PART I – GENERAL

The following specification is intended for use for the design, selection of materials, and construction of gravity sanitary sewer projects. The gravity sanitary sewer shall meet the requirements of the Florida Department of Environmental Protection permit.

1.1 SCOPE

1.1.1 General

This specification provides the requirements for gravity sewer system construction for the project.

1.1.2 Work Included

The Contractor shall, unless specified otherwise, furnish all labor, materials, equipment, tools and all other associated appurtenances, necessary to do the work required under the contract to include but not limited to unloading, hauling, and distributing all pipe, casting, fittings, manholes and appurtenances. The Contractor shall also remove any surfacing as required; excavate the trenches and pits to the required dimensions; construct and maintain all required for traffic control; sheet, brace, and support the adjoining ground or structures where necessary; handle all drainage or ground water; provide barricades, guards, and warning lights; lay and test the pipe, castings, fittings, manholes and appurtenances; backfill and consolidate the trenches and pits; maintain all surfaces over the trench until surface restoration is completed; restore the surfaces unless otherwise stipulated by CCU; remove surplus excavated material; and clean the site of the work.

The Contractor shall also furnish all labor, materials, equipment, tools and all other associated appurtenances required to rearrange sewers, conduits, ducts, pipes, or other structures encountered in the installation of the work.

1.1.3 Location of the Work

The location of this work is as shown on the Contract Documents.

1.1.4 Coordination of Work

The Contractor shall be responsible for the satisfactory coordination of the construction of the gravity sanitary sewer system with other construction and activities in the area. Delays in work resulting from lack of such harmony shall not in any way be a cause for extra compensation by any of the parties.

1.1.5 Working Hours

The work shall be carried out in accordance with local ordinance and not to cause any unreasonable nuisance to affected residents. Under emergency conditions, this limitation may be waived by the consent of Charlotte County Utilities (CCU).

1.2 METHOD OF MEASUREMENT & PAYMENT

The work shall be measured and the compensation determined in the following manner:

1.2.1 Gravity Sanitary Sewer Pipe:

Gravity Sanitary Sewer Pipe shall be paid for at the contract bid price per lineal foot for each size and type of material specified which shall include the cost of furnishing all pipe, pipe bend sections, jointing material, bedding material and all other associated appurtenances, and of delivering, handling, laying, dewatering, trenching, sheeting and backfilling, testing, restoring of the surface (unless separate bid item is provided), necessary permits and all material or work necessary to install the pipe complete in place at the depth specified. The length of pipe for which payment is made shall be the actual overall length measured along the axis of the pipe without regard to intervening manholes, tee sections or bend sections. Lengths of branches will be measured from the centers of connecting manholes to the center of manhole. All lengths will be measured in a horizontal plane unless the grade of the pipe is more than fifteen percent (15%). The depth of cut for payment shall be defined as the distance between the invert of the pipe at a particular point and the intersection of a vertical or plumb line extended from the said point to the point of intersection of the line with the ground surface as it exists at time of construction.

1.2.2 Gravity Sanitary Sewer Services

The method of measurement and payment shall be the same as in section 1.2.1 Gravity Sanitary Sewer Pipe with the length of branches being measured from the center of the gravity sewer pipe to which connection was made to the end of the gravity sanitary sewer service either being the right-of-way or the property line at which a clean out shall be installed. In addition, all fittings required for the gravity sewer service installation shall be considered incidental to this pay item and no direct compensation will be made therefore.

1.2.3 Gravity Sanitary Sewer Service Clean Outs

Gravity Sanitary Sewer Service Clean Outs shall be paid at the contract bid price per each size specified which shall include all labor, material, equipment and associated appurtenances to complete the installation as specified.

1.2.4 Gravity Sanitary Sewer Service Wyes, Tees and Special Fittings

Wyes and tees shall be paid for at the contract bid price for each unit furnished of the size and classification specified. Fittings shall be considered incidental and no direct compensation will be made therefore.

1.2.5 Standard and Drop Manholes

Standard and Drop Manholes (inside or outside as designated) shall be paid for at the contract bid price per each for each type and size specified which shall include the cost of furnishing all pipe, tees, horsehoes, precast sections, boots w/stainless steel straps, concrete slabs, adjusting rings and covers, mortar, castings, interior/exterior coatings, jointing, and other material and of delivering, handling, excavation, sheeting, backfilling, dewatering, restoring of the surface, and all material or work necessary to install the units complete in place at the depth specified for the depth of 0-6 feet plus an additional payment (sanitary manholes only) at the contract unit price per lineal foot of depth greater than six feet (6'). Manholes shall be measured from the invert of the sewer to the top of the cover.

a. The inside drop piping shall be included in the contract bid price of the inside drop manhole including all piping, fittings, support brackets and all associated appurtenances as specified and no direct compensation will be made therefore.

b. The outside drop piping shall be included in the contract bid price of the outside drop manhole including all piping, fittings, concrete/reinforcement and all associated appurtenances as specified and no direct compensation will be made therefore.

1.2.6 Core Existing Sanitary Sewer Manhole

The Contractor shall core the existing manhole(s) to the correct size hole and install a boot at the core w/stainless steel strap, grout, reconstruct the manhole bench for optimum flow, and line the inside of the manhole in accordance with specification 009920 “Sanitary Sewer Structures Rehabilitation”. Payment shall be at the contract bid price per each size and shall be compensation in full for providing all labor, materials, equipment, dewatering, reconstructing, grouting, coring, lining and all associated appurtenances for the installation of the boot as specified.

1.2.7 Connect to Existing Sanitary Sewer Manhole

In cases where a short sanitary pipe stub out of a manhole exists, the Contractor shall remove the existing pipe stub and connect the new pipe to the connection provided as shown on the engineering drawings and/or as directed by the Engineer. The Contractor shall line the inside of the manhole in accordance with specification 009920 “Sanitary Sewer Structures Rehabilitation”. Payment shall be made at the contract bid price per each stub out connection.

1.2.8 Connect to Existing Sanitary Sewer Stub Out

The Contractor shall remove the existing plug, verify the invert elevation and alignment of the existing pipe, and connect the new pipe as shown on the engineering drawings and/or as directed by the Engineer. Removal of plugs and verification shall be considered to be incidental to the connection. Payment shall be made at the contract bid price per each connection to the existing sanitary sewer stub out.

1.2.9 Gravity Sanitary Sewer Service Connection to Existing Gravity Sewer Main

a. Cut-in Connection

The gravity sanitary sewer service connection to the existing gravity sewer main shall be paid for at the contract bid price per each connection installed including cut into the main, the wye/tee, piping, repair couplings with stainless steel shear rings, hardware, bedding material, dewatering, pre-installation and post-installation television inspection of existing main, restoration (unless a separated bid contract item is provided), all equipment, materials, labor and all other associated appurtenances required to install the sewer service complete in place at the depth and location shown on the plans and/or as directed by CCU.

The sewer service piping shall be paid as described in section 1.2.2 Gravity Sanitary Sewer Services.

b. Saddle connection

The gravity sanitary sewer service connection to the existing gravity sewer main shall be paid for at the contract bid price per each connection installed including the tapping into the main, the collar wye/tee saddle, piping, repair couplings, hardware, bedding material, dewatering, pre-installation and post-installation television inspection of existing main, restoration (unless a separated bid contract item is provided), all equipment, materials, labor and all other associated appurtenances required to install the sewer service complete in place at the depth and location shown on the plans and/or as directed by CCU.

The sewer service piping shall be paid as described in section 1.2.2 Gravity Sanitary Sewer Services.

1.2.10 Testing

All required testing shall be considered incidental to the project and no direct compensation will be made therefore.

1.2.11 Miscellaneous

All other items required for the completion of the project and not included as a specific bid item shall be considered incidental to the project and no direct compensation will be made therefore.

1.3 REFERENCED STANDARDS (latest revisions)

AWWA: C-105, C-150, C-110, C-478, C-900, C-905, C-909, C 906-90, C-151, C-153, C-111, C-651, C-652, and C-652

ASTM: A-139, C-478, B-1785, D-638, D-790, D-1869, D-1120, D-2241, D3350, D 1248-68

1.4 PARTIAL LISTING OF RELATED SECTIONS

001570 - Erosion and Sediment Control
001760 - Surveying and Record Drawing
002240 - Dewatering
002530 - Submersible Sewage Pump Lift Station-Package Design
002540 - Submersible Sewage Pump Lift Station- Standard Design
002930 - Grassing
003300 - Precast Concrete Products
009900 - Surface Preparation, Painting and Coating

Note: This is only a partial listing of related sections. The Contractor shall be responsible to review the entire contract documents.

1.5 SUBMITTALS

1.5.1 For only those materials that the Contractor is requesting deviations from these specifications, the Contractor shall submit in writing documentation to justify approval of these materials by Charlotte County Utilities (CCU) prior to the start of the project. The Contractor shall submit four (4) signed copies of the material submittals.

1.5.2 The contractor submittals shall include the statement that the submittals have been reviewed and the materials meet the contract specifications and/or standard details.

1.5.3 Prior to the start of the project, the Contractor shall submit four (4) signed copies of shop drawings for any proposed structures including the specifications defining the concrete, coatings, sealers, and manhole covers and risers for CCU review.

1.5.4 Final approval is at the discretion of CCU.

PART II – PRODUCTS

2.1 MATERIALS

2.1.1 General

The materials used in this work shall be all new, and conform to the requirements for class, kind, size and material as specified below.

All pipe furnished for gravity sanitary sewer and service installations including wyes/tees shall be of the type, kind, size, and class indicated for each particular line segment as shown on the engineering drawings and/or designated in the Contract Items.

2.1.2 Ductile Iron Pipe (DIP)

The ductile iron pipe covered by this specification shall be the push-on joint type, centrifugally cast to conform to all requirements of AWWA Specification C-151, latest revision. All pipes shall have an epoxy bonded lining in accordance with AWWA Specifications, latest revision. The maximum allowable deflection of the pipe shall not exceed two percent (2%) of the pipe

diameter. Ductile iron pipe shall be fully encased in an 8 mil polyethylene sleeve in accordance with AWWA Specification C-150, Method A. Polyethylene material shall conform to ASTM standard Specification D-1248-68. All ductile iron pipe shall be marked "DUCTILE IRON" in large letters. The nominal wall thickness shall be plainly marked on each piece of pipe. The pipe and the polyethylene sleeve shall be color coded green by a means acceptable to CCU.

Ductile iron pipe joints shall be of the push-on type with rubber gasket which complies with the latest revision of AWWA Specification C-111.

2.1.3 Polyvinyl Chloride Sewer Pipe (PVC)

a. PVC pipe shall conform to the applicable requirements of AWWA C-900 (3" through 12"), AWWA C-905 (14" through 36"), and AWWA C-909 (6" through 12") and shall be Class 150 SDR 18 for depths of 0 to 4 feet of cover and SDR 26 for depths greater than 4 feet of cover. PVC pipe shall be Class 200 SDR 14 between the first upstream manhole and lift station wet well regardless of pipe depth. Three (3) inch diameter and smaller schedule 40 or 80 PVC pipe shall conform to the requirements of ASTM B-1785, latest revision. The manufacturer shall insure all quality control test and AWWA requirements are complied with during the production of PVC pipe.

   C-900, C-905, and C-909 pipes shall have an integral bell formed with a race designed to accept the gasket in accordance with AWWA requirements. The spigot end shall have a bevel and a stop mark on the outside diameter to indicate proper insertion depth. Provisions shall be made for expansion and contraction at each joint. All surfaces of the joint where the gasket may bear shall be smooth, free of cracks, fractures, or imperfections that could adversely affect the performance of the joint.

   Schedule 40 and 80 PVC piping can be joined by solvent cements, adhesive, or threaded type connections as approved by CCU prior to their use.

b. Pipe Color: All C-900, C-905, and C-909 polyvinylchloride sewer main pipes shall be green in color with a PVC ASTM D-1120 and ASTM D-2241 reference, the class pressure rating, and the SDR number permanently and plainly marked on the pipe. Schedule 40 and 80 PVC piping shall be white and/or grey and the type of pipe permanently and plainly marked on the pipe.

c. Rubber Gasket Joints: C-900, C-905, and C-909 polyvinylchloride pipe joints shall be the bell and spigot type using rubber gasket push-on type joints. Rubber gaskets shall be molded to a circular form to the proper cross section and shall consist of a vulcanized high grade elastomeric compound conforming to ASTM D-1869 and AWWA C-900, C-905, and C-909 elastomeric seals for joining PVC pipe.

2.1.4 Manholes

a. Manholes shall be constructed of precast sections. Manholes shall conform to ASTM C-478. No brick and mortar shall be used to complete the cone between the top precast section and the ring and cover. The manhole cover ring shall be mounted in the top precast cone section.

b. A minimum of one (1) and a maximum of three (3) four (4) inch precast adjusting rings shall be provided between the cast iron frame and the top concrete manhole section as outlined in section 3.5.3

c. The manhole shall be delivered to the job site with pre-installed elastomeric gasket(s) for all piping. The gasket(s) shall have a stainless steel adjustable strap to seal the gasket to the pipe. An elastomeric gasket(s) with a stainless steel adjustable strap to seal the gasket to the pipe shall be installed in all on site core bored holes.

d. The manhole invert shall have a 1% slope with the bench and channels constructed of 3000 psi concrete having a smooth trowel finish. The concrete shall be machine mixed and contain no pieces of bricks.

e. The individual manhole sections shall fit together with interlocking tongue and groove joints. Four (4) foot diameter manholes shall be sealed with a R-4 rubber gasket and six (6) foot or larger diameter manholes shall be sealed with two (2) 1-½" butyl rubber or plastic manhole joint seal squeezed in and out to verify sealing. The outside of the groove joints for all manholes shall be covered with a continuous overlapping butyl rubber wrap a minimum of six (6) inches wide.

f. Drop manholes are required when an invert exceeds 24" from the manhole bench. The drop pipe shall be external unless otherwise approved by CCU. The drop pipe shall meet the requirements of the CCU standard details. An external drop is required unless otherwise approved by CCU, on an existing manhole that has been core bored for a new gravity sewer and/or force main. Force mains at a manhole shall have a plug valve at the manhole.

2.1.5 External Manhole Coating:

The outside surface of the manhole shall be coated with 3 coats (black/red/black or color changes to allow CCU personnel to verify multiple coats) of coal tar epoxy coating with a minimum dry film thickness of 10 mils per coat for a total of 30 mils dry film thickness. Subsequent coats shall be applied within 48 hours of the previous coat. The coal tar epoxy coating shall be Koppers Bitumastic No. 300m or CCU approved equal.

2.1.6 Internal Manhole Coatings:

The internal manhole coatings shall be a polymorphic resin, a calcium aluminate mortar, an epoxy coating, or polyurethane coating. Coatings shall be installed in accordance with the manufacturer's specifications.

2.1.6.1 Polymorphic resin coating system

The sprayed applied polymorphic resin coating system shall be the Integrated Environmental Technologies (IET) System 3 or approved equal. The polymorphic resin shall be a 100% solids, two components, highly modified isothalic polyester resin material. The coating shall form a mechanical and chemical bond to the manhole liner surface with

less than 0.08% shrinkage (ASTM C596) in 28 days. The material shall have a minimum twenty-eight (28)-day compressive strength of 9,000-psi.

The three coat system is:

I. Prime Coat: DS-101 5-10 mils thick

II. Intermediate Coat: DS-301 20 mils thick

III. Final Coat: DS-401 5 mils thick

The finish resin shall be resistant to sulfuric acid attack associated with domestic sewage.

The existing manhole and junction chambers shall be prepared for the application of the polymorphic resin system by cleaning and stoppage of infiltration as specified above. Prior to applying the resin liner, the entire manhole surface and benches shall be patched and grouted to the extent needed to provide a smooth and even surface to which the liner will adhere.
The cured resin system shall conform to the minimum physical standards, as listed below:

CURED RESIN	STANDARD	LONG-TERM DATA
TENSILE STRENGTH	ASTM D-638	5,000 psi
FLEXURAL STRESS	ASTM D-790	8,630 psi
FLEXURAL MODULUS	ASTM D-790	15,120 psi

The Contractor shall provide certified independent, third party test results verifying the minimum physical properties listed above. The tests shall be in conformance with the ASTM specifications listed.
The finished liner shall be cured in strict accordance with the manufacturer's instructions.

2.1.6.2 Pure-fused Calcium aluminate mortar liner:

The sprayed applied pure-fused calcium aluminate mortar liner shall be SewperCoat as manufactured by Lafarge Calcium Aluminates Inc., Mainstay ML-CA or approved equal.

a. Lafarge Calcium Aluminates Inc. SewperCoat

The Lafarge Calcium Aluminates Inc. SewperCoat material shall form a mechanical and chemical bond to the manhole liner surface with less than 0.08% shrinkage (ASTM C596) in 28 days. The liner shall have a minimum twenty-eight (28) day compressive strength of 9,000 psi. The liner is a one coat application. The liner shall be spray applied directly to the damp manhole surface, trowel smooth, and "brushed" finished. The material shall completely cover the interior surface of the manhole with a minimum thickness of ½ inch.

b. Mainstay ML-CA coating shall yield .41 cu. ft. per 50# bag per one (1) gallon of water. The coating can be applied by pneumatic spray or by trowel up to 3" in a single lift but shall have minimum thickness of ½" but with a 1" thickness for smoothing concrete that will experience surface attack. Working time is approximately 30 minutes at 80F. Cured

properties are Compressive Strength meeting ASTM C 109 24 hrs. ≥ 8000 psi, 7 days ≥ 9000 psi, and 28 days ≥ 9000 psi; Flexural Strength meeting ASTM C 293 24 hrs. ≥ 900 psi, 7 days ≥ 1000 psi, and 28 days ≥ 1100 psi; Shrinkage @ 90% Relative Humidity meeting ASTM C 596 24 hrs. 0%, 7 days 0%, and 28 days 0%; Tensile Strength meeting ASTM C 496 28 days 600 psi; and Bond Strength meeting ASTM C 1042 28 days ≥ 3000 psi.

2.1.6.3 Urethane Resin System

The existing manhole and junction chambers shall be prepared for the application of the urethane system by cleaning and stoppage of infiltration as specified in section 221412 – Gravity Sanitary Sewer Manhole Rehabilitation. Prior to applying the urethane liner, the entire manhole surface and benches shall be patched and grouted to the extent needed to provide a smooth and even surface to which the liner will adhere.

The cured urethane system shall conform to the minimum physical standards, as listed below:

CURED URETHANE	STANDARD	LONG-TERM DATA
TENSILE STRENGTH	ASTM D-638	5,000 psi
FLEXURAL STRESS	ASTM D-790	10,000 psi
FLEXURAL MODULUS	ASTM D-790	550,000 psi

The Contractor shall provide certified independent, third party test results verifying the minimum physical properties listed above. The tests shall be in conformance with the ASTM specifications listed.

The finished liner shall be cured in strict accordance with the manufacturer's instructions.

A. The sprayed applied urethane resin system shall be SprayWall as manufactured by Sprayroq, Inc, Birmingham, Alabama or approved equal. The finished urethane shall be resistant to sulfuric acid attack associated with domestic sewage. The urethane shall be manually sprayed onto the structures or manholes to provide a uniform smooth surface. A minimum thickness of 250 mils (1/4") shall be applied for structural integrity. If design requires, 1" can be applied in a single application". The coating system shall be capable of being applied over wet surfaces without degrading the final product.

B. Epoxy coating systems will be considered equal to the specified Urethane Resin System provided that the material is a solvent-free, 100% solids epoxy and meets or exceeds the minimum physical properties listed above. Composite systems containing layers of different materials or cured-in-place resin systems that are inflated in the manholes will not be considered as equal. The epoxy liner shall be Raven 405 or approved equivalent. The liner shall be applied by brush, roller, plural component airless or air-assisted spray to a moist and damp condition. The Raven 405 shall be sprayed applied at a minimum thickness of 125 mils, unless otherwise specified by CCU, in a single application and shall completely cover the interior surface of the manhole. Raven 405 is a 100% solids epoxy with zero shrinkage. Therefore, actual wet film thickness and final dry film thickness are the same (i.e. 10 mils

WFT=10 mils DFT). Maximum physical properties are achieved in approximately eight hours at 70°F, however maximum chemical resistance may take three to seven days.

2.1.7 Manhole – Ring and Covers:

All covers shall be H-20 rated and conform to the requirements and dimensions shown on the engineering drawings and the CCU standard details. All covers shall fit closely in the rings in any and all positions and must fit the ring solidly in the ring and in all positions so that there shall be no rocking from pressure on any point of the cover. All manhole covers shall be ASTM A536, Grade 60-40-18 ductile iron; and meet the requirements of ASTM A-48, Class 35B, AASHTO M-306 or higher. The cover shall be marked as designated in the "hinged" or "non-hinged" cover requirements.

2.1.7.1 Hinged Cover

The hinged cover shall be manufactured from ductile iron IAW ISO 1083 or reinforced galvanized steel and incorporate a 90 degree blocking system to prevent accidental closure. Covers shall be one man operable using standard tools and shall be capable of withstanding a test loads of 120K lbs. or H-20 rated whichever is greater. The cover shall be simply removed by one person. Cover hinges shall be flush with the top of the cover.

a. Circular hinged covers shall be a 24" or 36" clear opening diameter, and the frame shall incorporate a 360 degree mechanically attached elastomeric seating gasket for infiltration control and traffic shock. The hinge box shall include a self-cleaning, dual wiper infiltration plug. The frame depth shall not exceed 4 inches, and the flange shall in corporate bedding slots, bolt holes, and lifting eyes. All components shall be black coated. The hinged cover shall have either a stainless steel tag permanently attached to the cover with Charlotte County and the date of installation embossed or painted on the tag or Charlotte County and the date of installation cast into the cover. The cover shall have at least one non-penetrating pick hole opposite the hinge. Installation location of the hinged cover shall meet the CCU standard details.

b. Rectangular covers shall be sized and installed as designated on the engineering drawings and meet the requirements of a circular cover as applicable. If required, the cover shall have a manual opening assist mechanism.

2.1.7.2 Non-hinged Cover:

Circular non-hinged covers shall be a 24" or 36" clear opening diameter, and the frame shall incorporate a 360 degree mechanically attached elastomeric seating gasket for infiltration control and traffic shock. The cover shall have two (2) non-penetrating pick holes 180 degrees apart and Charlotte County and the date of installation cast into the cover. The cover shall have no alignment tabs protruding from the bottom of the lid which would fit into the top of the manhole riser. A removable rain shield shall be installed with each manhole. Installation location of the non-hinged cover shall meet the CCU standard details.

2.1.8 Manhole Steps

Manhole steps are not required.

PART III – EXECUTION

3.1 MATERIAL HANDLING, ALIGNMENT AND GRADE

3.1.1 Material Handling

Manholes, piping, and other accessories shall be unloaded at the point of delivery and hauled to and distributed at the site of the project by the Contractor and be handled with care to avoid damage. In distributing the material at the site, each piece shall be unloaded opposite or near the place where it is to be laid in the trench. If any manholes, piping, and other accessories are damaged, the replacement or approved repair shall be made by the Contractor at the Contractor's expense as approved by CCU.

3.1.2 Pipe Alignment and Grade

All pipes shall be laid and maintained to the required lines and grades with manholes at the required locations. No deviation shall be made from the required line or grade except with the approval of CCU. All construction staking requirements of the project shall be performed by a Professional Surveyor and Mapper (PSM) licensed in the state of Florida, paid for by the contractor, to insure compliance with the construction plans.

3.2 LAYING PIPE

3.2.1 Trench preparation:

Prior to the laying of the pipe, the trench shall be excavated and prepared in accordance with the CCU standard details class of bedding, fill materials, and compaction requirements.

3.2.2 Cleaning pipe:

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 the pipe shall be kept clean by approved means during and after laying. The outside of the tongue or spigot end of the pipe shall be wire brushed and wiped clean, dry, and free from oil and grease before the pipe is laid.

3.2.3 Laying Pipe:

The pipe shall be laid proceeding upgrade with the tongue or spigot ends pointed in the direction of flow. Pipe shall not be laid in water or when the trench conditions are unsuitable for such work except by written permission of CCU. The excavation of trenches shall be fully completed a sufficient distance in advance of the pipe laying and the exposed ends of all pipe shall be fully protected with a board or approved stopper to prevent earth or other substances from entering the pipe. The interior of the sewer piping shall be continually cleaned of all dirt, cement, or superfluous material as the work progresses. If necessary and/or required by CCU at the completion of the installation, the pipe shall be thoroughly flushed by CCU approved method at the expense of the Contractor prior to testing.

3.2.4 Rock conditions:

No piping shall be laid directly on a bed of rock. All rock shall be removed or cut away to a minimum dimension of twelve inches (12") beyond the pipe wall in all directions. If cut away, proper specified bedding shall be placed between the rock surface and the outside of the pipe to prevent damage to the pipe.

3.2.5 Pipe Orientation:

Pipe shall be laid with the lettering designating manufacturers name, class, and size of pipe visible from the top of the open trench.

3.2.6 Pipe Continuity:

A continuous run of gravity sanitary sewer piping between manholes and/or between a manhole and a wet well shall be from the same manufacturer. A continuous run of gravity sanitary sewer piping shall be either PVC or DI and no mixing of type of piping is allowed.

3.2.7 Laser Beam Grade Control:

The Contractor shall maintain the line and grade of the pipe in the trench by means of a laser machine. The laser apparatus shall be in good working order when being used. When directed by CCU, the Contractor shall set the laser machine above ground and verify the working order of the laser machine to CCU's satisfaction. The Contractor shall check periodically the line and grade of the pipe being laid by other means. The Contractor shall check the grade of each structure placed by means of an automatic level or other means approved by CCU. All pipes and manholes shall be installed within tolerance levels of the laser apparatus as approved by CCU.

3.3 MARKER BALLS AND METALLIC MARKER TAPE

a. Marker balls and metallic marker tape: Contractor shall provide and install metallic marker tape and provide, program, and install marker balls for all installed trenched pipe. For trenchless pipe installations the Contractor shall provide, program, and install marker balls. Metallic marker tape is not required on trenchless pipe installations. The tape shall be marked green for sewer. The metallic tape shall be laid 12 to 18 inches above the pipe and the ball markers placed directly on top of the pipe or fitting.

b. Installation: The balls shall be installed at all changes of direction and fittings absent of any valve. For cul-de-sacs having continuous fused or roll piping with no in-line fittings, the balls shall be placed starting at the point of curvature of the cul-de-sac and every 50 linear foot to the end of the line. On straight runs of pipe, the balls shall be installed at every power pole. If power poles do not exist, the balls shall be placed every 150 feet from the nearest change of direction or fitting. On vertical deflections the marker ball shall be placed on the top fitting only.

c. Programming: The contractor shall program all balls and provide a copy of the programmed data in each marker ball in either Microsoft EXCEL or Access electronic format to CCU. The contractor as-built drawings shall show the location of all marker balls.

3.4 PIPE JOINTING

3.4.1 Joints for gravity sanitary sewer PVC and DI pipe shall be made by the use of push on rubber gaskets only. All jointing procedure shall be in accordance with the recommendations of the pipe manufacturer as approved by CCU.

3.4.2 All sliding surface of joints shall be cleaned and lubricated immediately before the pipe is brought home.

3.4.3 Only in specific locations approved by CCU, the contractor may use a Fernco Eccentric series fitting based on the eight-tenths rule for service connections only.

3.4 SERVICE CONNECTIONS, WYES, TEES

3.4.1 General

The appropriate size service connections, wyes, tees shall be installed for service connections in accordance with the engineering drawings, CCU standard details and/or at locations as determined by CCU. The joints and bedding shall be made as previously specified. The tops of all risers and openings to wyes and/or tee branches shall be capped by a slip joint plug to prevent any water from entering the service until the connection is place in service. A clean out as specified in the CCU standard details shall be installed at the end of all service connections which is either at the right-of-way or property line.

3.4.2 Pre-Installation and Post-Installation Television Inspection of Existing Sewer Main

When the new sewer services are being connected to the existing sewer main, the contractor shall video (TV) inspect the existing sewer main immediately before and after the new sewer services installation to verify the existing pipe conditions. The audio, video, and written records shall be provided to CCU for review.

3.4.3 Records and Location of service connections

The contractor shall keep written records of service connection, wye, tee locations, depth to top of riser, type of connection for completion of as-built drawings. A locate ball shall be placed on the service connection at the clean out location which is either at the right-of-way or property line. The wye or tee location shall be made to the nearest manhole center downgrade from the service.

3.5 SETTING MANHOLES

3.5.1 Manholes shall be set and jointed to the line in the manner specified for laying and jointing pipe and at location(s) as shown on the engineering drawings, CCU standard details and/or as directed by CCU.

3.5.2 Frames and covers shall be set to the designated elevation on a precast concrete riser section. The bottom of all manholes shall be constructed of half section of equivalent size pipe shaped to conform to the inlet and outlet pipe so as to allow a free, uninterrupted flow.

3.5.3 A minimum of one (1) and a maximum of three (3) four (4) inch precast adjusting rings shall be provided between the cast iron frame and the top concrete manhole section on a full bed of non shrinking mortar with non shrinking mortar between rings. The interior and exterior of rings shall be grouted.

3.5.4 The manholes shall be assembled/erected such that they are waterproof. The interlocking joints between manhole sections shall be sealed using a joint seal previously specified. A continuous and overlapping at its end outside wrap as previously specified shall be installed for all manhole joints between sections.

3.5.5 Not less than three (3) and not more than four (4) lifting holes shall be allowed in any pre-cast manhole section. All lifting holes shall be plugged with non-shrinking mortar and internally and externally coated to ensure a waterproof installation.

3.5.6 Precast concrete bases shall be of size and depth in accordance with CCU standard details. Concrete used shall have a 28-day compressive strength of at least 3,000 pounds per square inch. Bases must be placed in a waterless excavation on a minimum of eight inches of Number 57 stone thoroughly compacted and leveled off across the entire width of the base.

3.5.7 Manhole drop sections shall be constructed in accordance with CCU standard details.

3.6 BEDDING, BACKFILL, AND COMPACTION

3.6.1 All bedding, backfill and compaction shall meet the requirements of CCU Standard Design Details and Charlotte County Community Development Engineering Division (CCCDED).

3.7 QUALITY ASSURANCE

3.7.1 General:

The contractor shall verify the operability of the gravity sanitary sewer including service connections installed and manholes prior to CCU acceptance of the system. Verification of the operability of the gravity sanitary sewer including service connections and manholes includes cleaning of the gravity sanitary sewer and manholes prior to TVing, flow testing of gravity sanitary sewer, mandrel deflection testing, vacuum testing of manholes, and air pressure testing of gravity sanitary sewer including service connections in accordance with the specifications and CCU standard details. The gravity sanitary sewer flow testing and mandrel deflection testing (if required), shall be conducted after the air pressure testing of the gravity sanitary sewer and after the backfilling is complete above the gravity sanitary sewer. Oil filled gauges shall only be used for all pressure tests. All failed testing shall be redone at no cost to CCU. The specifics of all these tests are outlined in the CCU standard details except for deflection testing as outlined herein:

3.7.2 Gravity Sewer Main Air Test:

a. Gravity sewer system testing (inclusive of sewer mains, sewer services, and manholes) shall only be conducted after the placement and compaction of backfill and base materials are completed and the compaction has been tested and approved.

b. All services shall be installed prior to testing the gravity sewer main.

c. All gravity sewer pipe shall be air tested as follows:

1. The sewer main shall be flushed and cleaned prior to the air test.

2. The section of gravity main to be tested shall be isolated with air filled stoppers or plugs suitable for air testing.

3. The services shall be capped and weighted to preclude blowing off during the test.

4. Air shall be added slowly to the test section so that the test pressure equals 4.0 psig.

5. Test air pressure shall be maintained within 0.5 psig of the test pressure by regulating the air supply for a period of two (2) minutes to stabilize the temperature.

6. After two (2) minutes the air supply shall be disconnected and the pressure in the pipe adjusted to 3.5 psig.

7. Measure the time required for a one (1) psig drop in pressure using a stop watch.

8. Compare the recorded time with the allowable time in the following table:

Length of Test Section (Ft)	Test Time (Min:Sec)	
	10" Dia. Pipe	8" Dia. Pipe
150 & Less	7:34	9:26
175	7:34	9:26
200	7:34	9:26
225	7.34	9:53
250	7.34	9:53
275	7:35	11:52
300	7:35	11:52
325 & Greater	8:50	13.50

9. If the recorded time is less than allowable loss. Replace the defective fittings and pipe and re-test until a satisfactory test is achieved.

3.7.3 Gravity Sewer Main Flow Test:

All installed gravity sewer main piping shall be flushed with a high pressure water hose and televised with an in-line video camera having pan and tilt capabilities. A calibrated depth gauge shall be mounted to allow the camera to show the residual water in the main. Deviation from line or grade shall not be more than ½ inch for linear and ½ inch for grade. All sewer laterals shall be inspected.

3.7.3.1 Test results:

The contractor shall provide CCU audio, video, and written records of the flow testing for review and approval.

3.7.4 Gravity Sewer Deflection Test:

Deflection tests shall be performed on all plastic gravity sanitary sewer pipes at the discretion of CCU based upon field observations indicating non-conformance(s). The test shall be conducted after the sewer trench has been backfilled to the desired finished grade and has been in place for 30 days. The deflection test shall be performed by pulling a rigid ball or nine-point mandrels through the pipe without the aid of mechanical pulling drives. The ball or mandrel shall have a minimum diameter equal to 95% of the actual inside diameter of the pipe. The maximum allowable deflection shall not exceed five percent of the pipe's internal diameter. The line will be considered acceptable if the mandrel can progress through the line without binding. The time of the test, the method of testing, and the equipment to be used for the test shall be subject to the approval of CCU.

All testing shall be performed by the Contractor at his expense without any direct compensation being made therefore, and he shall furnish all necessary equipment and materials required.

Test Failure and Remedy: In the event of test failure on any test section, the section shall be replaced, with all repair work subject to approval of CCU. The replaced section shall be retested for leakage and deflection in conformance with the specifications contained herein. All repairs, replacement, and retesting shall be at the Contractor's expense.

3.7.5 Manhole Testing:

a. All Manholes shall be vacuum tested. Vacuum testing shall be done in accordance with the following table:

Manhole Depth (Ft)	Min. Test Time (Sec) (4' Dia. Manhole)
4	10
6	15
8	20
10	25
12	30
14	35

b. Procedure: Induce a back pressure of 5.0 psi, equivalent to 10" Hg (Mercury). Allowable loss is less than 1" Hg for the length of the time specified.

3.7.6 Internal Coating Thickness Testing:

3.7.6.1 Urethane resin system, epoxy and polymorphic resin and pure-fused calcium aluminate mortar coatings shall be high voltage spark tested in accordance with ASTM D-4787 using a Model AP/W Tinker Razor Holiday Detector or CCU approved equal device to verify the

dry film thickness of the coating is as required by the manufacturer or engineering drawings. A test voltage of 100 volts/mil of coating thickness shall be applied to the coating. All pinholes and any other areas damaged by the test shall be marked and repaired by the contractor in accordance with the coating manufacturer's specification.

3.7.6.2 Wet coatings shall be tested using a thickness gauge in a minimum of three locations: one towards the top and one towards the bottom and one in the center of the structure as approved by CCU.

3.7.6.3 All thickness testing shall be witnessed by CCU personnel.

END OF SECTION