SECTIOIN 334000 – STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The work of this section shall include all construction of entire storm sewer system and storm water detention system including connections between the storm water system and the leaders to the building storm water down spouts, yard drains, drain tile and associated underground piping.
- B. Related Sections include:
 - 1. Section 310000 Earthwork
 - 2. Section 312319 Dewatering
 - 3. Section 315000 Excavation

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for drainage materials and products.
- C. Shop Drawings showing pipe sizes, special fittings, attachments, manholes, catch basins, castings, grates, underdrains, etc. Include details of underground detention structure, connections and special piping shapes and sizes as shown on the Contract Drawings.

1.4 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm sewerage systems.
- B. Utility Compliance: Comply with local utility regulations and standards pertaining to storm water sewerage systems. Catch basins, manholes and inlets shall be installed in accordance with the plans, and shall be installed to proper plan elevation $\pm 1/2$ inch.

1.5 PROJECT CONDITIONS.

- A. Site Information: Verify existing utility locations and depths prior to starting work. Verify that storm sewerage system piping may be installed in compliance with reference standards.
- B. Prior to installing run of pipes determine that existing utility lines have been removed.
- C. Coordinate the work of this section with other site preparation work, such as tree clearing and earthwork.

PART 2 - PRODUCTS

2.1 CORRUGATED HIGH DENSITY POLYETHYLENE PIPE

- A. Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions, and markings found in AASHTO M252 Type S for 4" 10" diameters or AASHTO M294 Type S for 12" 60" diameters. As further defined and described in AASHTO M252 and AASHTO M294, the prescribed sizes of pipe are nominal inside diameters. Pipe diameter tolerance shall be 4.5 percent oversize and 1.5 percent undersize. Pipe lengths shall not be less than 99 percent of the manufactures stated length.
- B. Four- through 10-inch (100 through 250 mm) pipe shall be silt tight and shall be Hancor Sure-Lok F477 or pre-approved equal. Pipe supplied shall be smooth Interior and Annular Exterior Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO M252, Type S. The pipe supplied shall be silt tight as defined in the joint performance requirements of this specification.
- C. Twelve- through 60-inch (300 through 1500 mm) pipe shall be silt tight and shall be Hancor Sure-Lok F477 or pre-approved equal. Pipe supplied shall be smooth Interior and Annular Exterior Corrugated High Density Polyethylene (HDPE) Pipe meeting the requirements of AASHTO M294, Type S. The pipe supplied shall be silt tight as defined in the joint performance requirements of this specification.
- D. Virgin material for 4"- 10" Pipe and fitting production shall meet the requirements of AASHTO M252.
- E. Virgin material for 12"- 60" Pipe and fitting production shall meet the requirements of AASHTO M294 with the addition that it shall be a slow crack resistant material evaluated using the notched constant ligament-stress (NCLS) test according to the procedure described in AASHTO M294, Section 9.5. Average NCLS test specimens must exceed 24 hours with no test results less than 17 hours. The virgin material shall have a minimum 50-year tensile strength of 900 psi.
- F. Joint Performance
 - 1. Silt tight joints shall be bell-and-spigot meeting the silt tight requirements of AASHTO M252 or AASHTO M294. Silt tight joints shall meet a 2.0 psi (14kPa) laboratory test as further defined and described in the performance section of this specification. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable wrap to ensure the

- G. Fittings
 - 1. Fittings shall conform to AASHTO M252 or AASHTO M294. Fabricated fittings shall be welded on the interior and exterior at all accessible junctions.
- H. Acceptable Manufacturers
 - 1. Manufacturer shall submit production lot testing logs, signed by an executive officer, to verify adequate quality assurance quality control system. In lieu of test logs, manufacturer shall have an ISO 9001:2000 Quality Lab and a quality control quality assurance system based on ISO 9001:2000 standards and manufacturer shall be UL listed for quality systems on the ISO 9001:2000 quality systems certification.
- I. Installation
 - 1. Pipe installation shall be in accordance with Section 3 of this specification and the product manufacturer's published installation guides.

2.2 CATCH BASINS

- A. Standard Precast Concrete Catch Basins and Manholes
 - 1. Standard Precast Concrete Catch Basins shall meet ASTM C478/C478M, and shall be manufactured with precast reinforced concrete. Minimum diameter shall be 48-inch or 24" x 24" square.
 - a. Base section shall have a minimum floor slab thickness of 6 inches and shall have a minimum wall thickness of 4 inches. Wall and floor thickness of base section shall be as specified on project plans.
 - b. Riser Sections shall have a minimum wall thickness of 4 inches and a minimum diameter of 48 inches. Lengths and depths shall be as specified on project plans.
 - c. Top section shall consist of eccentric-cone type unless concentric-cone or flatslab-top type is specified on project plans.
 - d. Joint Sealant shall meet ASTM C990/C990M and shall be manufactured with bitumen or butyl rubber.
 - e. As specified on project plans, reinforced concrete grade rings shall be used to adjust final grate elevation. Inside diameter of grade rings shall be same as inside diameter of top section.
 - f. Steps shall consist of individual FRP steps, FRP ladder, or 1/2-inch steel reinforcing rods meeting ASTM A615/A615M encased in polypropylene meeting ASTM D4101. Steps shall be wide enough to allow worker to place both feet on one (1) step and designed to prevent lateral slippage off step. Steps shall be cast or anchored into sidewalls at 12- to 16-inch intervals. Steps shall be omitted if total depth from floor of catch basin to finished grade is less than 60 inches.
 - g. Pipe connectors shall meet ASTM C923/C923M, shall be resilient and shall be sized for each pipe connecting to base section. Pipe connectors shall be fitted or cast into manhole walls.

- B. Designed Precast Concrete Catch Basins and Manholes
 - 1. Designed precast concrete catch basins shall meet ASTM C913 and shall be designed according to ASTM C890 for AASHTO HS-25, heavy-traffic, structural loading.
 - a. Joint sealant shall meet ASTM C990/C990M and shall be manufactured with bitumen or butyl rubber.
 - b. As specified on project plans, reinforced concrete grade rings shall be used to adjust final grate elevation. Inside diameter of grade rings shall be same as inside diameter of top of top section.
 - c. Steps shall consist of individual FRP steps, FRP ladder, or 1/2-inch steel reinforcing rods meeting ASTM A615/A615M encased in polypropylene meeting ASTM D4101. Steps shall be wide enough to allow worker to place both feet on one (1) step and designed to prevent lateral slippage off step. Steps shall be cast or anchored into sidewalls at 12- to 16-inch intervals. Steps shall be omitted if total depth from floor of catch basin to finished grade is less than 60 inches.
 - d. Pipe connectors shall meet ASTM C923/C923M, shall be resilient and shall be sized for each pipe connecting to base section. Pipe connectors shall be fitted or cast into manhole walls.
 - 2. Catch Basin Frame and Grates
 - a. Frames and grates shall be manufactured with grade 80-55-06 ductile iron meeting ASTM A536 as specified on project plans. Frames and grates shall be designed to accept H-25 and HS-25 live loads with a concrete collar installed under the frame.
 - b. Grates shall be bicycle safe.

2.3 DRAIN TILE

- A. Plastic Pipe
 - 1. ANSI/ASTM D2751, SDR 35, Acrylonitrile-Butadiene-Styrene (ABS) material; inside nominal diameter of 4 inches, bell and spigot style solvent sealed joint end.
 - 2. Fittings shall be same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling shall be as specified in Division 3 Section 310000 "Earthwork." Embankment and fill shall be compacted in place prior to trenching.

3.2 IDENTIFICATION

- A. For all stormwater and subsurface drainage piping, install green warning tape directly over pipe and at outside edges of underground structures.
 - 1. Green warning tape or detectable warning tape shall be installed over ferrous piping.
 - 2. Detectable warning tape shall be installed over nonferrous piping and over edges of underground structures

3.3 PIPE INSPECTION

- A. General
 - 1. Piping, fittings, and drainage structures shall be inspected prior to installation and any defective or damaged product shall be replaced.
 - 2. All pipe shall be in new condition.
- B. Corrugated HDPE Pipe and Fittings
 - 1. Any pipe, fittings, or drainage structures with cuts, punctures, or other damage on the interior or exterior shall be rejected and replaced.
 - 2. Any pipe, fittings or drainage structures with damaged ends or joints, which would prevent proper sealing of the joints, shall be rejected and replaced.

3.4 PIPING, FITTING, AND DRAINAGE STRUCTURE INSTALLATION

- A. General
 - 1. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm and drainage piping system, when determining location and arrangement of piping layout in the field, consider field conditions. Install piping system as indicated herein and as directed by the product manufacturer, to extent practical. Where specific installation procedure is not indicated, follow product manufacturer's written instructions.
 - 2. All products shall be inspected for defects and cracks before being lowered into the trench, piece by piece. Any defective, damaged or unsound pipe, fitting or drainage structure or any product that has had its grade disturbed after laying, shall be taken up and replaced. Open ends shall be protected with a pipe plug to prevent earth or other material from entering the pipe during construction. The interior of the pipe shall be free from dirt, excess water and other foreign materials as the pipe laying progresses and left clean at the completion of the installation.
 - 3. Install piping system beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions. Follow product manufacturer's instructions for the use of lubricants, cements, and other special installation requirements.
 - 4. Use Manholes or Catch Basins for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.
 - 5. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

B. Trench Excavation

1. Excavation

- a. Excavate trenches to ensure that sides will be stable under all working conditions. Slope trench walls or provide supports in conformance with all local and national standards for safety. Open only as much trench as can be safely maintained by available equipment. Backfill all trenches as soon as practicable, but not later than the end of each working day.
- b. Where trench walls are stable or supported, provide a width sufficient, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other embedment materials. The space between the pipe and trench wall must be wider than the compaction equipment used in the pipe zone. Minimum width shall be not less than the greater of either the pipe outside diameter plus 16 in. or the pipe outside diameter times 1.25, plus 12 in. In addition to safety considerations, trench width in unsupported, unstable soils will depend on the size and stiffness of the pipe, stiffness of the embedment and in-situ soil, and depth of cover.
- c. When supports such as trench sheeting, trench jacks, trench shields or boxes are used, ensure that support of the pipe and its embedment is maintained throughout installation. Ensure that sheeting is sufficiently tight to prevent washing out of the trench wall from behind the sheeting. Provide tight support of trench walls below viaducts, existing utilities, or other obstructions that restrict driving of sheeting.
- 2. Dewatering
 - a. Do not lay or embed pipe fittings or drainage structures in standing or running water. At all times, prevent runoff and surface water from entering the trench.
 - b. When water is present in the work area, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom. Use, as appropriate, sump pumps, well points, deep wells, geofabrics, perforated under drains, or stone blankets of sufficient thickness to remove and control water in the trench. When excavating while depressing ground water, ensure the ground water is below the bottom of cut at all times to prevent washout from behind sheeting or sloughing of exposed trench walls. Maintain control of water in the trench before, during, and after pipe system installation and until embedment is installed and sufficient backfill has been placed to prevent flotation of the pipe, fitting, or drainage structures. To preclude loss of soil support, employ dewatering methods that minimize removal of fines and the creation of voids in in-situ materials.
- 3. Removal of Rock
 - a. Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between exposed rock and the pipe of at least 12 inches (0.3m). Where Bell-and-Spigot pipe is used, the cushion shall be maintained under the bell as well as under the straight portion of the pipe. Rock excavation shall be as specified and defined under section 02300 Earthwork.
- 4. Removal of Unstable Material
 - a. Where wet or otherwise unstable soil incapable of properly supporting the pipe system, as determined by the Engineer, is encountered in the bottom of a trench,

such material shall be removed to at least 24 inches below bottom of pipe and replaced to the proper grade with select granular material, compacted as directed by the engineer. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Owner.

- 5. Bedding
 - a. Stable and uniform bedding shall be provided for the pipe and any protruding features of its joint and/or fittings. The middle of the bedding, equal to one-third of the pipe outside diameter, shall be loosely placed while the remainder shall be compacted to a minimum of 90% of maximum density per AASHTO T99, or as shown in the plans. Pipe bedding shall be a minimum of 4" 6" in thickness. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.
- 6. Placing Pipe
 - a. Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and the pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches shall be provided as directed by the engineer; see dewatering section.
- 7. Jointing
 - a. Joints shall be constructed as described herein and in accordance with manufacturer's installation instructions.
 - b. All Bell-and-Spigot pipe joints shall be thoroughly cleaned. Joint lubricant, supplied by the manufacturer, shall be liberally applied to entire interior of bell and gasket on spigot prior to assembly.
- 8. Backfilling
 - a. General
 - 1) Backfill material, placement, and compaction shall be constructed in accordance with the specifications herein and the product manufacturer's published installation guides.
 - b. Backfilling Pipe in Trenches
 - 1) After the pipe and pipe system have been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layer depths to ensure minimum compaction density is obtained evenly throughout the backfill material. The backfill shall be brought up evenly on both sides of pipe and pipe system for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by

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mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used may be left in place. Untreated sheeting shall not be left in place beneath structures or pavements. Backfilling Pipe in Fill Sections

- 1) For pipe placed in fill sections, fill shall be
 -) For pipe placed in fill sections, fill shall be constructed to at least 12 inches above the top of proposed pipe prior to trench excavation. Fill shall be placed in 12-inch lifts and shall be compacted in accordance with section 310000. Once fill is placed and compacted pipe trench shall be constructed in accordance with the Trench Excavation section of this specification.
- d. Movement of Construction Machinery
 - 1) When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.
- e. Compaction
 - 1) General Requirements
 - a) Non-cohesive materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, non-cohesive soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.
 - 2) Minimum Density
 - a) Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.
 - b) Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, all trench backfill shall be compacted #57 crushed aggregate up to the subgrade elevation. Recycled concrete or asphalt material is not acceptable for use.
 - 3) Determination of Density
 - a) Testing shall be the responsibility of the Contractor and performed at no additional cost to the Owner. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval by the Engineer. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers shall be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with

ASTM D2167 or ASTM D2922. When ASTM D2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in the Calibration paragraph of the referenced publications. ASTM D2922 results in a wet unit weight of soil and when using this method ASTM D3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D3017 or ASTM D2922. Test results shall be furnished to the Engineer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.5 MANHOLE AND CATCH BASIN INSTALLATION

- A. In addition to the piping, fitting, and drainage structure installation specifications, the following shall be considered for the installation of manholes and catch basins.
 - 1. Manholes and catch basins shall be installed according to the manufacturer's written instructions.
 - 2. Manholes and catch basins shall be installed complete with appurtenances and accessories indicated on the project plans.
 - 3. Precast concrete manhole and catch basin sections shall be installed with gaskets according to ASTM C891.
 - 4. Cast in place manholes shall be constructed as indicated on the project plans.
 - 5. Tops of frames and covers shall be set flush with finished surface of manholes in paved areas.

3.6 FINAL INSPECTION

A. Upon completion of the work and before final acceptance by the Owner, the entire drainage system shall be subject to a final inspection in the presence of the Owner and Architect. The work shall not be considered as complete until all requirements for line, grade, cleanliness, and workmanship have been completed. The contractor shall provide an as-built survey of the storm sewer systems.

END OF SECTION 33 40 00

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