STANDARD SPECIFICATIONS FOR
CONSTRUCTING SANITARY SEWER FACILITIES

DIVISION III - CONSTRUCTION SPECIFICATIONS

SECTION 3
GENERAL SPECIFICATIONS FOR SANITARY SEWER MAINS

3.01 SCOPE

These general and detailed specifications form a part of the Contract documents and shall govern the handling and installation of sanitary sewer mains, manholes, service connections, and accessories described herein, and as shown on the accompanying plans. Existing sanitary sewer facilities are owned and operated by Daphne Utilities, hereinafter referred to as "Owner." The construction methods employed in the placement of the sanitary sewer main and appurtenances shall be in accordance with current codes, practices and specifications of the Owner. See Appendices included herein for sanitary sewer construction details pertaining to this section.

3.02 WORK INCLUDED

The Work includes furnishing all labor, equipment, and material necessary to complete the work ready for operation as stipulated herein. The lines shall be laid in the locations and to the grades shown on the Plans.

The Contractor shall clear and grub as necessary, remove as much of the pavement as may be necessary; excavate the trenches and pits to the required dimensions; excavate the bell holes, construct and maintain all bridges required for traffic control; sheet, brace and support the adjoining ground or structures where necessary; handle all drainage or ground water; guard the site, unload, haul, distribute, and lay the pipe; fittings and accessories; rearrange the branch connections to main sewers, or rearrange other conduits, ducts or pipes where necessary; connect new sewers to existing sewers; connect existing sewer laterals to new mains; replace all damaged drains, sewers, or other structures; backfill the trench and pits; restore the roadway surface; remove surplus excavated material; clean the site of the work; and maintain the street or other surface over the trenches.

3.03 SCHEDULE OF OPERATIONS

The Contractor shall prepare and submit to the Owner/Engineer for approval by the Owner/Engineer, prior to beginning construction, a schedule of his proposed operations outlining his sequence of pipe installation, connections to existing sewers and placement of new sewers in service.

3.04 MATERIALS

A. Ductile Iron Pipe Gravity Sewer & Force Mains: Where specifically designated on the Plans or at locations determined in the field, ductile iron pipe shall be used for gravity sewers and force mains.

Ductile iron pipe and fittings shall be as hereinafter specified except that the minimum wall thickness shall be as specified in ASTM A746 for thickness Class 52. Extra thickness shall be provided where required by deep cover in accordance with ASTM A746, for type 2 laying conditions. Pipe shall be centrifugally cast. Ductile iron pipe for sewers shall be mechanical joint or push on joint conforming to ASTM A746. Ductile iron pipe and fittings shall have a cement mortar lining conforming to ANSI/AWWA C104/A21.4.

The pressure rating, metal thickness, net weight of pipe without lining, length of pipe, name of manufacturer, and letters "D.I." shall be clearly marked on each length of pipe.

Ductile Iron Pipe Gravity Sewer & Force Mains: The pipe shall also be permanently marked with “Sanitary Sewer Gravity Main” or “Sanitary Sewer Force Main”, or similar designation.

Where it is necessary to cut new ductile iron pipe or existing cast iron pipe, in no case shall it be cut by burning, but shall be cut by saw, cutter, abrasion or other approved means.

1. Ductile Iron Lock Joint Pipe: Ductile iron lock joint pipe shall meet the requirements of ANSI/AWWA C151/A21.51 for ductile iron pipe and may be of the bolted or boltless type suitable for 150 psi working pressure. If bolted type pipe is used, all bolts and nuts shall be Corten Steel.

2. Ductile Iron Fittings: Ductile Iron fittings shall be designated for pressure rating of 250 psi and shall be in accordance with AWWA C110 or AWWA C153. Fittings shall be mechanical joint. Ductile iron compact fittings shall be in accordance with ANSI/AWWA C153/A21.53-88, latest edition. Fittings shall have cement mortar lining and the exterior shall be coated with an approved bituminous coating.

3. Positive Restrained Joint Pipe & Fittings: If approved by the Owner, prior to construction, positive restrained joint pipe and fittings 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 manufacturer’s standard restrained joint. The joint 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. When available, the fittings shall be the same manufacturer and joint restraint.

4. Friction Restrained Fittings: Friction restrained fittings shall be a mechanical restraint retainer gland with stainless steel bolts. The restraint shall be provided by an approved Manufacturer Listed in the Appendix or engineered approved equal.

5. Polyethylene Sheath: Unless otherwise indicated by soil testing, polyethylene sheath shall be installed on all ductile iron pipe and appurtenances. The exterior of the ductile iron pie shall be covered with a sealed polyethylene sheath

in accordance with AWWA Specifications C105, latest revision and shall be either 4 mil HDCL or 8 mil LLD. The installation shall be method A.

Polyethylene encasement shall not be exposed to sunlight longer than 7 days. Contractor shall furnish written certification, accompanied by a copy of test results, that the pipe and pipe material has been sampled, tested, and inspected as required. These certifications and test results shall be submitted, in five complete copies, to the Owner/Engineer for review and the pipe manufacturer shall retain duplicate copies of all test results in permanent files to be made available upon request.

Care shall be taken not to damage the polyethylene sheath during the backfill operation. Any polyethylene sheath, which is damaged, shall be replaced or repaired by the Contractor at no additional expense to the Owner.

B. PVC Pipe:

1. Gravity Sewers: Plastic pipe for gravity sewers, stacks and laterals, and fittings shall be polyvinyl chloride (PVC), meeting or exceeding ASTM Specification D3034 latest edition, Classification SDR 35. Pipe lengths shall not exceed 20 feet and provisions shall be made at each joint to accommodate expansion and contraction. All 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 25 psi for one hour with no leakage.

In every instance where pipe enters or leaves a manhole, a fitting shall be provided which will accommodate expansion and contraction of the pipe, release strain on the pipe (caused by differential settlement between pipe and manhole) and provide a rubber ring water seal between pipe and manhole. Where indicated fittings shall also be provided for stubouts for future connections and stubout shall be sealed with PVC plug. Fittings shall be included in the price of the manholes.

Pipe shall be retained in shipping cradles when stored along the right-of-way until pipe is ready to be laid. In no case will removal of pipe from cradles be permitted more than 24 hours in advance of installation.

PVC pipe shall be installed in accordance with ASTM D2321, latest edition. If there is a conflict between the provisions of ASTM D 2321 and the Project Specifications, the Project Specifications shall govern this conflict. Deflection of PVC pipe after installation and backfill shall not exceed 5 percent. Pipe found to be deflected more than five percent shall be replaced at the Contractor's expense.

2. Force Main Pipe: PVC pipe for force mains shall be provided as shown on the plans. PVC pipe shall conform to the requirements of AWWA C900/C905, standard for pressure pipe with ductile iron pipe outside diameter. Pipe shall be a minimum Class 235 with a standard dimension ratio of 18 or heavier.

   For pipe diameters less than four inches, PVC pipe shall conform to the requirements of ASTM D2241 for pressure pipe with iron pipe outside diameter. Pipe shall be a minimum Class 200 for ASTM D2241. A ductile iron solid sleeve fitting shall be used to transition from PVC to ductile iron.

   PVC pipe for sewer force mains shall be permanently marked with "Sanitary Sewer Force Main" or similar designation every four (4) feet. Pipe joints shall be integral bell and spigot type with rubber ring sealing gasket. The pipe bell shall be designed to be at least as strong as the pipe wall.

   All sanitary sewer PVC pipe shall be green. White pipe may be substituted provided a manufacturer applied permanent stripe further defined below is applied to the surface of the pipe 180 degrees from the normal pipe markings. The pipe shall be placed in the trench with the stripe visible from the top of the pipe trench. For pipe sizes four inches in diameter and smaller, a manufacturer applied one inch wide continuous green stripe shall be applied. For pipe diameters greater than four inches, a three-inch wide continuous permanent green solid stripe shall be applied.

3. Fittings for PVC Pipe: Fittings for PVC pipe shall be made of ductile iron conforming to the section above for ductile iron. Fittings shall be provided with a transition gasket specifically designed to accommodate the outside diameter of the PVC force main. Also certified test results detailing that fittings meet or exceed these Specifications shall be provided.

4. Lower Pressure PVC Pipe Systems: PVC piping for lower pressure systems shall be Schedule 80, Class 200 or HDPE SDR 7, when approved by the Owner, for pipe sizes are 3 inches or less in diameter. Material selection shall be per the Owner's current standards. Refer to standard drawings for additional details on connections and fittings.

5. Tapping saddles shall be used for insertion of corporation stops or other outlets for testing of force mains.

C. High Density Polyethylene (HDPE): When approved by the Owner for site specific conditions, HDPE may be used. HDPE pipe for sewer applications shall have a green stripe applied by the manufacturer or be sold green. Solid black pipe shall not be permitted. Pipe shall be made from high density polyethylene resin compound which meets ASTM D3350, PE 4710, SDR 11 DIPS OD, unless pipe size is less than three inches than IPS may be utilized. Pipe shall be on the Owner's list of materials and approved manufacturers. Dimensions and workmanship shall conform to ASTM F714.

Fittings for HDPE pipe shall be made of ductile iron conforming to the section above for ductile iron. Adapters or transition coupling shall be utilized to transition between HPDE and DI. The adapter shall be mechanical joint, threaded, or flanged depending on the application and suitable for connection to the DI Fitting.

Polyethylene pipe shall be the nominal pipe size and dimension ratio shown on the plans, or in the proposal. Unless field conditions dictate a heavier wall thickness, SDR 11 shall be used. Installation shall be in accordance with ASTM D2321 or as modified herein. For 4 inches in diameter and larger, pipe shall conform to DIPS. For 2 inches in diameter, pipe shall conform to SDR 7, CTS.

Shipping lengths of pipe shall be assembled into one continuous length at the job site by thermal butt-fusion. Fusion machine and fusion machine operator shall be approved by pipe 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. A data logger shall be utilized to record all HDPE welds and data records shall be submitted to the Owner/Engineer. Hand written records will not be acceptable.

Contractors shall provide written certification from the manufacturer that the personnel performing the joint welding has received proper training for the welding of the manufacturers piping material.

Installation of polyethylene pipe in areas where flotation is probable whether on land or a subaqueous location installation shall conform with manufacturer's recommendation.

Polyethylene pipe shall not be crimped in any way during construction. Fabricated polyethylene bends shall be manufactured by pipe manufacturer. SDR of fabricated polyethylene bends shall be equal to SDR of connecting pipe.

When connecting polyethylene pipe to manholes provide a rubber ring water seal between pipe and manhole. Grouting around the ring shall also be required inside and outside the manhole.

Deflection of polyethylene pipe after installation and backfilling shall not exceed 5 percent.

D. Fusible PVC: Fusible PVC may be submitted for consideration by the Owner in areas of transmission mains for directional drills provided the material meets all standards for C 900 PVC and is constructed in accordance with all manufacturer recommendations and procedures.

E. Marking for PVC & HDPE Pipe: Marking for PVC/HDPE pipe shall be provided for all PVC/HDPE force mains and shall be marked in accordance with both items below:

1. Tracer Wire: All PVC/HDPE pipe shall be marked using a 12 gauge insulated copper wire and have a green coating placed six inches over top of pipe. Where directional drill operations are occurring, 8 gauge insulated copper wire shall be utilized. Backfill shall be carefully placed to the depth of six inches by hand to assure that the wire is secured in place over the pipe. It is the intent of this paragraph to provide means to locate PVC pipe using standard pipe location equipment. The wire shall be carried up through all valve boxes and lateral stub outs and terminated at least 2 feet above the ground line to permit connecting of location equipment. Excess wire at valve boxes shall be neatly rolled and stored in the valve box. Valve boxes for termination of wire shall be placed approximately every 750 linear feet along force main or as directed by the Owner.

2. Marking Tape: Shall be green with imprint "Caution: Buried Sewer Line Below," buried at least 15 inches above the top of the pipe and shall be green in color. Tape shall be 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 approximately 15 inches above top of the pipe and the tape shall then be placed flat with imprint up. Backfill shall be carefully placed to a depth of six inches over tape by hand to assure that the tape is secured in place over the pipe. It is the intent of this Paragraph to provide a means of identifying and protecting force mains. Marking tap used with PVC/HDPE for mains shall be metalized so that the PVC/HDPE pipe can be located using standard pipe location equipment.

3.05 ENCASEMENT PIPE

See section entitled "Encasement Pipe."

3.06 PRECAST MANHOLE

Precast manholes shall conform to the requirements of ASTM C-478, latest edition with a minimum wall thickness of 5 inches. Variations to these requirements are subject to approval in writing from the Owner. Every manhole is to be fully and completely built as reached with new sewer pipe and shall meet the following requirements:

A. All aggregate shall be made from 97 percent calcareous rocks. Manholes shall be smooth and free from fractures and honeycombs. The Contractor shall provide manufacturer's certification stating the type of aggregate used.

B. All Portland Cement shall be Type II or Type V.

C. Manholes shall be neatly and accurately built, according to the plans and specifications, of proper materials and in a workmanlike manner. Care shall be taken not to damage the manhole sections during handling and installation.

D. The invert and bottom curves of all manholes shall be neatly and accurately constructed and so formed as to facilitate the entrance and flow of sewage over them.

E. When required, stubouts consisting of one segment of ductile iron pipe of the required size shall be built into manholes to receive either present or future branch lines shall have an Engineer approved mechanical plug.

F. The cone shaped top section shall be eccentric and the cone and riser sections shall conform to the requirements of ASTM C-478, latest edition, and as hereinafter specified. The top section of manholes less than 6 feet in depth shall be flat concrete slabs and shall conform to the requirements of ASTM C-478. Basis of acceptance for flat slab tops shall be either proof of design testing or rational design calculations as described in ASTM C-478, and shall be submitted to the Engineer/Owner for review.

Both cone shaped top sections and flat slab tops shall be designed to withstand a minimum H-20 wheel loading in accordance with AASHTO requirements.

G. The minimum nominal diameter of manholes shall be 48 inches for pipe sizes less than 24 inches. Where larger manholes are required, eccentric transition sections may be installed not less than 6 feet above the invert, except where total depth of the manhole will not permit.

H. New manholes shall be supplied with an approved cast-in flexible manhole pipe connector (boots) for each pipe cutout. The flexible manhole pipe connector (boot) shall meet ASTM C-923 requirements. The flexible manhole pipe connector (boot) shall be secured to incoming and outgoing pipes with a stainless steel clamp. The clamp shall be tightened to 60 inch pounds of torque or as required by the manufacturer. The connector shall be installed in the manhole wall in accordance with the manufacturer's recommendations. Grouting around boots shall be required as recommended by the boot manufacturer.

Existing manholes cored for each pipe cutout shall be fitted with flexible manhole pipe connectors (boots). The flexible manhole pipe connector (boot) shall meet ASTM C-923 requirements. The flexible manhole pipe connector (boot) shall be secured to incoming and outgoing pipes with a stainless steel clamp and a stainless steel rigid adjustable expansion ring. The clamp shall be tightened to 60 inch pounds of torque or as required by the manufacturer. The connector shall be installed in the manhole wall in accordance with the manufacturer's recommendations.

Existing pipes requiring a doghouse manhole or a cast in place manhole shall be supplied with a waterstop gasket connector. The connector shall be secured to the pipe with a stainless steel clamp. The clamp shall be tightened to 60 inch pounds of torque or as required by the manufacturer. The connector shall be cast in or sealed with non-shrink grout or an approved equal. The connector shall be installed in accordance with the manufacturer's recommendations.

Connection manholes for HDPE pipe shall be as directed by the Engineer/Owner. All connectors shall be sized specifically for the pipe material, pipe size, and manhole size being used.

I. The Contractor shall use riser rings to set the manhole cover in line and on grade. The Owner prefers pivoted turnbuckle style provided by an approved Manufacturer listed in the Appendix or Owner approved equal. The tops of manholes are to be flush with existing or proposed ground or streets or where directed. In locations where manhole covers are flush with the ground, markers approved by Daphne Utilities shall be placed near them for locating purposes. Where the manholes are flush with the ground and are located in the clear zone, a break away type marker shall be used.

J. Joints in riser and cone sections shall have rubber gaskets or an approved equal meeting the requirements of ASTM C443. Also, an external join seal similar to Wrapidseal or Owner approved equal shall be utilized.

K. Manhole riser sections and cone shall have manufacturer installed steps conforming to the section entitled “Manhole Steps.”

L. A black mastic joint sealer, included on the list of materials and approved manufacturers, or an approved equal shall be placed on top of the cone section of the manhole before setting the castings to prevent infiltration.

M. Castings shall conform to the section entitled “Cast Iron Frames and Covers.”

N. Pipes entering a manhole more than 24 inches above the manhole invert shall be a drop connection and shall be constructed of either PVC or ductile iron of like materials to that of the sewer being laid.

O. Manhole bottoms shall be either 8 inches thick cast in place concrete or integral with the lower section of riser walls as hereinafter specified.

1. Poured in place bottoms shall be a minimum of 8" thick and shall be not less than 12 inches in diameter larger than the outside of the riser section. The top of the manhole bottom shall be not less than 3 inches below the lowest pipe invert. The invert of the manhole shall be built up with cement grout.

   Special care shall be taken to assure a good seal around the manhole bottom. The joint between the bottom and walls shall be sealed on the manhole exterior with grout.

2. Bottoms integral with side walls shall be set on a prepared bed of not less than 2 inches of gravel, slag, crushed stone, reef shell or an approved equal. The bed shall be accurately shaped to fit the manhole bottom to assure uniform bearing over the entire manhole bottom. The invert of the manhole shall be built up with cement grout, as shown on Daphne Utilities’ standard manhole detail.

3. Backfill of undercut shall not be permitted. Any undercut shall be filled with concrete with a minimum compressive strength of 4,000 psi.

4. Anti-Flotation Collars shall be required for all manholes unless otherwise directed by the Engineer. Anti-flotation collars shall be at least 12 inches in diameter larger than the outside sections of the riser.

P. Where manholes intercept existing sewer mains or laterals connected to existing manholes, the Contractor shall keep the sewer main or lateral service to the existing manhole intact until the next adjacent section of new sewer is completed and approved. The laterals or mains shall then be broken and fed to the new sewer laterals or mains and the dead end of the abandoned mains or laterals plugged at the manhole wall with an approved plug.

Q. Manholes that are in low areas or near areas with a potential for rising water as determined by the Owner shall be installed a minimum of four feet above grade and at least one foot above high water level. Inflow dishes may be necessary in some field conditions. Owner shall be contacted to determine which method shall be utilized for site conditions and operation and maintenance of the system.

R. Manholes shall be provided with "Flex-Seal" or "Cretex" or "Ring Seal" or an Owner approved chimney seal equal. The chimney seal shall be installed in new or existing manholes to stop infiltration in the chimney area. The chimney seal shall be flexible and allow repeated vertical and horizontal movement due to traffic loading. The chimney seal shall be secured to the manhole cone. The chimney seal shall have a design life of at least 25 years. The chimney seal shall be installed in the manhole in accordance with the manufacturer's recommendation.

S. Before installation of any precast manholes, the following information shall be submitted and approved the Engineer:

1. Project name and number.
2. Manhole manufacturer.
3. Manhole shop drawings including dimensions, materials, and manhole designation numbers.
4. Gasket manufacturer and specifications.
5. The name of the independent testing laboratory proposed to certify the manholes.
6. Written acknowledgement that material certification in accordance with these standard specifications.

T. Failure to comply with any part of these Specifications shall be reason for rejection of the entire manhole. Any defects shall be remedied by the Contractor immediately. Any manhole section which does not meet these Specifications shall be removed from the job site. Refusal to comply with any part of these Specifications shall be reason for denial or revocation of permission to install precast manholes.

U. All new and rehabilitated manholes and manhole components shall be warranted to be free from defects in materials and workmanship for a period of five (5) years from the date of project acceptance. Should a defect occur during this five (5) year period that is attributable to the installation or materials, then this defect shall be repaired within four (4) weeks from the date of defect notification to the Contractor at no additional cost to the Owner.

V. Brick manholes shall not be permitted.

W. All manholes that have a discharge from a force main shall be lined with the rehabilitation product for manholes specified herein.

3.07 MANHOLE TESTING

A. Laboratory Testing:

1. Testing of manhole sections shall be performed in accordance with ASTM C- 478, latest edition and ALDOT. Testing documentation and necessary stencils shall be in accordance with ALDOT requirements. The cost of the testing shall be borne by the manhole supplier.

2. Manholes shall be inspected and certified by the manhole supplier per industry standards and ALDOT and referenced ASTM. Only in emergency situations shall the manholes be inspected and certified in the field. Manholes shall not be installed by the contractor unless the certification is stenciled on the interior of each manhole section.

   Manholes shall not be certified after installation. Manholes physically damage during shipment will not be accepted.

3. The manhole supplier shall obtain a letter of certification from the aggregate supplier per ALDOT requirements. The manhole supplier shall furnish a letter certifying that this same calcareous aggregate is being used in the production of the manholes being furnished.

4. The manhole supplier shall obtain a letter of certification from the cement supplier indicating that Type II or Type V cement is being provided for the production of manholes. The cement supplier shall furnish this Type II or Type V cement certification letter at least quarterly to the manhole supplier.

5. The manhole supplier shall furnish to the Engineer a document at the completion of each project that states the following:

   a. The project name.
   b. A Summary of the manholes provided that includes the diameter, number, and location of each manhole.
   c. The most recent documentation from the aggregate supplier.

d. Certification from the manhole supplier that the aggregate is the same used in producing the manholes.

e. The most recent documentation from the cement supplier showing that Type II or Type V cement was supplied for the manufacture of these manholes.

f. Certification that all concrete cylinder breaks made during the manufacture of the supplied manholes successfully passed established compressive strength requirements.

The manhole supplier shall provide documentation (a) through (f) to the Owner.

The Owner will not accept projects for which the above documentation cannot be furnished by the sewer constructor's representative. It shall be the responsibility of the sewer constructor's representative to obtain said documentation from the manhole supplier and furnish it to the Owner prior to the acceptance of the facilities by the Owner.

The manhole supplier shall maintain the above documentation for a minimum period of three years from the date of the documentation transmittal.

B. Vacuum Testing:

1. Approximately 10% of all new and rehabilitated manholes, as randomly selected by Daphne Utilities, shall be tested by the Contractor using the vacuum test method, by following the manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Any leakage in the manhole or structure, before, during, or after the test shall be repaired by the contractor for no additional compensation from the Owner. Also, Daphne Utilities may elect to require testing of all new or rehabilitated manholes if a test failure occurs in the 10% of manholes tested. There will be no additional compensation from Daphne Utilities for this requirement.

2. All pipes for vacuum testing entering the manhole shall be installed at the top access point of the manhole. A vacuum of 10 inches of mercury (Hg) (5.0 psi) shall be drawn on the manhole, and the time shall be measured for the vacuum to drop to 9 inches of mercury (Hg) (4.5 psi). Manholes will be considered to have failed the vacuum test if the time to drop 1 inch of mercury is less than the limits shown in the following table:

Vacuum Test Timetable

Manhole Diameter - Inches

Depth - feet	48 inches	60 inches	72 inches	96 inches
4	10 sec.	13 sec.	16 sec.	19 sec.
8	20 sec.	26 sec.	32 sec.	38 sec.
12	30 sec.	39 sec.	48 sec.	57 sec.
16	40 sec.	52 sec.	64 sec.	76 sec.
20	50 sec.	65 sec.	80 sec.	95 sec.
+ Each 2'	+5 sec.	+6.5 sec.	+8.0 sec.	+9.5 sec.

3. Manhole depths shall be rounded to the nearest foot. Intermediate values shall be interpolated. For depths above 20 feet, add the values listed in the last line of the table for every 2 feet of additional depth.

4. If the manhole or structure fails the vacuum test, the Contractor shall perform additional repairs and repeat the test procedures until satisfactory results are obtained.

   After the manhole installation and/or rehabilitation work has been completed, the manhole shall be visually inspected by the Contractor in the presence of the Engineer and the Work shall be accepted if found satisfactory to the Engineer. The finished surface shall be free of blisters, “runs” or “sags” or other indications of uneven lining thickness. NO EVIDENCE OF VISIBLE LEAKS SHALL BE ALLOWED.

5. The Contractor shall furnish to the Owner documentation showing the results of the vacuum test for each manhole.

6. All new and rehabilitated manholes may be retested 11 months after the manholes where installed or rehabilitated and must pass the above vacuum test requirements.

3.08 MANHOLE STEPS

Manhole steps shall be steel rods encased in polypropylene plastic and shall be of the type by an approved Manufacturer listed in the Appendix or Owner approved equal. Steps shall be Type PS-1 or PS- 2, for precast manholes. Steps shall conform to the requirements of ASTM C-478. Manhole steps shall be driven into wet well wall during manufacture.

3.09 CASTINGS

Cast iron frames and covers shall conform to the plans in all essentials of design. All castings shall fit the manholes properly. 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 A-48 for Class 30 Gray Iron Castings. Frames and covers shall not weigh less than that shown on the Plans. The castings shall be smooth, true to pattern and free from projections, sand holes or defects and shall properly fit the manhole opening. The portion of the frame and cover which forms the cover seal shall be machined so that no rocking of the cover is possible. The cover shall have non-

penetrating pick holes. The frames and covers shall be by an approved Manufacturer listed in the Appendix or Owner approved equal.

On paved streets, the frame and cover shall be set flush with the finished grade and in the plane of the paved surface. In other locations, they shall be set to the grades determined in the field by the Engineer/Owner.

Where shown on the Plans or directed by the Engineer/Owner, sealed castings shall be of the bolted watertight manhole rings and covers and meet the above requirements.

3.10 DROP CONNECTIONS FOR MANHOLES

Where indicated on the plans or instructed in the field, drop connections shall be neatly and accurately constructed of proper materials and in a workmanlike manner, in strict accordance with the details shown on the plans. Piping for drop connections shall be ductile iron or PVC as determined by the Daphne Utilities.

3.11 CONCRETE

The minimum compressive strength required at 28 days is 4,000 pounds per square inch. 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 U.S. gallons per sack of cement. Slump shall range between two and five inches.

3.12 MORTAR FOR SEWER STRUCTURES

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 10% by weight of the cement.

3.13 RUNNING BOARDS, SADDLE PILES AND MATS

Running boards, saddle piles and mats shall be two inch pine which has been pressure treated with pentachlorophenol, C.Z.C. or other suitable preservative to resist decay.

3.14 GRAVEL, SLAG OR CRUSHED STONE

See section entitled “Erosion Control”, paragraph entitled “Crushed Slag or Crushed Stone”.

3.15 EMBEDMENT OF PVC PIPE FOR GRAVITY SEWER PIPE

A. Embedment: 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. The table below shall be used in determining the material required for embedment, which may be referred to as “haunching," "foundation or bedding," and "initial backfill" as used in these specifications, of PVC gravity sewer pipe.

EMBEDMENT FOR PVC GRAVITY SEWER PIPE

Pipe Depth	Bedding or Foundation	Haunching	Initial Backfill
16' or less	C1. I, II, or III	C1. I, II, or III	C1. I, II, or III
Greater than 16'	C1. I or II	C1. I	C1. I, II or III

In areas where the existing soil is other than as described above and is not acceptable for use as embedment material, crushed stone or reef shell as herein before specified shall be used. Separate payment will be made for crushed stone used for foundation, bedding, or haunching under the items of "Crushed Stone Foundation" and "Select Haunching for PVC Sewer Pipe" respectively. There will be no payment for embedment material when existing material is utilized.

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, crushed stone or reef shell shall be used for haunching of the pipe. Separate payment will be made for crushed stone used for haunching of the pipe under the item of "Select Haunching for PVC Sewer Pipe."

Crushed stone foundation is required for sewer installations ten (10) feet and deeper.

B. 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 broad categories according to the suitability for this application:

1. Class I - Angular, 6 to 40 mm (1/4 to 1-1/2 inch), graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

2. Class II - Coarse sands and gravels with maximum particle size of 40 mm (1-1/2 inch), 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.

3. 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.

4. Class IV - Silt, silty clays, and clays including inorganic clays and silts of 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.

5. Class V - This class includes the organic soils OL, OH, and PT as well as soils containing frozen earth, debris, rocks larger than 40 mm (1-1/2 inch) in diameter, and other foreign materials. These materials are not acceptable for bedding, haunching, or initial backfill.

3.16 BACKFILL

See section entitled “Backfilling.”

3.17 EROSION AND PROPERTY CONTROL

See Section entitled “Erosion Control.”

3.18 ALIGNMENT AND GRADE

A. General: The grade as shown on the Plans is that of the invert and to which the Work must conform. Any variation from the grade will be deemed sufficient reason to cause the Work to be rejected and rebuilt at the Contractor’s expense. The Owner reserves the right to make adjustments to the grades and slopes to fit actual field conditions.

B. Protecting Underground and Surface Structures: Temporary support, adequate protection and maintenance of all pipelines, underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense. Existing side drain pipes and curbs and gutters that interfere with the Contractor's operation shall be removed and replaced in kind at no additional cost to the Owner.

C. Sub-Surface Explorations: Existing underground pipes and structures have been shown on the plans from existing records for the contractor's convenience. The contractor shall verify locations of existing underground pipes and structures through examination of all available records and shall make all explorations and excavations necessary to determine the location of existing pipelines, service connections, or other underground structures. This investigation shall be made in advance of any pipe laying and any damage to existing pipelines, service connections or underground structures shall be repaired by the Contractor at no additional cost to the Owner.

D. Establishing Grade: The Contractor may use laser beam for establishing grade of sewer, but he shall be entirely responsible for the accuracy of the Work. If laser beam is used, the Contractor shall check the grade of sewer using a level and rod, at 50 feet to 100 feet from manhole from which pipe is being laid, and at each manhole and anytime a new set up is made in the same section.

In lieu of the laser beam, the Contractor may, at his option, have a minimum of 3 batter boards placed ahead of the pipe laying at all times not to exceed a maximum distance of 50 feet between batter boards.

The Contractor shall furnish the Engineer with a centerline cut sheet for approval prior to beginning construction on the sewer line. The cut sheet will contain data obtained by

the Contractor in the field and will show station number, centerline elevation, manhole offset hub elevation, invert elevation, centerline cut, hub cut, and percent of grade. Data will be obtained and shown at each 50-foot station, manhole stations, and at each point of significant elevation change and in terrain.

3.19 EXCAVATION AND PREPARATION OF TRENCH

A. Perform all excavation of every description and of whatever substance encountered to the depth specified on the Plans or as staked in the field.

B. All excavated material not required for filling shall be removed from the site or otherwise satisfactorily disposal methods.

C. The trench width may vary with and depend upon the depth of trench and the nature of the excavated material encountered; but in any case shall be of ample width to permit the pipe to be laid and jointed properly. The width of the trench shall be at least 12 inches greater than the nominal diameter of the pipe. The maximum clear width of trench at top of the pipe shall not be more than 36 inches greater than the pipe diameter.

D. The bottom of the trench shall be carefully graded, formed and aligned before any sewers are laid therein.

E. 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 uniform contact and support throughout its entire length.

F. Where the bottom of the trench does not make a suitable foundation for the sewer, the trench shall be deepened and backfilled with shell, gravel, or slag and shaped as above, or the pipe shall be placed on running boards or mats.

G. The Contractor shall have a berm at least two feet in width between the trench and the excavated material.

H. The trench shall be dug to the alignment and depth required and only a minimum distance in advance of the pipe laying. The trench shall be so drained that workmen may work therein efficiently. It is essential that the discharge from pumps be led to natural drainage channels, to drains, or to sewers.

I. In excavating streets that have been surfaced with shell, sand-clay, clay gravel or other base course, such base material shall be either stockpiled and kept separate from the earth excavation or the Contractor shall at his expense provide new base of like kind and equal quality.

J. Excavation for manholes or other structures shall be sufficient size to leave at least one foot in the clear between their outer surface and the embankment, or sheeting which may protect it.

K. Overcut in depths of manholes shall be backfilled with concrete. Overcut in sewer trench shall be backfilled in accordance with Section entitled "Backfilling." Backfill for correcting overcut conditions shall be at the Contractor's expense.

L. Bell holes of ample dimensions shall be dug in earth trenches at each joint to permit the joining to be made properly.

M. When the material through which the trench is excavated has the potential 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 placed to a point at least two (2) feet above the top of the pipe. The Contractor shall exercise every precaution 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. The top of sheeting left in place shall be at least twelve (12) inches below natural ground. The Contractor shall place sheeting and/or bracing as he and his surety deem necessary to protect workmen and the public.

N. If local conditions permit, all surface materials suitable for re-use in restoring the surface shall be kept separate from the general excavation material.

O. All excavated material shall be piled in a manner that will not endanger the work and that will avoid obstructing sidewalks and driveways. Gutters and storm drains shall be kept clear, or other satisfactory provisions made for proper street drainage.

P. The use of trench-digging machinery will be permitted except in places where their operation will cause damage to trees, building, or existing structures above or below ground, in which case hand methods shall be employed.

Q. To protect persons from injury and to avoid property damage, adequate barricades, and construction signs in accordance with Section G of the Alabama Manual on Uniform Traffic Control Devices, shall be placed and maintained during the progress of the construction work and until it is safe for traffic to use the highway in which the construction is being performed. Rules and regulations of the local authorities and OSHA regarding safety provisions shall be observed.

R. Excavations for pipe laying operations shall be conducted in a manner to cause the least disruption to traffic. Where traffic must cross open trenches, the Contractor shall provide suitable bridges at street intersections and driveways. Hydrants under pressure, valve pit covers, valve boxes, curb stop boxes, fire or police call boxes, or other utility controls shall be left unobstructed and accessible during the construction period.

S. Adequate provisions shall be made for the flow of sewers, drains and water courses encountered during construction, and the structures which have been disturbed shall be satisfactorily restored upon completion of the work. No separate compensation will be made to the Contractor for removal, replacement and restoration of existing facilities.

T. Trees, fences, poles, and all other property shall be protected unless their removal is authorized by the Owner; and any property damaged shall be satisfactorily restored by the Contractor. No separate compensation will be made to the Contractor for removal of existing obstructions, including abandoned concrete slabs, within the roadway right of way.

U. Dead ends of abandoned or new lines shall be capped or plugged as shown on the plans.

3.20 REMOVING AND REPLACING PAVEMENT

See section entitled “Removing & Replacement Paving.”

3.21 PUMPING AND BYPASSING

No sewage or solids shall be dumped, bypassed or allowed to overflow into streets, streams, ditches, catch basins or storm drains nor will it be allowed to "back up" upstream to such an extent that homes, businesses, etc. along the sewer are flooded.

When pumping/bypassing is required, the Contractor shall supply the necessary pumps, conduits and other equipment to divert the flow of sewage around the manhole or pumping station at which work is to be performed. All hoses shall be in good condition and shall not have repairs or be modified for the operation of the system. The bypass system shall be of sufficient capacity to handle existing flows plus additional flow that may occur during periods of heavy rainfall. The Contractor shall provide a spare bypass pump equal in size for each pump required for all bypassing operations. The spare pump shall be on-site and piped for immediate service during all bypass operations. The spare pump shall be configured to start automatically if initial pump fails or cannot maintain flow level in manhole or wet well.

The Contractor will be responsible for furnishing the necessary labor and supervision to set up and operate the pumping and bypassing system. The Contractor is responsible for all maintenance of the bypass pumping system to ensure no disruption in the system. The Contractor shall assure that an overnight bypass will not result in an overflow event. Twenty four (24) hour supervision of the operation will be on a case by case base. At a minimum SCADA monitoring with alarms shall be utilized by the Contractor. However, it is the Contractor’s sole responsibility to determine if additional efforts are necessary. If pumping is required on a 24-hour basis, all engines shall be equipped in a manner to keep the pump noise at a minimum.

Where pump discharge lines cross streets or alleys, they shall be covered with wooden or metal ramps designed and installed in such manner that they do not unreasonably impair vehicular traffic traveling said streets and alleys. All "pumping" or "bypassing" work, the arrangement or layout of the pumping and bypassing facilities, and the manholes and sewer lines to be utilized in such work must be approved by the Owner's representative prior to the time said "pumping" and "bypassing" work is started.

Whenever possible, the Contractor and the Owner's representative shall discuss and resolve the use of and arrangement of any "pumping" and "bypassing" facilities well in advance of the time of the need for such work and facilities is anticipated.

The Contractor shall inspect the various sewer lines to determine for himself the quantity and depth of sewage flow in said lines, and shall determine therefrom the size of and the number of pumps and related pumping facilities will need to adequately perform the "pumping" and "bypassing" work. No direct payment will be made for pumping and bypassing.

3.22 TRANSITIONS FOR DISSIMILAR PIPES

Transitions for dissimilar pipes up to 12 inch O.D. shall be made by use of a flexible coupling with an adapter bushing and stainless steel band and clamps with stiffner. Transitions from dissimilar type pipe over 12 inch O.D. shall be made by use of approved adapters specifically designed for this purpose. Joining of dissimilar pipes with concrete collars shall not be permitted except at such places where specifically approved by the Owner.

3.23 INSPECTION

A. Material at Factory: All materials are subject to inspection and approval at the plant of the manufacturer.

All material shall meet the requirements specified and suppliers of pipe and fittings shall furnish, in triplicate, to the Engineer, an affidavit stating that all pipe and fittings furnished under this contract conform to the requirements as set forth in these specifications.

B. Field Inspection: All pipe and accessories shall be laid, jointed and backfilled in the presence of the Engineer. The Engineer in charge of construction shall be notified by the Contractor at least forty-eight (48) hours in advance before any section of sewer is checked with the "GO-NO-GO" mandrel. The Engineer shall give a certified certificate to the Owner that the pipe after inspection meets the Owner's specifications.

C. Disposition of Defective Material: All material found during the progress of the work to have flaws, or other defects will be rejected and the Contractor shall promptly remove from the site of the work such defective material.

3.24 HANDLING PIPE AND ACCESSORIES

A. Care: Pipe, fittings, valves, and other accessories shall, unless otherwise directed, be unloaded at the point of delivery, hauled to and distributed at the site of the project by the Contractor; items shall at all times be handled with care to avoid damage. In loading and unloading, items shall be lifted by hoists or slid, or rolled on sideways in such manner as to avoid shock. Under no circumstances shall they be dropped. Pipe handled on sideways must not be skidded or rolled against pipe already on the ground.

B. At Site of Work: In distributing the material at the site of the work, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. Pipe shall be retained in shipping cradles when stored along the right-of-way until pipe is ready to be laid. In no case will removal of pipe from cradles be permitted more than 24 hours in advance of placing in trench.

C. Care of Pipe Coating: Pipe shall be handled in such manner that a minimum amount of damage to the coating will result. Damaged coating shall be repaired in accordance with the pipe manufacturer's recommendations.

D. Bell Ends (Direction): Pipe shall be placed on the site of the work parallel with the trench alignment and with bell ends facing the direction in which the work will proceed.

E. Pipe Kept Clean: The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Each pipe shall have a swab run through it until all foreign matter has been removed.

3.25 PIPE LAYING

A. Manner of Handling Pipe and Accessories into Trench: Proper implements, tools, and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All pipe, fittings, and accessories shall be carefully lowered into the trench, piece by piece, by means of derrick, ropes or other suitable tools or equipment, in such manner as to prevent damage to pipe or pipe coating. Under no circumstances shall pipe or accessories be dropped into the trench.

B. Pipe Kept Clean: All foreign matter or dirt shall be removed from the inside of the pipe before it is lowered into its position in the trench and it shall be kept clean by approved means during and after laying.

C. Laying the Pipe: The pipes and fittings 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.

The joints between the individual pipes shall in all cases be made as nearly watertight as possible.

Any debris or dirt which may find entrance into the pipe in making the joint shall be removed by a suitable scraper or other approved means.

Wyes or tees shall be inserted or proper opening provided in the sewer lines wherever designated. All branches thus inserted, unless connected with a lateral, shall be capped.

Magnetic marker tape shall be used to identify the location of sewer laterals, and shall be on Daphne Utilities' list of materials and approved manufacturers. Magnetic marker tape shall be attached to a 5/8-inch diameter steel rod extending from end of sewer lateral. "Where sewer laterals are being installed in new subdivisions, each lateral shall be marked with a 4 inch diameter PVC pipe and a magnetic marker. The posts shall be placed at the end of the laterals as they are installed, shall extend 2 feet from the ground and shall be painted green.

In sewers over 8 feet in depth, or whenever instructed, PVC stacks shall be carried up from the tee or wye connection at an angle of 45 degrees with the vertical, and the end shall terminate within 4 feet of the ground surface or as directed by the Engineer. Where laterals are called for on the Plans, or instructed by the Owner, they shall be laid to the right-of-way line or as the Owner may direct. The ends of the stacks or laterals shall be closed with covers as specified for wye or tee branches.

Whenever pipe laying is stopped for the night or for any other cause, the end of the pipe shall be securely closed with a stopper to prevent the entrance of water, mud, or other obstructing matter, and shall be secured in such a manner as to prevent the end pipe from being dislodged by sliding or other movement of the backfilling.

No pipe shall be laid in water, or when the trench conditions or weather is unsuitable for such work. The Contractor shall remove any water that may be found or may accumulate in the trenches and shall perform all work necessary to keep them clear of water while the foundations are being laid, the masonry being constructed, or pipe laying is in progress. Such water removal shall be accomplished by means of a well point system or other approved means. Comprehensive plans for dewatering operations, if used shall be submitted prior to installation. No additional payment will be made for dewatering.

Wherever house laterals are intercepted by the excavation for the new sewer, connection shall be maintained temporarily to the old sewer until the particular section of new sewer is completed and tested, then the house lateral shall be broken and reconnected to the new sewer through a wye, tee or opening which shall have been placed in the sewer for that purpose.

After each pipe is laid, it shall be partly backfilled and made secure before the next joint is laid.

Workmen 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.

After placing a length of pipe in the trench, the joint shall be held around the bottom of the spigot, so that it will enter the bell as the pipe is shoved into position.

The spigot shall be centered in the bell, the pipe shoved into position, and brought into true alignment; it shall be secured there with earth carefully tamped under and on each side. Care shall be taken to prevent dirt from entering the joint space, and joints between individual pipes shall be made watertight.

In every instance where pipe enters or leaves a manhole, a fitting shall be provided which shall accommodate expansion and contraction of the pipe, release strain on the pipe (caused by differential settlement between pipe and manhole) and provide a rubber ring water seal between pipe and manhole. Where indicated, fittings shall also be provided for stubouts for future connections and stubouts shall be sealed with plug fittings. Fittings shall be included in the price of the manholes.

D. Connecting Existing Sewer Laterals: Wherever existing sewer laterals are intercepted by the excavation for the new sewer, the existing connection shall be maintained temporarily to the old sewer until the particular section of new sewer is completed and tested, then the house lateral shall be cut at the required location and connected to the new sewer through the tee or wye placed in the sewer line for that purpose. No separate compensation shall be allowed the Contractor for connecting the existing lateral to new main.

Sewer laterals shall be constructed of a minimum of six inch (6") PVC pipe. Residences shall not be allowed to share a common lateral. Each residence shall be served by an individual lateral. Where existing lateral elevations dictate the rolling of tees or wyes 45 degrees in the vertical plane, the sewer lateral pipe shall be cut and a 45-degree bend provided for vertical alignment of the new and existing sewer lateral.

Where existing sewer laterals are inactive, six-inch (6") PVC sewer pipes shall be extended to the right of way line at the depth of the existing laterals and plugged. The location of the lateral shall be referenced both horizontally and vertically by the Contractor.

The Contractor shall take particular care to keep sewer laterals clean of all dirt, mud and other obstructing matter.
No separate compensation shall be allowed the Contractor for work and materials required in maintaining temporary service of the existing sewer lateral to the old sewer line nor for handling sewage while connecting the existing lateral to the new main.

All pipe for laterals shall be marked within the right of way using a metalized tape buried between 18 and 24 inches below the ground surface. Tape shall be 3" wide minimum. The pipe trench shall be backfilled to approximately 24 inches below the ground surface and then metalized tape shall be placed flat over top of pipe. Backfill shall be carefully placed to a depth of 3 inches by hand to assure that the tape is secured in place over the pipe. All laterals shall be marked at the street with an embedded metal rod inserted in the pavement or curbing. It is the intent of this paragraph to provide a means to locate sewer laterals using standard pipe location equipment. Tape shall be extended from the centerline of the sewer main to the end of the sewer lateral and approximately 3 feet of tape shall be neatly wrapped around the end of the lateral at the right of way limits in locations where service is currently not required. Cost of marking sewer laterals shall be included in unit price bid for sewer pipe for stacks and laterals.

E. Thrust Restraint for Force Mains: Thrust restraint for sewer mains at bends shall be provided by concrete thrust blocks and mechanical joint restraint. Thrust blocks of concrete of a mix not leaner than one cement, two fine aggregate and four course aggregate, having a compressive strength of not less than 3,000 psi shall be installed. The blocking shall be poured against undisturbed earth. Mechanical joint restraints shall be of adequate strength to prevent movement shall be used to supplement concrete blocking where noted. Assembly shall be designed for minimum pressure of 250 psi.

3.26 BRACING

In the event that the pipe installer or his surety deems it necessary, desirable, or for other reasons to open sheet or close sheet the trenches, the sheeting shall be accomplished in such a manner that the pipe will be protected at all times. Such sheeting shall remain in place until the backfill is carried to a point at least 2 feet above the top of the pipe. Exercise every precaution 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. The top of sheeting left in place shall be at least 12 inches below the finished ground.

3.27 CREEK CROSSINGS

Creek crossings shall be constructed in accordance with the details on the Plans. Except as hereinafter set forth, all preceding paragraphs shall govern this Work.

A. The width of trench in the creek bed or across drains shall be 5 feet wider than out- to-out width of all pipes. This bottom shall be cleared of rocks, stumps, or other obstructions and shall be reasonably smooth and level and to the elevations shown. It will be permissible to pre-assemble and lay the individual lines in 1 piece, provided the trench is shaped in such a manner that the pipe bears full length on the bottom.

B. The section of lines in the creek bed or across drains shall be backfilled in layers not exceeding 1 foot in depth and shall be spaded or rodded around and between pipes as the backfilling progresses. Backfill shall be brought flush with the bottom of the creek bed. Rocks or boulders shall not be used in the backfill.

3.28 INSTALLATION OF FORCE MAINS

Force mains shall be constructed to the alignment and depth required. Force mains 16 inches and larger shall have minimum cover of 48 inches, and force mains smaller than 16 inches shall have minimum cover of 30 inches, except where otherwise noted on the plans. The trench shall be braced and drained so that workmen may work safely therein. The width of the trench shall be at least 12 inches greater than the nominal diameter of the pipe and the maximum clear width of the trench shall be not more than 36 inches greater than the pipe diameter.

A. Pipe Foundation: 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.

B. Pipe Laying: 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 the trench. Any defective pipe shall be rejected.

C. Jointing: Joints shall be installed in strict accordance with the recommendations of the pipe manufacturer.

D. Thrust Blocks: At bends, thrust blocks of concrete of a mix not leaner than 1 cement, 2 fine aggregate and 4 coarse aggregate, having a compressive strength of not less than 3,000 psi shall be installed. The blocking shall be poured against undisturbed earth.

E. Retainer Glands: Locked mechanical joint retainer glands of adequate strength to prevent movement shall be used to supplement concrete blocking where noted. Assembly shall be designed for minimum pressure of 250 psi.

F. Backfilling: Backfilling shall be as specified in the section entitled "Backfilling".

G. Testing: After the pipe has been laid and partially backfilled, all pipe, or any valved section, shall unless otherwise specified, be subjected to hydrostatic testing as specified in subsection "Testing for Sanitary Sewers" herein.

H. Resilient Seated Gate Valves: All valves shall be non-rising stern for underground direct burial and shall close when operating nut is turned in clockwise rotation. Valves shall be in accordance with and meet the requirements and recommendations of AWWA C515. O-ring seals shall be provided. The valves shall be a compression resilient seated gate valve. Disc shall be SBR coated. Valve body shall be fusion-epoxy bonded inside and out. Valve shall be furnished complete with necessary gaskets, bolts, and nuts as needed for mechanical joint ends. Mechanical joints and accessories shall comply with the latest published AWWA C111.

1. Valves (12 Inches and Smaller): Each valve shall have mechanical joint bell ends, and shall be an approved manufacturer by the Owner. Valves shall be installed with the operating stern in the vertical position. Valve stem shall be furnished with 2-inch square water works nut.

3.29 AIR AND VACUUM VALVES FOR FORCE MAINS

Sewage air and vacuum valves shall permit unrestricted passage of air during filling of the force main and unrestricted entry of air into the force main under vacuum condition. Float shall be stainless steel, and valve shall be designed so that the venting mechanism does not come into contact with sewage. Valves shall have NPT inlet and shall be fitted with back flushing device. The valve shall be installed in pit as shown on plans. Models shall be stainless steel. Owner will give consideration to outer material provided interior components are stainless steel. Final decision on material will be in the sole opinion of the Owner based on field conditions and maintenance.

Sewage air and vacuum valves, short-bodied version, shall be on the Owners list of materials and approved manufacturers.

The valve shall be fitted to a minimum 18 foot length of ductile iron force main by means of a tapping saddle, a Type 304 Schedule 40 stainless steel pipe, and bronze gate valve with hand wheel. Pit shall consist of 36 inch concrete pipe with cast iron cover as shown on the plans. Cover of pit shall be flush with ground. Depth of force main shall be sufficient to install air and vacuum valve.

3.30 INFILTRATION

Leakage into the completed sewer main shall not exceed 50 gallons per mile of sewer per inch of inside diameter of the sewer per 24 hours in any section between successive manholes. The amount of leakage shall be measured by a suitable weir or other device. All equipment and labor for measuring the infiltration shall be furnished by the Contractor. If the infiltration exceeds the amount specified above, the Contractor shall make the necessary corrections to bring it within the acceptable limits. All visible leaks or points of infiltration shall be repaired even though the infiltration is below the maximum specified.

3.31 TESTING OF SANITARY SEWERS

A. General: On all sanitary sewer lines, including laterals, wherever possible and practical, the Contractor shall conduct a line acceptance test. The test shall be conducted after the pipe has been backfilled and the cost of testing shall be included in other items of work. Equipment to be used in making the test shall be specifically designed for this purpose. Air tests for gravity sewers shall be conducted using products listed in the Appendix. The Engineer shall be advised at least 48 hours before tests are conducted.

B. Procedures: Sanitary sewer lines shall be tested by the following methods:

1. Gravity Sanitary Sewer Lines Up to 24-Inch Diameter:

a. 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 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold this pressure without bracing and without movement of the plugs out of the pipe.

b. After a manhole to manhole reach 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 25 psig. Low pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. At least two 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 the 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 the following table:

Pipe Dia. in Inches	Minutes
4	2.0
6	3.0
8	4.0
10	5.0
12	5.5
15	7.5
18	8.5
21	10.0
24	11.5

c. In areas where groundwater is known to exist, the Contractor shall install a one-half inch (1/2") diameter capped pipe nipple, approximately ten (10) inches long, through a 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 hose shall be held vertically and 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 a half (11½) 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.

2. Gravity Sanitary Sewer Lines - (30-Inch to 48-Inch Diameter): All pneumatic plugs shall be seal tested before being used in the actual test installation. When testing sewer lines 30-inch to 48-inch only the pipe joints need to be tested. The joint tester shall be located so that the end elements (inflatable pneumatic rings or plugs) are located on both sides of the joint to be tested. Air shall then be introduced into the plugs to 50 psig. The plugs shall hold against the pressure without bracing and without movement.

The center cavity shall then be pressurized to 3.5 psig. An additional .43 psig is added to the 3.5 psig for every foot of water head above the top of the pipeline, to a maximum pressure of 15 psig. Allow pressure to stabilize for approximately 10-15 seconds and then turn off the pressure source. If the pressure in the cavity holds or drops less than 1 psig in 5 seconds, the joint shall be found to be acceptable. If the pressure drops over 1 psig, the joint is defective and should be repaired.

When the joint test is completed all pressure must be exhausted from the center cavity and then from the plugs. The joint tester can then be moved to the next joint.

Should the line or joint fail the pressure test, the Contractor shall, at his expense, determine the source of leakage and make repairs as necessary to eliminate leakage. Air testing shall be in addition to infiltration tests specified in Paragraph entitled "Infiltration."

3. Sanitary Sewer Force Mains: All sanitary sewer force mains shall be tested as follows:

After the pipe has been laid and partially backfilled, all pipe or any valved section shall, unless otherwise specified, be subjected to a minimum hydrostatic pressure of 100 psi. The pressure test shall be for at least four hours or until the line has been completely inspected for visible leaks, whichever is longer. Before testing, all air shall be expelled from the line. The Contractor shall make all necessary taps to expel the air and then plug all taps watertight.

Approved and suitable means shall be provided by the Contractor 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 100 psi) is less than 25 U.S. gallons per 24 hours per mile of pipe per inch nominal diameter of pipe. Any observed leaks shall be repaired by the Contractor.

C. Should the line fail the pressure test, the Contractor shall, at his expense, determine the source of leakage and make repairs as necessary to eliminate leakage. Air testing shall be in addition to infiltration tests specified elsewhere herein.

D. No direct payment will be made for air testing of sewers. Payment for this item shall be included in the unit price bid for the sewer pipe installed.

3.32 INSTALLATION OF FORCE MAIN VALVES

A. Resilient Seated Gate Valves: All valves shall be non-rising stem for underground direct burial service and shall close when operating nut is turned in clockwise rotation. Valves shall be in accordance with and meet the requirements and recommendations of AWWA C515. O-ring seals shall be provided. The valve shall be a compression resilient seated gate valve. Disc shall be SBR coated. Valve body shall be fusion-epoxy bonded inside and out. Valves shall be furnished complete with necessary gaskets, bolts, nuts as needed for mechanical joint ends. Mechanical joints and accessories shall comply with the latest published AWWA C111.

1. Valves (12 Inches and Smaller): Each valve shall have mechanical joint bell ends, and shall be on the Owner's list of materials and approved manufacturers. Valve shall be installed with the operating stem in the vertical position. Valve stem shall be furnished with 2 inch square water works nut.

B. Check Valves: Check valves shall be swing check valves and on the Owner's list of materials and approved manufactures. Check valves shall be cushioned gravity swing type and shall be furnished with levers, weights, and air cushion chamber adjustable for controlling closure. Swing check valves shall be manufactured of cast iron bodies conforming to ASTM A48 Class 40 Standards, stainless steel seats conforming to ASTM A276 Standards, and Buna-N seat rings (80 Durometer), and extended type 304, 309, or 316 stainless steel hinge pins. Valves shall be equipped with flanged ends conforming to ANSI B16.1 for Class 125.

3.33 CLEAN-UP

Where these operations are on City, State, County or Private Property, the construction area 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. The Owner reserves the right to demand that the Contractor's forces be diverted to this clean-up at any time that condition of streets, driveways, sidewalks, or private property warrants such diversion. Such diversion of Contractor's forces will not entitle the Contractor to any extension of time or additional compensation.

3.34 USE OF CHEMICALS

All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with manufacturer's instructions.

3.35 PERMITS, CERTIFICATES, LAWS AND ORDINANCES

The Contractor shall, at his own expense, procure all permits, certificates and licenses required of him by law for the execution of his work. He shall comply with all Federal, State, or Local laws, ordinances, or rules and regulations relating to the performance of the work.

3.36 UNDERGROUND UTILITIES

The plans show certain features of topography, and certain underground utilities, but they do not purport to show in complete detail all such lines or obstructions. Such topography and notes on the plans were inserted from records available and are for the Contractor's convenience only, and shall not be used as the basis for claims of extra compensation. Whenever necessary to determine the location of existing pipes, valves, or other underground structures, the Contractor shall examine all available records and shall make all explorations and excavations for such purpose. Any damage to existing facilities resulting from the Contractor's operations shall be immediately repaired by the Contractor at no cost to the Owner.

3.37 SHOP DRAWINGS AND RECORD DRAWINGS

The Contractor shall submit to the Engineer for review and approval prior to ordering materials six (6) sets of shop drawings for valves, fittings, special connection fittings, and piping at connections to existing pipes. No separate compensation will be allowed the Contractor for Shop Drawings. Review and approval of Shop Drawings by the Engineer shall in no way relieve the Contractor of his responsibilities for materials and workmanship in construction of the project. Upon project completion, two (2) sets of record drawings shall be submitted to the building inspector showing final construction conditions noting installed materials and locations.

Refer to Design Criteria section certification by manufacturers and suppliers for equipment and products.

3.38 ABANDONED SEWER MAINS AND APPURTENANCES

The Owner shall retain ownership of all salvageable material removed from the project. The Contractor shall neatly store these materials at locations designated by the Engineer. The cost of removing and storing these materials as directed will be borne by the Contractor with no direct payment. Any material deemed unsalvageable by the Engineer or that is not wanted by the Owner shall become the property of the Contractor and removed from the work site for no additional compensation.

3.39 PROJECT DOCUMENTATION

A. General: Prior to start of construction, work on private property or within easements shall be documented by the use of photographs or video. Pictures or videos (photo or video), in color, shall be taken at a minimum of 50 feet on centers and shall be taken along the centerline of the Project looking up station. At least one station marker shall be visible for identification purposes and station markers shall be set by the Contractor. During the course of the documentation, any features or items of interest or importance which may be encountered shall be photographed or videotaped. Photos and videos shall be delivered to the Engineer within one week after they are made.

B. Photographs: Clear, legible photographs shall be taken by a skilled technician using a digital camera with a resolution capacity of current standards on equipment. Each photograph shall clearly identify the date, time, and location the photograph was taken. Two copies of the photographs shall be provided on a CD, DVD, or hard drive using a standard digital format such as JPEG, GIF, or BMP which can be viewed on a standard PC.

C. DVD: The purpose of the video recordings shall be a supply of continuous visual and audio record of problem areas, items, and features found within any particular area. This video record may be supplemented with photographs to exactly identify and locate specific bad features or items.

The video camera shall be capable of recording and reproducing a picture having not less than 500 lines of resolution. The video camera shall be one on which both sound and video information can be recorded using a standard digital format such as WMA or

MPEG. The replay of the video information, when reviewed on a monitor/receiver, shall be free of electrical interference and shall produce clear, stable images. To determine whether the equipment to be used in this Work meets the stated minimum requirements, a video of a suitable test pattern will be required prior to initiation of Work.

The audio portion of the video shall be sufficiently free of electrical interference and background noise to provide an oral report that is clear and completely and easily discernible.

The audio portion of the video report shall be recorded by the operating technician as the video is being recorded and shall include the location or identification of the section being viewed, the station-to-station direction of travel, the distance traveled on the specific run, and any problems encountered.

Two (2) copies of the video shall be provided to the Engineer on CD, DVD, or hard drive each within a sleeve or plastic container which shall clearly indicate the date the tape was taken and the designated section(s) of the Project contained on the video.

END OF SECTION