted for green pipe.
 - vii. Refer to the specifications for sanitary sewer manholes herein for the material and installation requirements for sealing pipe-to-manhole connections.
- c. PVC Pipe for Force Mains
- i. PVC pipe for force mains shall be IPS pressure-rated pipe conforming to the requirements of ASTM D2241 in accordance with ASTM D1784, most recent revision. PVC force main pipe shall have a minimum pressure rating of 200 psi and shall have a minimum SDR of 21 for both barrel and bell dimensions. Under special circumstances and with prior approval by the OWNER, PVC pipe conforming to the requirements of AWWA C900 with a minimum pressure rating of 150 psi and an SDR of 18 may be used for force mains.
 - ii. Certificates of conformance with the foregoing Specifications shall be furnished with each lot of pipe supplied.
 - iii. Pipe shall be joined by means of a bell and spigot joint with rubber ring sealing gasket that shall be an integral and homogeneous part of the pipe barrel. All PVC pipe and fittings shall be joined by means of an integral wall bell and spigot and

sealed with a rubber gasket. The gasket shall be an integral and homogeneous part of the pipe bell.

- iv. Fittings for PVC force mains shall be ductile iron as specified herein in Section 400.2, Part B, Paragraph 1 - Ductile Iron Pipe and Fittings for Sanitary Sewer Gravity Mains and Force Mains.
 - v. The color of PVC pipe used for force mains shall be green or brown, or, as an alternate, white PVC having a continuous, brown stripe painted along the length of each pipe segment 180 degrees from the normal pipe markings. White PVC force main pipes up to four (4) inches in diameter shall have one (1) one-inch wide brown stripe. White PVC force main pipes six (6) inches in diameter and larger shall have one (1) three-inch wide brown stripe. The paint used shall be Sherwin Williams "Bolt Brown SN 4001 Epoxy Paint" or approved equivalent. The pipe shall be installed such that a continuous solid brown stripe is visible from the top of the pipe trench.
 - vi. Marking tape shall be provided and installed for all PVC force mains. Marking tape shall be green and imprinted with "Caution: Buried Sewer Line Below", buried six (6) to twelve (12) inches above the top of the pipe. Tape shall be three (3) inches wide minimum, made of an inert plastic film resistant to alkalis, acids, or other destructive chemical components likely to be encountered in soils. The pipe trench shall be backfilled to at least six (6) to twelve (12) inches above the top of the pipe and the tape shall then be placed flat with the imprint faced up. Backfill shall be carefully placed to a depth of 3 inches over tape by hand to assure that the tape is secured in place over the pipe. Marking tape used with PVC force mains shall be metalized so that the PVC pipe can be located using standard pipe location equipment.
 - vii. Tapping saddles meeting the OWNER's specifications for water mains shall be used for insertion of corporation stops or other outlets for testing of force mains.
3. Polyethylene (PE) Pipe for Sanitary Sewer Gravity Mains and Force Mains
- a. Where specifically designated on the Plans, the Specifications, or at locations determined in the field, PE pipe made from high density polyethylene resin compound in conformance with ASTM D1248 shall

be used for sanitary sewer mains and/or force mains. Dimensions and workmanship shall conform to ASTM F714.

- b. The PE pipe shall have the nominal pipe size and dimension ratio shown on the Plans or in the Specifications. Installation of PE pipe shall be in accordance with ASTM D2321 or as modified herein.
- c. Shipping lengths of PE pipe shall be assembled into one continuous length at the job site by thermal butt fusion. The fusion machine and fusion machine operator shall be approved by the pipe's manufacturer. The resultant joint shall be as strong as the intervening lengths. Jointing of pipe and installation of outlets shall be in accordance with the pipe manufacturer's written recommendations. The pipe manufacturer shall provide the services of a trained representative to instruct the Contractor's forces in the proper techniques for jointing of pipe and the installation of outlets or other items.
- d. Installation of PE pipe in areas where flotation is probable whether on land or a subaqueous location installation shall conform to the manufacturer's recommendations. Fabricated polyethylene bends shall be manufactured by the pipe's manufacturer and shall match the SDR of the connecting pipe. Deflection of polyethylene pipe after installation and backfilling shall not exceed 5 percent.

4. Valves for Sanitary Sewer Gravity Mains and Force Mains

- a. Check Valves for Force Mains – Check valves shall be iron bodied, fully bronze mounted with bronze clapper disc and bronze seat ring, and shall have a weighted lever arm capable of being mounted on either side of the valve.
- b. Gate Valves
 - i. Gate Valves for Force Mains - Gate valves shall be non-rising stem for underground direct burial service and shall close when the operating nut is turned in clockwise rotation. Valves shall be as manufactured by Mueller 2360 series, or approved equal, and be the resilient seat type or equal in accordance with and meet the requirements and recommendations of the latest published AWWA Specification C500. Stem sealing shall be provided by O-Ring packing. Valves shall be furnished complete with necessary gaskets, bolts, nuts as needed for mechanical joint ends unless

noted otherwise on the Plans.

- ii. Gate Valves for Gravity Mains – Gate valve for gravity mains shall meet the same requirements as gate valves for force mains. However, gate valves for gravity mains shall include a valve stem extension assembly. The valve stem extension assembly shall be permanently attached to the operating nut of the valve and to each individual link of the assembly by set screw couplings. The operating nut of the valve stem extension assembly shall be between one (1) foot and two (2) feet below finished grade. The Contractor shall provide an extended valve box assembly that is centered on the gate valve and is continuous from the gate valve to finished grade.
- c. Plug Valves for Force Mains – Plug valves shall be eccentric action and resilient plug facing with heavy duty stainless steel bearings and welded-in corrosion resistant nickel seat. Force main plug valves shall provide clean passage for a solid sphere of at least 67% of the adjoining pipe diameter to facilitate pigging of the force main. Force main plug valves shall be "full-port" cross-sectional area perpendicular to the flow of at least 100% of the adjoining pipe.
- d. Valve Boxes – Gate valves or plug valves on sanitary sewer mains shall be provided with a height-adjustable valve box having a cast iron top and body. The cast iron body shall include base section that covers the operating nut and the head of the valve. The valve box shall be installed plumb and centered on the operating nut of the valve. The inside diameter of the vertical shaft of the valve box shall be at least 5-1/4 inches. The top section of the valve box shall be adjusted to be even with either finished grades or the finished surface of paved areas. The cover shall be marked in large letters with "SEWER" and shall be field-painted green. In unpaved areas, the top of the valve box shall be installed within a 3,000 psi concrete circular collar having a diameter of at least 18 inches and a thickness of at least five inches as shown on the Plans or standard drawings.

5. Encasement Pipe

a. General

- i. Encasement pipe shall conform to all AASHTO requirements and ALDOT's specifications for encasement pipe, most recent version, when encasement is placed within a right-of-way maintained by ALDOT or Baldwin County to. When encasement pipe is placed under railroads, encasement pipe shall conform to all AREA 1-5-B requirements. Encasement pipe shall be installed by open cutting where allowable or otherwise installed by a dry boring method in which the casing pipe is placed simultaneously with the boring action, thus eliminating the possibility of cave-ins.
- ii. Roadways, railroad tracks or other facilities directly above the Work shall be inspected before, during, and after the placing of the encasement for any shifting, settlement, or other damage. If settlement occurs that damages a paved surface, the Contractor shall repair the pavement in accordance with the requirements of ALDOT or other controlling authority at no additional cost to the OWNER. If settlement damages a railway, the track shall be repaired to its original alignment and condition by the means required by the operator of the railway at no additional cost to the OWNER.
- iii. All pipes installed within encasement pipe shall have restrained joints and not be allowed to rest on the pipe bells. Encasement pipes shall have an inside clear dimension of at least two (2) inches greater than the maximum outside dimension of the carrier pipe bell or the mechanical joint restraints.

b. Welded Steel Encasement Pipe – Welded steel encasement pipe shall be of the size and wall thickness shown on the Plans and shall conform to ASTM A252, Grade 2. The pipe shall be coated on the outside only with a coal tar primer coat followed by a single application of hot coal tar enamel 3/32 inches thick $\pm 1/32$ inches. Uncoated pipe may be used subject to the approval of ALDOT or other corresponding authority provided the wall thickness is at least 0.063 inches greater than required on the Plans or Specifications.

c. Encasement Pipe Spacers – When pipe is installed in encasement pipe, commercially-fabricated encasement spacers (Raci Casing Spacers or approved equivalent) shall be used to prevent damage to

the carrier pipe bell joints during installation and to provide proper long-term pipe support. The installation and spacing from center to center of encasement spacers shall be in accordance with the manufacturer's requirements for the specific installation. Use of wooden skids will not be permitted. Encasement spacers must be fastened securely to prevent sliding along the carrier pipe and shall provide sufficient height to permit clearance between bell joints and the encasement walls. Encasement spacers shall be constructed entirely of nonmetallic materials. The space between the encasement pipe and the carrier pipe shall not be filled with backfill unless specifically required by the Plans and Specifications.

- d. Filling Encasement Pipe – Where required by the Plans and Specifications, the space between the encasement pipe and the carrier pipe shall be filled with sand to the full diameter of the encasement pipe. The sand shall be placed by flooding, pumping, or other approved methods. The encasement pipe shall not be permitted to fill with water after the carrier pipe is installed and prior to placing of sand fill. If the carrier pipe is displaced by flotation, it shall be reinstalled to line and grade.
- e. Encasement Pipe End Seals – The ends of encasement pipe shall be sealed with approved rubber end seals having stainless steel clamping bands. Masonry plugs shall not be used unless approved by the OWNER.

6. Sewage Air Release Valves and Air and Vacuum Valves for Force Mains

- a. The sizing and location of all sewage air valves, which includes air release valves, air/vacuum valves, and combination air and air/vacuum valves, shall be done by a Registered Professional Engineer and shall meet or exceed the recommendations of the valve manufacturer. The size and location of all sewage air valves shall be submitted to the OWNER for review and approval. Sewage air release valves shall be used where necessary to permit unrestricted passage of large volumes of air during filling of a force main and continuous air release during operation. At a minimum, sewage air release valves are required at all “high” points along a force main that are more than 1/2 the pipe’s diameter higher than adjacent portions of the pipe.
- b. Where necessary or as required by the ENGINEER or the OWNER, sewage air/vacuum valves shall be used to permit both unrestricted

passage of large volumes of air during filling of the force main and unrestricted entry of air into the force main under vacuum conditions. Where the functions of both a sewage air release valve and an air and vacuum valve are required, a sewage combination air and air/vacuum valve shall be used.

- c. Sewage air valves shall meet the requirements of AWWA C512 and shall be constructed specifically for wastewater applications. Floats shall be stainless steel and the sewage air valve shall be designed so that the venting mechanism does not come into contact with sewage. Sewage air valves shall have a minimum two (2) inch NPT inlet or larger depending on the manufacturer's recommended valve size for the particular application.
- d. Sewage air valves shall be supplied with a bronze inlet shut-off valve, 304 Schedule 40 stainless steel pipe nipples (as necessary), and a manufacturer-supplied backflushing assembly that includes a blow-off valve, a clean water inlet valve, rubber supply hose, and quick disconnect couplings. All inlet and backflushing valves shall be quarter-turn full-ported bronze ball valves with an operating handle.
- e. Sewage air valves shall be installed centered on a minimum 10-foot length of ductile iron force main pipe by means of an approved tapping saddle.
- f. Vaults or pits for sewage air valves shall be constructed from a precast concrete concentric manhole cone section or manhole riser section and have an appropriately-sized vented cast iron cover as shown on the Plans and Specifications. The cast iron cover shall be rated by the manufacturer for traffic loading. The cover of the vault shall be flush with finished grade. Where required, the cover of the vault shall be centered within a 4' by 4' concrete pad (3,000 psi min. concrete with min. 8" pad thickness). The installation depth of force mains shall be sufficient to install the required air valve. All valves on the sewage air valve assembly shall be easily accessible to operate by hand without having to enter vault.
- g. Sewage air valves shall be manufactured by APCO Valve Corp., Val-Matic Valve and Mfg. Corp, G.A. Industries, Inc. or approved equal.

7. Repair Couplings for Dissimilar Pipes

- a. Transitions and repair connections between gravity mains and lateral pipes that are of dissimilar type (for example, ductile iron pipe to vitrified clay pipe or cast iron to PVC pipe) shall be made by the use of a flexible coupling with a rubber sleeve, stainless steel sealing clamp bands to create a positive seal, and a stainless steel shear ring to prevent lateral movements and maintain the alignment of the pipes being coupled. Under no circumstances shall couplings that do not have an integral stainless steel shear ring (commonly referred to as "Fernco couplings") be used.
- b. Transition and repair couplings for sanitary sewer gravity mains and laterals shall be manufactured by Mission Rubber Company (Flex-Seal or Heavyweight series adjustable shear ring repair couplings), manufactured by Fernco, Inc. (Shear Ring, ProFlex, or Strong Back RC series), or approved equivalent. On the Plans or in the Contract, these types of couplings may generically be referred to as "Mission couplings".

8. Gravel, Shell or Slag Foundation Material

- a. Gravel or slag shall be screened, washed and shall be one hundred percent (100 %) retained by a one-fourth (1/4 inch) screen. One hundred percent (100 %) shall pass a one (1) inch opening and shall be uniformly graded from maximum size to minimum size. Foreign matter shall not exceed three percent (3 %) by weight when dry.
- b. Reef shells shall be washed dead oyster shells and shall not contain any live shells. A screen washer shall be used for washing shell, the mesh of which shall not be smaller than one-fourth (1/4) inch. The foreign matter content as determined by washing shall not exceed ten percent (10 %) by weight when dry.

9. Running Boards and Saddle Piles

Running boards and saddle piles shall be two (2) inch pecky cypress or creosote-treated southern pine with minimum of eight (8) pound creosote retention.

10. Testing of Materials

The manufacturers or suppliers of pipe, fittings and other materials specified herein shall, at their expense, have their product(s) tested and inspected at the production facility by an established and reputable commercial test laboratory in accordance with accepted industry standards for the specific material. Each joint of pipe and each fitting shall bear the stamp of the laboratory making such inspection. Certificates from the testing laboratory for all testing shall be submitted prior to the installation of any material.

400.03 SANITARY SEWER SERVICE CONNECTIONS (LATERALS)

A. Design

1. General Design Requirements

- a. In general, all residential subdivision lots and commercial lots shall be served by a lateral flowing to sanitary sewer gravity main unless otherwise approved by the OWNER. If a small pump station is approved to serve a lot, it shall be privately maintained, must pump into a service connection placed on the lot, and must have a note on the recorded plat indicating that a private pump is required to serve the lot.
- b. Service connections to gravity sanitary sewer mains shall generally be perpendicular to the main line and shall extend to the edge of the right-of-way or easement limit. Sewer laterals shall not be located in easements when service by gravity can be provided to the property frontage at the street.
- c. Cleanouts are required on all laterals with a maximum spacing of 75 feet on four (4) inch diameter services and 100 feet on six (6) inch diameter services. Cleanouts are also required within approximately two (2) feet from private property lines (at the right-of-way line or easement limit). Cleanouts may be placed farther away from the right-of-way line or easement limit if necessary to avoid sidewalks, driveways, or other obstructions. In general, cleanouts shall not be placed in paved areas, areas that are to be paved, or areas that are subject to vehicular loadings.

- d. Cleanouts shall extend from a two-way sanitary tee on the lateral pipe.
- e. As shown on the Plans or standard detail drawings, the tops of cleanouts shall be within approximately four (4) inches below finished grade, have a PVC cleanout assembly with a recessed nut cap and be covered by cast iron handhole ring and cover (US Foundry USF 7610). The top of the ring and cover shall match grade. The handhole shall rest on a four (4) inch thick layer of gravel around the PVC cleanout.
- f. All service lines which are connected into manholes shall not be through the cone section or at or near manhole joints. Service lines shall be installed six (6) inches above, but no more than thirty (30) inches above, the invert of the manhole or shall be installed with a drop connection.
- g. Multiple service connections shall not be maintained by the OWNER for a single residential lot.
- h. New construction service connections shall be by installation of a tee or wye along sanitary sewer main line. Service saddles and direct service taps shall not be used for new construction.
- i. Direct service taps shall not be allowed on outfall gravity mains 10-inches in diameter or larger. Where access to the system for a lateral cannot be provided elsewhere, laterals shall be routed to manholes along outfall gravity mains.
- j. Direct service taps shall only be performed by Riviera Utilities personnel.

2. Materials

a. Pipe Materials

- i. PVC Pipe and Fittings for Laterals - PVC pipe and fittings for laterals shall be as specified for PVC pipe and fittings for sanitary sewer gravity mains. Solvent weld pipe shall not be allowed.
- ii. Ductile Iron Pipe for Laterals - DI pipe and fittings shall be as specified for push-on DI pipe and fittings for sanitary sewer gravity mains.

- iii. Service Saddle Materials - Service saddles shall be "ROMAC CB" type consisting of a virgin SBR gasket compounded for sewer service, a ductile iron saddle casting, a 304 stainless steel adjustable strap for fastening the gasket and the saddle casting to the sewer main and a 304 stainless steel adjustable circle clamp for securing the service line into the SBR gasket.

400.04 SANITARY SEWER MANHOLES

A. General Design Requirements

1. Location and Siting of Sanitary Sewer Manholes

- a. In general, sanitary sewer manholes shall be spaced at a maximum distance of 400 feet.
- b. When possible, manholes to be installed within roadways shall be installed at locations that will minimize direct impacts from vehicular traffic.

2. Design Criteria of Sanitary Sewer Manholes

- a. Unless noted otherwise on the Plans, manholes shall typically be of precast concrete and have a minimum inside diameter of four (4) feet unless the number of main connections or presence of a drop connection warrants a larger size. Manholes with an outgoing pipe of diameter greater than 24-inches shall have a minimum inside diameter of five (5) feet.
- b. Manholes shall be installed at each deflection of line and/or grade. The flow channel through manholes shall have a uniform and smooth finish free of irregularities or obstructions. The invert channel shall conform to the shape and slope of the entering/exiting sewer line. Manholes for new construction shall have precast inverts.
- c. The flow deflection angle, which is defined as the smallest angle between an incoming gravity main and the outgoing gravity main, shall not be less than 90 degrees for 8-inch and 10-inch diameter gravity mains, less than 75 degrees for 12-inch to 20-inch diameter gravity mains, and less than 60 degrees for gravity mains larger than 20-inch diameter.

- d. Free falls of wastewater flow, including interior or exterior drop connections to manholes, are not allowed without approval from the OWNER. While certain physical constraints may dictate the need for a drop connection, drop connections may not be used as a matter of convenience and cost saving measure to decrease trenching depth. To avoid the need for free falls of wastewater and drop connections, the grade of the entire incoming pipe segment shall be increased such that the top of the invert of the incoming pipe is no more than twelve (12) inches above the outgoing invert. For connections to existing manholes having a bench where the connection will be made, the grade of the entire incoming pipe segment shall be increased such that the incoming invert is only slightly higher than the top of the bench and a trough shall be built up to the incoming invert to direct flow to the primary invert flow channel. These measures allow for the flow to be more efficiently transmitted through the manhole with minimal splashing, minimal turbulence and higher flow velocities.
- e. In certain circumstances standard free drops may be allowed, if not exceeding 20-inches, when pipe diameter changes occur at a manhole. In these cases, the crown of the smaller-diameter pipe shall be positioned no higher than the larger-diameter pipe crown to limit the drop. When free drops are necessary due to pipe size changes, the Contractor shall take preventive measures to prevent free drops into the manhole invert, such as building a flume or trough up to the incoming invert, or piping the flow to the primary invert flow channel.
- f. If the need for a drop connection cannot be avoided, they shall be constructed with an outside drop connection as shown on the Plans that is constructed of ductile iron pipe having the same diameter as the gravity main and encased in concrete.
- g. Inside drop manholes shall only be allowed in unique circumstances and with approval by the OWNER. Inside drop connections shall be constructed with ductile iron pipe fastened to the manhole wall with stainless steel straps and hardware as shown on the Plans. Under no circumstances shall inside drop connections be installed in new-construction manholes.
- h. The City of Foley's and Riviera Utilities' ability to locate, view, open, and access manholes shall not be obstructed at any time. Burying or paving over of manholes, valve boxes, markers, or other components of the wastewater collection and transmission system is illegal and will not allowed under any circumstances. Any such obstructions

shall immediately be removed by the responsible party. If adjustment of components is necessary to allow for roadway repaving, new construction, etc., the work shall be coordinated with the OWNER and done in accordance with the Plans. The cost of all labor, materials, and incidentals for exposing and/or adjusting rims to grade of buried manholes, valve boxes, etc. shall be borne by the responsible party.

- i. Unless noted otherwise on the Plans or directed otherwise by the ENGINEER or the OWNER, rim elevations of manhole covers shall be determined as follows:
 - i. Roadways – Manholes installed within or near roadways and road shoulders shall be installed with the ring and cover flush with finished paving or finished grade. It shall be confirmed that covers do not rock, shift, rebound, or create loud noises when driven over by vehicular traffic.
 - ii. Outside of Roadways and Within Maintained Easements – Manholes installed outside of areas subject to vehicular traffic and within easements that are maintained free of heavy brush growth shall be elevated at least one (1) foot above finished grade unless directed otherwise by the OWNER.
 - iii. Easements in Wooded, Forested, or Brushy Areas – Manholes within easements that are not frequently cleared of brush overgrowth shall be elevated at least two (2) feet above finished grade unless directed otherwise by the OWNER.
 - iv. 100-Year Flood Zones or Areas Prone to Holding Water – 100-year flood zones are defined herein as land areas subject to inundation by a flood that has a 1% probability of being equaled or exceeded in any given year as shown on the most recent FEMA Flood Insurance Rate Map (FIRM map) for the area. All manholes located within any portion of a 100-year flood plain shall be elevated at least 18-inches above the 100-year flood elevation or have watertight covers and vents that extend at least 18-inches above the 100-year flood elevation. Manholes within areas that tend to retain water shall be constructed in the same manner.
- j. When connecting a new sanitary sewer gravity main to an existing gravity main at a location where there is not an existing manhole, the connection shall be established with a precast concrete, “doghouse”-

type manhole installed over the existing gravity main as shown on the Plans. In designing a manhole connection with a doghouse manhole, the angular separation between any incoming or outgoing mains shall be greater than 35 degrees unless a larger angular separation is recommended by the manhole's manufacturer.

- k. In every instance where pipe enters or leaves manhole, a boot-type rubber connector fitting shall be provided that will accommodate expansion and contraction of the pipe, release strain on the pipe (caused by differential settlement between pipe and manhole) and provide a permanent water-tight seal between pipe and manhole. Pipe penetrations sealed with mortar or concrete shall not be allowed without prior approval by the OWNER.
- l. Where indicated, fittings shall also be provided for stubouts for future connections and the stubout shall be sealed with a PVC plug.

B. Materials

1. Precast Concrete Manholes and Related Materials

- a. Manholes of the form and dimensions shown on the Plans shall be constructed of precast reinforced concrete (4,000-psi minimum strength) manhole sections erected on a one-piece precast concrete bottom section with an integral manhole base. Design and manufacturing of precast manhole sections shall conform to all requirements of ASTM C478. Brick manholes or brick riser sections are not permitted. Doghouse-type manholes with poured-in-place bases shall only be permitted with prior approval by the OWNER of the planned materials, dimensions and methods of construction to be used for the manhole.
- b. Every manhole is to be fully and completely built as the work progresses and as each is reached.
- c. Cast-in-place sections, foundations, or bases shall not be permitted without prior approval by the OWNER. Cast-in-place sections and foundations are subject to field review by the OWNER. The excavation shall be kept free of water while the manhole is being constructed and the manhole shall not be backfilled until inspected by the ENGINEER or the OWNER.

- d. Manholes with a total depth of more than five (5) feet, as measured from the top of the cover to the invert of the outgoing main, shall have an eccentric cone top section as shown on the Plans or on the standard detail drawings. Steps within the eccentric cone top section shall be placed along the flat side of the cone and these steps shall be vertically aligned with the steps of subsequent sections. The top section of manholes less than five (5) feet in total depth shall have a flat top style as shown on the Plans or on the standard detail drawings.
- e. Manhole bottom sections shall be precast concrete conforming to ASTM C478 with the base of the manhole as an integral part of the bottom section. Inverts shall be formed as an integral part of the precast bottom and constructed as shown on the Plans or on the standard detail drawings.
- f. Sewer mains shall enter and exit radially oriented toward the center of the manhole base. Inverts shall be constructed with a depth from the bench to the invert that is approximately equal to $1/2$ the diameter of the effluent pipe. Where there are changes in the flow direction between the incoming and outgoing mains in a manhole, the centerline of the invert shall have a true curve with a radius as large as the size of the manhole will permit. All inverts and bottom curves shall be neatly and accurately built and smoothly finished as to facilitate the entrance and flow through of wastewater with minimal energy loss. A minimum fall of 0.10 feet shall be provided through all manholes. The tops of manhole benches shall have a broom finish and shall be sloped toward the invert such that water will not pool on top of the bench.
- g. For new construction, each penetration for incoming and outgoing pipes shall have a positive-sealing, flexible boot-type compression connector cast into the manhole section. Flexible connectors are to be manufactured of high quality rubber or synthetic rubber and all strap clamps or draw bolts shall be stainless steel. Boots are to meet standards of ASTM C923. Rings and clamps are to meet standards of ASTM A167 and/or ASTM C923. Connection of a main to an existing manhole shall be done through a core-drilled penetration with a rubber connector fitting specifically designed for installation within cored holes (Kor-N-Seal by NPC, Inc., A-Lok G3 by A-Lok Products, Inc.).

- h. Precast manhole section joints shall be formed entirely of concrete and wholly watertight. Visible infiltration of water at section joints or between the cover ring and the upper manhole section is not acceptable and, at the discretion of the OWNER, may be used as grounds to require the Contractor to remove and replace manhole sections as necessary to replace improperly installed joint sealing materials.
- i. Precast manhole section joints shall be sealed by means of rubber joint gaskets or a field-installed butyl rubber sealing compound. Regardless of the joint sealing method used, joints shall also receive a flexible external joint wrap. The interior void between manhole joints shall be filled with mortar and trowel-finished smooth.
 - i. Rubber joint gaskets shall be a profile-type gasket designed to meet the requirements of ASTM C443, most recent version, or a rubber O-ring-type gasket designed to meet the requirements of ASTM C391, most recent version. Joint gaskets shall be capable of withstanding a hydrostatic pressure in excess of 13 psi. Joint gaskets shall be Press-Seal Concrete Pipe Gaskets (Profile or O-Ring) as manufactured by Press-Seal Gasket Corporation, or approved equivalent.
 - ii. Butyl rubber sealing compound shall be non-shrink and permanently flexible. The compound shall be supplied in preformed strips or rolls and installed continuously around the entire circumference of the joint. The compound shall be supplied by the manhole manufacturer (ConSeal CS-101/CS-102 by ConSeal Concrete Sealants, Inc., EZ-Stik/Pro-Stik Butyl Joint Sealant by Press-Seal Gasket Corp., or approved equivalent). Installation of butyl rubber sealing compounds shall be in accordance with the manufacturer's recommendations.
 - iii. External joint wrap shall have a minimum width of six (6) inches and shall be centered over the entire circumference of each precast manhole section joint. External joint wrap shall consist of a butyl sealant material with a plastic or rubber backing that is specifically designed for sealing joints in concrete. External joint wrap and concrete primer material shall be installed in accordance with the manufacturer's recommendations. External joint wrap shall be ConSeal Polyolefin Backed Exterior Joint Wrap by ConSeal Concrete Sealants, Inc., EZ-Wrap by Press-Seal Gasket Corp., or approved equivalent.

- j. At the discretion of the ENGINEER or the OWNER, manholes within areas that may be subject to inundation by water shall receive an internal frame chimney seal and extensions as needed. The seal and extension(s) shall span the entire adjustment area of the manhole such that the seal connects to the bottom of the frame and to the top of the manhole cone section. This shall result in a watertight seal between the frame and the top of the manhole that extends over any adjustments to the rim elevation of the frame such as concrete riser rings, built-up mortar, etc.
 - i. Internal frame chimney seals shall remain flexible throughout a 50-year design life. The sleeve and extensions shall be made of high quality rubber conforming to the applicable requirements of ASTM C923. The sleeve shall be pleated to allow repeated vertical and horizontal movement of the frame. The area of the sleeve that compresses against the manhole frame and the concrete of the manhole top section shall have a series of sealing fins that can conform to surface irregularities to facilitate a watertight seal.
 - ii. A positive seal shall be obtained by integrally formed Type 304 stainless steel expansion bands conforming to the applicable material requirements of ASTM C923. The expansion bands shall have a minimum adjustment range of 2-1/2 diameter inches and a positive locking mechanism which secures the band in its expanded position after tightening.
 - iii. Internal frame chimney seals shall be Cretex Internal Seal as manufactured by Cretex Specialty Products, Flex-Rib by NPC, Inc., or approved equivalent.
- k. Steps shall be placed in manholes and shall be equally spaced not more than sixteen (16) inches vertically and shall be so arranged such that the lowest step is no more than two (2) feet above the bench. The top step shall not be more than three (3) inches below the bottom of the manhole frame. Holes cast or drilled into the manhole section for steps shall not protrude completely through the manhole wall or allow infiltration of groundwater. Whenever possible, steps shall not be placed directly above the manhole flow channel. Manhole steps shall be plastic coated steel bars with an embossed tread design. The plastic coating shall be a co-polymer polypropylene meeting or exceeding the requirements of ASTM 2146-69 under Type II, Grade 49108. The steel bar shall be equivalent to, or greater than,

three-eighth (3/8) inch reinforcing rod, grade 60 conforming to ASTM A-615. The complete product shall meet the requirements of ASTM C-478.

- l. The minimum compressive strength required for concrete used in sanitary sewer structures shall be 3,000 pounds per square inch at 28 days from pouring. If required, field specimens and laboratory tests shall be made in accordance with the standards of the American Society of Testing Materials. The minimum amount of water shall be used to produce a workable mix and shall not exceed six (6) U.S. gallons per sack of cement.
 - m. Mortar for masonry in sewer structures shall be a 1:3 Portland Cement Sand Mix, provided that hydrated lime or mortar mix may be substituted for, not to exceed ten percent (10 %) by weight of the cement.
 - n. All anchors bolts or other hardware necessary for installing drop connections or other appurtenances shall be stainless steel.
 - o. Where required, fittings of required size shall be built into manholes to receive either present or future branch lines. Where it is not intended to construct the branch lines at once, the fittings thus inserted must be securely closed in such a manner that future connections can be made without breaking the fittings.
 - p. Where manholes intercept existing laterals connected to existing sewers or manholes, the lateral service to the existing sewer or manhole shall be kept intact until the next adjacent section of new sewer line is completed and approved. The laterals shall then be broken and fed to the new sewer and the dead end of the laterals plugged at the manhole wall with an approved plug.
2. Manhole Covers and Frames
- a. Manhole frames and covers shall conform to the Plans or standard drawings in all essentials of design. All castings shall be made of clean, even grain, tough gray cast iron. The quality of iron in the castings shall conform to the current ASTM Specification A48 for Class 30 Gray Iron Castings. Frames and covers shall weigh not less than that shown on the Drawings. The castings shall be smooth, true to pattern and free from projections, sand holes or defects. The portion of the frame and cover which forms the cover seat shall be machined

so that no rocking of the cover is possible. The castings shall be coated with coal tar pitch varnish. All frames and covers shall be domestically made and manufactured in the USA from domestic iron.

- b. Standard manhole covers installed within the City of Foley shall be marked with "SANITARY SEWER" and shall also be provided with the standard tree emblem design as required by The City of Foley. No exceptions will be permitted. Standard manhole frames and covers shall be a Model No. 355 Heavy Duty Frame and Cover as manufactured by U.S. Foundry.
- c. Where required, watertight manhole frames and covers shall have neoprene gasket and machined bearing surfaces. Bolts shall be standard hexagonal-head, countersunk such that when fully tightened the bolt head is flush with the top of the cover. Only stainless steel tightening bolts shall be used. Material requirements for installations requiring vented, watertight and locking manhole frames and covers shall be coordinated with the OWNER.
- d. Installation of manhole frames and covers within roadways, driveways or other areas subject to vehicular traffic shall be set flush with and in the plane of the paved, graveled or unpaved surface. Such manhole frame and cover installations shall include a sufficient depth of concrete mortar around the ring to ensure complete and watertight contact with the top of the manhole. In addition, all manhole frames in such areas shall be encased on the exterior in a minimum six-inch (6") thick concrete collar of 3000-psi concrete beneath the asphalt with the cover flush with the top of finished pavement. The concrete frame encasement shall extend at least twenty four (24) inches from the frame itself and may be circular or square shaped.
- e. Installation of manhole frames and covers in locations other than paved areas shall be set to grades as determined in the field, directed by the ENGINEER or the OWNER, or as indicated herein. In these locations, frames and covers shall be anchored through to the cone section or flat top slab section with 7/8" diameter by 9" long stainless steel anchor bolts (minimum of four spaced evenly around frame). Where necessary, anchor bolts shall be drilled through risers installed on top of the top section to allow the anchor bolts to be firmly secured within the cone section or flat top slab section.

- f. Manhole frames and covers within 100-year flood zones or in areas prone to standing water shall either be watertight with locking covers or shall be set above grade to a rim elevation that is at least 18-inches above the 100-year flood plain or, in areas prone to standing water, at least 18-inches above maximum observed water levels.
- g. Allowable methods of adjustment of manhole rim elevations to proper grade shall be as follows. Other methods of manhole rim elevation adjustment shall be subject to approval by the OWNER.
 - i. Precast concrete rings with an inside diameter of at least 27" having nominal heights of 3", 6" or 12". Joints between concrete rings and the manhole top section, frame, or other concrete rings shall be sealed watertight with an approved permanently flexible butyl rubber sealing compound as specified herein. Precast concrete rings for manhole adjustment shall have a mortar coating (minimum thickness ½") over all interior and exterior surfaces of the rings.
 - ii. Molded high density polyethylene (HDPE) adjustments rings as manufactured by LADTECH, Inc. or approved equal. HDPE rings shall be installed in accordance with the manufacturer's recommendations.

3. Manhole Interior Lining Materials

- a. Where required by the ENGINEER or at the discretion of Rivera Utilities, the vertical walls and top of bench of manholes shall be coated with a material specifically designed for adhesion to and protection of concrete surfaces within municipal wastewater treatment structures and collection system structures.
- b. All new or existing manholes that receive flow from a sanitary sewer force main shall be lined as directed by the ENGINEER or the OWNER.
- c. Lining materials shall be impermeable, high strength, and resistant to corrosion by a broad range of chemicals, including strong acids and those chemicals commonly found in sanitary sewers. Lining materials shall prohibit water infiltration and shall be suitable for installation over damp or dry concrete surfaces.
- d. Manhole lining materials shall be proprietary formulations and shall be cement-based, urethane-based or epoxy-based material. Surfaces

shall be prepared for lining and lining materials shall be installed by approved installers using equipment approved by the material's manufacturer. The preferred method of application is by spray-applying a monolithic coating. Coatings shall be free of any drips, pinholes, gaps, or other voids.

- e. The specific manhole lining material(s), lining thickness to be applied and required testing for approval shall be as determined on a case-by-case basis by the OWNER.
- f. Manhole lining materials shall be installed in the field after installation of the manholes. Factory application to manhole sections is not allowed.

400.05 INSTALLATION

A. General

- 1. The upstream side of the last (downstream) manhole(s) of a sanitary sewer line extension under construction shall be plugged with an inflatable plug or by constructing a brick/block wall to prevent the passage of groundwater, runoff and sediment into the sanitary sewer system. All water upstream of the wall shall be pumped out of the sanitary sewer line and all sediment and solids shall be removed and properly disposed of by the Contractor. The plug wall shall not be removed until the line has been inspected by the OWNER to ensure that all possible points of inflow or infiltration have been eliminated.
- 2. Manholes shall not be buried or hidden, which is a violation of the policies of the OWNER and subject to penalty by fines or other legal actions.
- 3. All connections to existing manholes, whether incoming sewer mains, force mains, or service laterals, shall be cored with a concrete coring machine unless an alternate method is approved by the OWNER. All pipe connections must be made with flexible watertight couplings or boots as specified herein.
- 4. All manhole joints in new construction shall be externally wrapped with an approved joint sealing material as specified herein. There shall be no exceptions to this requirement.

5. Where directed by the ENGINEER or the OWNER, manholes shall have an internal frame chimney seal from an approved manufacturer.
6. After installation, manholes directly receiving flow from force mains or immediately downstream of said manholes shall receive an interior lining as specified herein to minimize the potential for corrosion. The required material to be used for lining shall be at the discretion of the OWNER.

B. Sanitary Sewer Service Connections

1. All service connections to existing sanitary sewer mains shall be made by the OWNER personnel unless other arrangements are made.
2. Service connections to new mains may be made by the Contractor, but must include the use of connections having a tee fitting on the main. Taps onto new lines may only be performed if so approved by the OWNER.
3. Service taps into mains shall be made on the top quarter of the main.
4. Service connections made using a service saddle shall utilize a rubber saddle designed for the size and pipe material of the existing gravity main. The opening in the sewer main for the service sewer saddle shall be cut with a hydraulically or pneumatically driven circular tapping saw of the same nominal diameter as the service connection.

C. Clearing and Grubbing

1. Clearing and grubbing shall be confined to the limits of the easements and to the minimum width required for installation of the pipe. All trees, stumps, roots and debris shall be disposed of in an approved manner in accordance with local, state and Federal regulations. Burying of stumps and other debris on the site will not be permitted.
2. Where trees within the easements are designated in the field or on the Plans to be retained, such trees shall be protected from damage at all times. Should, by accident or otherwise, such trees be damaged, they shall be repaired by personnel trained in this type of repair work.

D. Excavation

1. All excavated material not required for filling shall be removed from the site or otherwise disposed of satisfactorily.

2. The trench width may vary with and depend upon the depth of trench, trench safety requirements, and the nature of the excavated material encountered; but in any case shall be of ample width to permit the pipe to be laid, jointed, and haunched properly and the backfill to be placed and compacted properly. The width of trench shall be at least one (1) foot greater than the nominal diameter of the pipe; the maximum clear width of trench at top of pipe shall be not more than eighteen (18) inches greater than the pipe diameter.
3. If PVC sewer pipe is being installed, the trench shall be backfilled to the springline of the pipe (haunched) with reef shell or an approved equal, and in accordance with Paragraph 400.18, EMBEDMENT OF PVC GRAVITY SEWER PIPE.
4. The bottom of the trench shall be carefully graded, formed and aligned before any sewers are laid therein.
5. Where the natural soil at the bottom of the trench makes a satisfactory foundation for the sewer, it shall be shaped to the bottom quadrant of the pipe and slightly hollowed under each bell to allow the body of the pipe to have a uniform contact and support throughout its entire length.
6. Where the bottom of the trench does not make a suitable foundation for the sewer or where required by the ENGINEER or the OWNER, the trench shall be deepened and backfilled with reef shell, slag, or gravel, or an approved equal and shaped as above, or the pipe shall be placed on running boards.
7. A berm at least two (2) feet in width shall be constructed between the trench and the excavated material.
8. The trench shall be dug to the alignment and depth required and only a minimum distance in advance of pipe laying. The trench shall be so drained that workers may work therein efficiently. It is essential that the discharge from pumps be led to natural drainage channels, to drains or to storm sewers.
9. In excavating streets that have been surfaced with shell, sand clay, clay, gravel or other type of base course, such base material shall be either stockpiled and kept separate from the earth excavated or new base of like kind and equal quality shall be provided.

10. Excavation for manholes or other structures shall be of sufficient size to leave at least one (1) foot in the clear between their outer surfaces and the embankment, or sheeting which may protect it.
11. All new manholes shall be installed on a twelve (12) inch thick bedding of compacted No. 57 gravel.
12. Overcuts at excavations for manholes and the manhole bedding shall be backfilled with concrete; overcuts in sewer trenches shall be backfilled with select material from the excavations, reef shell, slag or gravel, or an approved equal.

E. Embedment of PVC Sanitary Sewer Gravity Pipe

1. Except as modified hereinafter, embedment material for PVC gravity sewer pipe shall be either Class I, II, or III material as described in ASTM D2321. A detail drawing for PVC gravity pipe embedment has been prepared and included in the Plans or standard detail drawings to illustrate the meaning and limits of the terms "haunching," "foundation or bedding," and "initial backfill" as used in these Specifications.
2. Table 400.3 shall be used in determining the material required for embedment of PVC gravity sewer pipe.

<u>Pipe Depth</u>	<u>Bedding or Foundation</u>	<u>Haunching</u>	<u>Initial Backfill</u>
16' or less	CLASS I, II, Or III	CLASS I, II, Or III	CLASS I, II, Or III
>16'	CLASS I Or II	CLASS I	CLASS I, II, Or III

*Table 400.3 - Minimum Embedment Requirements by Material Class
for PVC Sanitary Sewer Gravity Mains*

3. In areas where the existing material is other than as described above, and is not acceptable for use as embedment material, gravel, slag or reef shells, as specified herein, shall be used.
4. In areas where the pipe is below the water table or expected to be below the water table in the future and the foundation or bedding material is Class I material, whether existing or as installed, reef shell, gravel or slag shall be used for haunching of the pipe.
5. Embedment materials listed here include a number of processed materials plus the soil types listed under the USGS Soil Classification System (FHA Bulletin No. 373). These materials are grouped into five (5) broad categories according to the suitability for this application:

- i. Class I - Angular, six (6) millimeter to forty (40) millimeter (0.25 to 1.5 inches), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone and crushed shells.
- ii. Class II - Coarse sands and gravels with maximum particle size of forty (40) millimeters (1.5 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class.
- iii. Class III - Fine sand and clayey gravels, including fine sands, sand-clay mixtures, and gravel-clay mixtures. Soil Types GM, GC, SM, and SC are included in this class.
- iv. Class IV - Silt, silty clays, and clays, including inorganic clays and silts or medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class. These materials are not acceptable for bedding, haunching, or initial backfill.
- v. Class V - This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than forty (40) millimeters (1.5 inches) in diameter, and other foreign materials. These materials are not acceptable for bedding, haunching, or initial backfill.

F. Bracing

When the material through which the trench is excavated tends to fall in, run or cave, the sides of the trench shall be braced, open sheeted or close sheeted, to an extent necessary to protect the pipe being laid. Such sheeting shall remain in place until the backfill is carried to a point at least two (2) feet above the top of the pipe. Precaution shall be exercised in removing the sheeting in order to avoid damaging the pipe. Should there be evidence that the removal of sheeting would damage the pipe, the sheeting shall be left in place and no additional compensation will be allowed therefore. The top of sheeting left in place shall be at least twelve (12) inches below the finished ground.

G. Riprap

1. All stone for riprap shall consist of rough unhewn quarry stone weighing not less than one hundred and sixty five (165) pounds per cubic foot, and

as nearly rectangular in section as practicable. The stone shall be resistant to the action of air, temperature changes, and water; it shall be sound and dense, and suitable in all other respects for the purpose intended. The stone shall be a well graded mixture with individual pieces ranging in weight from fifteen (15) to one hundred and fifty (150) pounds. Over and undersize stones will be permitted to such extent that sizes larger than one hundred and fifty (150) pounds shall not exceed ten percent (10 %) and sizes smaller than fifteen (15) pounds shall not exceed five percent (5 %). Sizes larger than two hundred (200) pounds will not be permitted. (Approximately seventy percent (70 %) of the stones shall weigh from one hundred (100) to one hundred and fifty (150) pounds.)

2. A six (6) inch thick blanket of reef shell shall be placed as a bed for riprap. Reef shell shall be as previously specified.
3. Riprap shall be placed in such a manner as to insure that the larger pieces are distributed uniformly and that the smaller pieces will fill the spaces between the larger pieces. After placing, the riprap shall present a reasonably smooth surface.
4. After riprap is in place, the voids shall be completely filled with clean reef shell. The reef shell shall be worked into the crevices between the rocks with rodding or other approved methods.

H. Laying Sanitary Sewer Force Main Pipe

1. Force mains shall be constructed to the alignment and depth required. The force mains shall have at least thirty (30) inches cover unless additional cover is required by the Plans. The trench shall be braced and drained so that workman may work safely therein. The width of the trench shall be at least one (1) foot greater than the nominal diameter of the pipe and the maximum clear width of the trench shall be not more than two (2) feet greater than the pipe diameter.
2. The trench shall have a flat bottom with bell holes of ample dimensions to allow jointing and so the barrel of the pipe will have a bearing for its full width.
3. All pipe, fittings, etc., shall be lowered into the trench by means of derrick, ropes or other suitable tools, and under no circumstances shall pipe be dropped into trench. Any defective pipe shall be rejected.

4. Joints shall be installed in strict accordance with the recommendations of the pipe manufacturer.
 5. Thrust Blocks - At bends, thrust blocks of concrete of a mix not leaner than one (1) part cement, two (2) parts sand, and four (4) parts stone, having a compressive strength of not less than two thousand (2,000) psi shall be installed in accordance with the Plans. The blocking shall be poured against undisturbed earth.
 6. Backfilling shall be as specified herein.
- I. Laying Sanitary Sewer Gravity Main Pipe
1. Pipes and appurtenances shall be so laid in the trench that after the sewer is completed, the interior surface of the bottom thereof shall conform accurately to grade and alignment. Sewers shall be laid in the direction opposite to the direction of flow with spigot ends of pipe pointing down grade.
 2. The Contractor shall utilize equipment that projects a laser beam within the pipe for setting the alignment and grade for the main between adjoining manholes. The laser beam shall be aligned coaxially through the center of the main being installed. The laser beam device shall be rigidly mounted to its support assembly such that misalignment or vibration will not occur from traffic or equipment vibration. All equipment for said method shall be supplied by the Contractor and shall include equipment necessary to calibrate for atmospheric conditions and to maintain the alignment and grade to acceptable standards of accuracy. The equipment shall be operated by competent personnel properly trained and experienced with the equipment.
 3. Before being set in place, each pipe must be thoroughly cleaned and freed of all dirt. Any debris or dirt which may find entrance into the pipe in making the joint shall be removed.
 4. The joints between the individual pipes shall in all cases be made watertight.
 5. Four (4) inch or six (6) inch diameter tees shall be inserted along the sanitary sewer main wherever designated.
 6. To indicate the end locations of capped laterals, a length of 2x4 or 4x4 treated southern pine post shall be installed such that it extends from the

bottom of the trench to at least two (2) feet above grade. The exposed portion of the post shall be painted green. PVC pipe shall not be used for marking the ends of capped laterals.

7. To indicate the locations of laterals where concrete curbs, gutters or valley gutters are present, an "S" shall be imprinted or permanently scribed on the curb or gutter.
8. Laterals shall be PVC pipe as specified herein unless field conditions dictate otherwise or as directed otherwise by the ENGINEER or the OWNER.
9. The minimum grade of any segment of lateral pipe shall be 1.0%.
10. Ends of laterals shall terminate at such depth as required to serve the adjacent property except that the minimum depth below the ground surface at the end of the lateral shall be four (4) feet. For sewer mains over eight (8) feet in depth or where directed, stacks shall be carried up from the tee connections at an angle of forty-five (45) degrees with the vertical, and the end shall terminate at depth specified for laterals. The ends of the stacks or laterals shall be closed with covers as specified for tee branches.
11. The entire length of all PVC sanitary sewer mains and laterals shall be marked with detectable sewer marking tape that is laid approximately 24 inches above the pipe. The tape shall be green and shall be imprinted with "CAUTION SEWER LINE BURIED BELOW".
12. Whenever pipe laying is stopped for the night or for any other cause, the end of the pipe shall be securely closed with a plug or cap to prevent the entrance of water, mud, and other objects, and shall be secured in such manner as to prevent the end pipe from being dislodged by sliding or other movement of the backfilling.
13. Any water which may be found or may accumulate in the trenches shall be removed and trenches shall be kept clear of water while the foundations are being laid, the masonry being constructed, or pipe laying is in progress.
14. Wherever existing laterals are intercepted by the excavation for a new sewer main, the connection shall be temporarily maintained until the particular section of the new sewer main is completed and tested as

required herein. Upon approval of the new sewer main, the existing lateral shall be smoothly cut and then connected to the newer sewer main by means of a tee on the main. Couplings used to transition between the existing lateral pipe and the new lateral connection shall be as specified herein. The remaining existing lateral pipe shall be cut as close to the side of the excavation as is practicable and capped with a PVC cover.

15. After each pipe segment is laid, it shall be partly backfilled and made secure before the next joint is laid.
16. Workers shall not walk or stand upon the newly laid pipe until the necessary backfill has been placed and tamped to prevent the displacement of the pipe.

J. Backfilling

1. Before backfilling any trench, the completed line and all joints shall be examined and any deficiencies that exist shall be corrected.
2. No trenches or excavations shall be backfilled until concrete in the structures placed therein has acquired a suitable degree of hardness, and the work shall be prosecuted expeditiously after it has commenced.
3. Undercutting of trench bottom shall be backfilled with select material from the excavations and compacted to not less than ninety-five (95) percent maximum density as determined by AASHTO T-99 prior to placing of pipe. Select material shall be granular soil free from rock, grass, wood or other deleterious material. If the material from the excavation is not considered to be satisfactory for backfill, the undercut shall be backfilled with reef shell, slag or gravel or an approved equal.
4. After the pipe has been installed, selected material from the excavation shall be placed along the side the pipe in layers not exceeding four (4) inches in depth. Select material shall be as specified above for filling undercut. Care shall be taken to insure thorough compaction of the fill under the haunches of the pipe. Each layer shall be thoroughly compacted by hand tamping with iron tampers, the tamping face area of which shall not exceed fifty (50) square inches, to not less than ninety (90) percent maximum density as determined by AASHTO T-99. This method of filling and compacting shall be continued until the fill has reached a depth of at least two (2) feet above the top of the pipe. All material shall be deposited carefully in the trench to avoid damaging the

sewer. The operation of heavy equipment shall be conducted so that no damage to any sewer mains or sewer structures will result.

5. The remainder of the trench above an elevation of two (2) feet higher than the top of pipe shall be backfilled uniformly in layers not exceeding six (6) inches in thickness. Mechanical backfilling will be permitted providing material being placed by bucket has a free fall of not greater than one (1) foot from the bucket. Each six (6) inch layer shall be completed by mechanical tamping except as hereinafter permitted.

6. Sand

Flooding or jetting will be permitted where the clay and silt content of the backfill material is low enough to permit this method of consolidation. Where allowed, this method will be used from a point two (2) feet above the top to the original ground line.

7. Muck

Flooding or jetting will be permitted or required where the clay and silt content or water content is high enough to make tamping ineffective. Flooding or jetting will be confined to that portion of the trench starting two (2) feet above the top of pipe and ending two (2) feet below the original ground surface. The last two (2) feet shall be backfilled with selected earth and shall be mechanically rolled or tamped to the degree of compaction of the surrounding ground.

8. Backfill Under Pavement

Backfill under all existing or proposed pavement for streets, sidewalks or roadways up to the existing grade or proposed grade, whichever is lower, and to a minimum distance of ten (10) feet adjacent to existing or proposed pavement, shall be in accordance with the requirements and specifications of the Alabama Department of Transportation. Where pavement is not to be replaced, the top six (6) inches of backfill shall be of a select granular material.

9. Fields and Open Country

The backfill above a point two (2) feet above top of pipe shall be placed in trench until full. The remaining earth shall be placed on top of the trench and dressed until it settles.

- K. Grassing and Mulching

1. All areas disturbed by construction shall be grassed and mulched as hereinafter specified, where indicated on the Plans or where directed.

2. General - The area to be grassed shall be graded to the final grade and roots, stumps or other materials which might be harmful to grass growth shall be removed and disposed of. Care shall be taken to spread topsoil over the entire area to be grassed to the extent that topsoil along and adjacent to the trench lines is available.
3. Fertilizer - After the surface has been prepared for grassing and before any grass or seeds are planted, the soil shall be loosened by harrowing or other approved methods, and the areas specified to be grassed shall be fertilized at a uniform rate of one thousand five hundred (1,500) pounds per acre with a standard commercial 8:8:8 fertilizer and three thousand (3,000) pounds of agricultural lime per acre.
4. Seeding - The areas to be grassed shall be seeded with good sound seed in the following minimum quantities per acre:

Pensacola Bahia	20 pounds	Common Bermuda	10 pounds
Kentucky 31 Fescue	34 pounds	White Dutch Clover	10 pounds
5. In some areas, it may be necessary to vary the concentrations of various seed to suit local conditions and the OWNER reserves the right to require a change in proportions of the various seed so long as the total amount of seed does not exceed seventy four (74) pounds per acre at no change in Contract price.
6. Seeds shall be broadcast with hand operated equipment, such as a "Cyclone" seeder, Seymour "Seedkaster," or equivalent. When broadcast, seed shall be sown over the areas and raked or dragged and covered to the desired depth. Hydro seeding may be used in lieu of the above.
7. Mulching - The surface of sprigged and over seeded slopes of the roadway or embankments shall be protected by the application of mulch. The mulch shall be spread uniformly in a continuous blanket by hand or by suitable approved equipment, at a rate of two (2) tons to the acre. Mulching material which is too coarse or too short for proper securing in the surface soil will be rejected. Mulching shall be started at the windward side of relatively flat areas or at the upper part of a steep slope and continued uniformly over the entire area. The mulch material shall be anchored to the soil by spraying a light coating of emulsified asphalt over the straw or hay after these materials have been placed. The asphalt shall be applied by hand sprayers attached by hoses to an asphalt

spreader or other approved methods. The asphalt adhesive shall be applied to the mulch at a rate of one hundred and fifty (150) gallons of undiluted (straight emulsion) asphalt per ton of straw or hay (300 gallons per acre). If the straight emulsion is further diluted with water in the ratio of 60 (straight emulsion) to 40 (water), the application rate shall be two hundred and fifty (250) gallons of asphalt emulsion per ton of straw or hay, (500 gallons per acre). The purpose of the asphalt adhesive is to secure the mulch on the ground to form soil binding mulch and prevent loss or bunching by wind or water.

8. Maintenance - All grassed areas shall be maintained until acceptance of the utilities and for a period of three (3) months thereafter. Areas upon which an established stand of grass is not obtained, reseeding and remulching shall be required. A satisfactory stand of grass is defined as a cover of living grass in which gaps larger than twelve (12) inches do not occur at the time of acceptance. Maintenance shall consist of watering, preserving, protecting, replacing dead grass, filling washes and generally maintaining the area until final acceptance.
9. If the grassing operation is accomplished after the month of August or before the month of March, in addition to the seeding as outlined above, the entire grassed areas shall also be over seeded with Italian Rye Grass Seed at the uniform rate of forty (40) pounds per acre at no additional cost to the Utilities Board.
10. Asphaltic Adhesive - Asphalt shall be a bituminous soil cover suitable for mulching of seeded areas and shall contain no petroleum solvents or other diluents which would be toxic to plant growth. It shall be a homogeneous emulsification of especially refined petroleum asphalt suitable for spray application with or without dilution with water. Laykoid Soil Cover, manufactured by American Bitumuls and Asphalt Company, or other commercial types of asphalt specifically designed for mulching of seeded areas for erosion protection against rain or wind, will be acceptable.

L. Removing and Replacing Pavement

1. Any paved streets disturbed by construction operations shall be repaved in a workmanlike manner and restored to their original condition or better as shown on the Plans or the standard detail drawings. The paving materials and construction methods used in public right-of-ways shall be in accordance with the requirements and specifications of the controlling authority (City of Foley, Baldwin County, or the Alabama Department of

Transportation). Otherwise, paving shall be of material equal to that removed and shall be laid in accordance with the OWNER's current detail drawings and specifications for pavement replacement.

2. Where paved streets are cut, crushed limestone gravel or other approved base material shall be provided immediately following backfill, and such crossing shall be maintained until it has been paved. Temporary crossing material shall be well compacted and shall be graded to be even with adjacent pavement. The material shall not be allowed to be displaced from the crossing. Any settlement that may create a hazard for vehicular traffic shall immediately be repaired.
3. Unless requirements and specification of another authority control, an eight (8) inch minimum thickness crushed limestone base course shall be constructed full width of the trench to the finish grade as detailed and noted. After base has been compacted, a bituminous prime coat shall be applied at the rate of approximately 0.2 gallons per square yard of cut-back asphalt and the trench shall be paved with two (2) inches of hot asphaltic concrete. The paved surface shall be finished flush with the existing pavement and shall conform to the existing contour of street or roadway.
4. Where concrete or other types of pavement are removed, they shall be replaced with the same type and thickness as that removed. Just prior to repaving, jagged edges shall be squared and cut to a string line so that the patch will present a neat appearance.
5. Pavement markings shall be replaced as a subsidiary obligation of the work requiring the same.
6. Prior to excavation in paved streets or other paved areas, the pavement shall be cut along straight and perpendicular lines parallel to the center line of the existing or proposed pipe.
7. For those areas where the pipe trench crosses at a right angle or other angles to the center line of the road or street, except those crossing included within limits of complete resurfacing, pavement replacement shall be as specified above with modifications as hereinafter specified. Just prior to placing of wearing layer, the existing pavement on each side of the trench line shall be stripped off for a distance of ten (10) feet, terminating in a straight line. The existing base course shall then be shaped to conform to the contour of the roadway and primed. After curing, the wearing layer shall be constructed to the thickness of the

original pavement of one hundred (100) pounds per square yard whichever is greater. In no case shall this pavement replacement be less than twenty two (22) feet long measured along the center line of the roadway or street.

M. Concrete, Sidewalk and Ditch Pavement Replacement

Where concrete pavement in sidewalks, paved ditches or other areas is removed, it shall be replaced with the same type and thickness as that removed including finish. A six (6) inch compacted thickness sand-shell or sand-clay base course shall be provided under new concrete paving subject to vehicular traffic as specified above. Existing pavement shall be cut back a minimum of nine (9) inches from edge of trench to provide an undisturbed foundation for the concrete replacement.

N. Cleanup

Where these operations are on city, county, or private property, the job shall be kept clean at all times. Loose dirt shall not be allowed to clog ditches or cover sidewalks. Soft clay or other undesirable material removed from the trenches shall be removed from the streets, sidewalks, or ditches.

400.06 INSPECTION AND TESTING

A. The Contractor shall furnish all materials, labor, and equipment to perform all testing. Water for testing purposes may be provided by the OWNER if so arranged for by the Contractor. The Contractor shall reimburse the OWNER for all water used for construction at current water rates.

B. Sanitary Sewer Gravity Mains and Service Laterals

1. Visual Inspection

- a. All materials used must be approved by the ENGINEER and/or the OWNER prior to installation. Rejected materials shall be immediately removed from the job.
- b. Gravity sanitary sewer lines shall be clean and free from obstructions, and shall be visually inspected from every manhole. Lines which do not exhibit a true line and grade or which have structural defects shall be corrected. Sanitary sewer service connections shall be visually

inspected prior to backfilling.

- c. Any portions of the gravity mains, laterals or manholes that are found to not be water tight shall be repaired by the Contractor regardless of favorable test results.

2. Air Pressure Test (Required)

a. General

On all sanitary sewer lines, including laterals, a line acceptance test using low pressure air shall be performed. The air test shall be conducted after the pipe has been backfilled. Equipment to be used in making the test shall be specifically designed for this purpose and shall be Cherne Air-Lock Equipment, NB Products, Inc. Equipment or approved equal. The ENGINEER and the OWNER shall be advised at least forty eight (48) hours before tests are conducted.

- b. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to twenty five (25) psig. The sealed pipe shall be pressurized to five (5) psig. The plugs shall hold this pressure without bracing and without movement of the plugs out of the pipe.
- c. After a manhole to manhole segment of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to twenty five (25) psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches four (4) psig greater than the average back pressure of any groundwater that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The test time required in minutes for pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any groundwater that may be over the pipe) shall not be less than the time shown for the given diameters in Table 400.4
- d. In areas where groundwater is known to exist, one-half ($\frac{1}{2}$) inch diameter capped pipe nipple shall be installed, approximately ten (10) inches long, through the manhole wall on top of one of the sewer

lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the groundwater shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The tube shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings (For example, if the height of water is eleven and one-half (11-1/2) feet, then the added pressure will be five (5) psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one (1) pound and the timing remain the same.) Other methods for determining groundwater level may be used if approved in advance and if results are expected to be accurate in determining the groundwater level.

<u>Nom. Pipe Dia. (inches)</u>	<u>Min. Time Required for Pressure Drop (minutes)</u>
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
16	7.5
18	8.5

Table 400.3 – Minimum Allowable Time for Pressure Drop for Gravity Main Air Pressure Tests

- e. Should the line fail the pressure test, the source of leakage shall be determined and repairs as necessary shall be made to eliminate leakage. Air testing shall be in addition to infiltration tests as specified herein, if required.
3. Deflection Testing for Flexible Pipe (Required)
 - a. The mandrel (go/no-go) deflection test shall be performed on all PVC gravity mains prior to acceptance and no sooner than 30 days after installation. The Contractor shall supply the mandrel used for this performance test.
 - b. The mandrel device shall be cylindrical in shape having nine (9) possible contact points with the pipe. The mandrel shall have an

outside diameter of not less than ninety five percent (95 %) of the PVC pipe's inside diameter. The mandrel's length and diameter (ID of proving ring) shall be in accordance with Table 400.4.

Nom. Dia. (inches)	Proving Ring Min. Length (inches)	Mandrel Dia. (inches)
6	6	5.70
8	8	7.60
10	10	9.50
12	10	11.40
15	12	14.25
16	12	15.20

Table 400.4 – Proving Ring Minimum Length and Mandrel Diameter for Deflection Testing of Flexible Pipe

4. Internal Video Assessment and Cleaning (Required)

- a. As a final measure required for acceptance, the Contractor shall clean and televise all newly installed sewer mains prior to acceptance by the OWNER. The Contractor shall televise the sewer main and all lateral connections installed from the upstream to downstream manhole with no reverse setups or cutaways. Throughout shooting, the camera shall be panned and tilted for a complete view of the main. Lighting shall be adequate to view the entire sewer main and service connections from beginning to end. The video inspection shall be submitted to the Inspector on a CD or DVD and formatted with software compatible and readable by the OWNER. The OWNER shall not be responsible for purchasing additional software necessary to view the assessment videos.
- b. The camera shall be advanced at a uniform rate that allows a full and thorough inspection of the new sewer main. The camera shall be a color, pan and tilt camera. The picture quality and resolution shall be acceptable and sufficient to allow a complete inspection with no lapses in coverage. The length of the sewer main shall be measured and recorded on the video screen. The distance counter shall be calibrated before shooting the inspection video.
- c. The Contractor shall clean the sewer mains ahead of video inspection with a high-velocity water jet. The video inspection shall take place within 2-hours of cleaning operations and be witnessed by the ENGINEER and/or the OWNER. All construction debris shall be collected in the downstream manhole and shall not be released into the sewer system.

- d. The ENGINEER and/or the OWNER shall be present throughout the cleaning and televising of the sewer mains to verify that the video work complies with the specifications.
- e. Prior to submitting the CD's to the Inspector, the Contractor shall label the CD's with the following information:
 - i. Name of the Project/Development.
 - ii. Name and contact information of Contractor and Contractor's field representative
 - iii. Date of televising.
 - iv. Manhole identification as shown on the design Plans.

C. Sanitary Sewer Force Mains

1. Hydrostatic Testing (Required)

- a. After the force main pipe has been laid and partially backfilled, all pipe, or any valved section, shall unless otherwise specified, be subjected to hydrostatic pressure of one hundred (100) psi. The pressure test shall be for at least two (2) hours or until the line has been completely inspected for visible leaks, whichever is longer.
- b. Before testing, all air shall be expelled from the line. All necessary taps to expel the air shall be made and then all taps plugged watertight. In no case shall water be obtained from existing water mains through direct connections to the force mains.
- c. Approved and suitable means shall be provided for determining the quantity of water lost by leakage. No pipe installation will be accepted until or unless the leakage (evaluated on a pressure basis of one hundred (100) psi) is less than twenty five (25) U.S. gallons per twenty four (24) hours per mile of pipe per inch nominal diameter of pipe. Any observed leaks shall be repaired.

D. Sanitary Sewer Manholes

1. Vacuum Testing (Optional at the discretion of the OWNER)

- a. When required, newly stalled manholes shall pass a vacuum test in accordance with ASTM Specification C1244, most recent revision. The Contractor shall supply all equipment and materials necessary to vacuum test the manholes.
- b. Vacuum testing shall not be initiated until the manholes and all specified coatings and lining materials have been cured in accordance with manufacturer recommendations.
- c. The ENGINEER and/or the OWNER shall be present and witness all vacuum testing. The Contractor shall provide forty eight (48) hours notice prior to testing.
- d. The following vacuum testing criteria shall apply for test compliance.
 - i. A vacuum of ten (10) inches of mercury shall be drawn with an approved vacuum testing unit.
 - ii. The testing time shall not begin until after the vacuum pump has been shut off.
 - iii. The time required for the vacuum to drop from ten (10) inches to nine (9) inches of mercury shall meet or exceed the values listed in Table 400.5.

Depth (feet)	Pressure Drop Time (seconds)	
	48" Dia. Manhole	60" Dia. Manhole
6	15	20
8	20	26
10	25	33
12	30	39
14	35	48
16	40	52

Table 400.5 – Minimum Time Required for Vacuum Drop of 10" to 9" of Mercury During Manhole Vacuum Tests