SECTION 334600

SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Perforated-wall pipe and fittings.
2. Drainage conduits.
3. Geotextile filter fabrics.

B. Related Sections:
1. Section 312000 Earthwork.
2. Section 334000 Storm Sewer Utilities.

1.3 DEFINITIONS AND ABBREVIATIONS

NPS: Nominal Pipe Size.

PVC: Polyvinyl Chloride.

HDPE: High Density Polyethylene.

PE: Polyethylene.

SDR: Standard Dimension Ratio.

MARV: Minimum Average Roll Value.

1.4 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

a. F 667 Standard specification for 3 through 24 inch corrugated polyethylene pipe and fittings.
b. D 2729 Standard specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
c. D 3350 Standard specification for polyethylene plastics pipe and fittings materials.

d. D 4716 Standard test method for determining the (in-plane) flow rate per unit width and hydraulic transmissivity of a geosynthetic using a constant head.
e. D 4491 Standard test methods for water permeability of geotextiles by permittivity.
f. D 4632 Standard test method for grab breaking load and elongation of geotextiles
g. D 4633 Standard test method for energy measurement for dynamic penetrometers
h. D 4533 Standard test method for trapezoid tearing strength of geotextiles
i. D 3786 Standard test method for bursting strength of textile fabrics – diaphragm bursting strength tester method.
j. D 4491 Standard test methods for water permeability of geotextiles by permittivity.
k. D 4751 Standard test method for determining apparent opening size of geotextile
l. D 4355 Standard test method for deterioration of geotextiles by exposure to light, moisture and heat in a xenon arc-type apparatus.

2. American Association of State Highway and Transportation Officials (AASHTO)

a. M 288 Class 2 Geotextiles.
b. M 252 Standard specification for corrugated polyethylene drainage pipe.
c. M 294 Standard specification for corrugated polyethylene pipe (12 to 60 inches) diameter.

1.5 ACTION SUBMITTALS

A. General:

1. Make submittal in compliance with all provisions of Division 01 pertaining to submittals and quality assurance.
2. Render submittals and receive approval prior to delivery of installation.
3. Approval in writing by the Engineer of submitted products, samples, test reports, and certificates, does not constitute final acceptance.

B. Product Data:

1. Drainage conduits, including rated capacities.
2. Drainage panels, including rated capacities.
3. Geotextile filter fabrics.

C. Samples for Verification:
1. Drainage conduits: 12 inch length.
2. Geotextile filter fabrics: 12 by 12 inches.

1.6 INFORMATIONAL SUBMITTALS

A. None.

1.7 QUALITY ASSURANCE

A. Products Criteria:

1. When two or more units of the same type or class of materials or equipment are required, these units shall be products of one manufacturer.
2. A nameplate bearing manufacturer's name or trademark, including model number, shall be securely affixed in a conspicuous place on equipment. In addition, the model number shall

be either cast integrally with equipment, stamped, or otherwise permanently marked on each item of equipment.

1.8 DELIVERY STORAGE AND HANDLING

A. Product labels shall clearly show the manufacturer of supplier name, style name, and product number.

B. Each product shall be wrapped with material that will protect the product from damage due to shipment, water, sunlight, and contaminants.

C. Store products in a manner that prevents excessive mud, wet concrete, epoxy, or other deleterious materials from coming in contact with and affixing to the material. Store materials above -20ºF (-29ºC) and avoid handling below 14ºF (-10ºC).

D. During storage, materials shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, excess temperatures, and any other environmental conditions that may damage the physical property values of the geosynthetic.

1.9 PROJECT CONDITIONS

A. Existing Conditions

1. Carefully examine the site before submitting a bid. Be informed as to the nature and location of the Work, general and local conditions including climate, adjacent properties and utilities, conformation of the ground, the nature of subsurface conditions, the character of equipment and facilities needed prior to and during execution of the Work.
2. Should the Contractor, in the course of Work, find any discrepancies between Drawings and physical conditions or any omissions or errors in Drawings, or in layout as furnished by the Engineer, it will be his duty to inform the Engineer immediately in writing for clarification. Work done after such discovery, unless authorized by the Engineer, shall be done at the Contractor's risk.

B. Field Measurements: Verify actual grade elevations, service and utility locations, structural components, and dimensions of footings, walls, pavement areas, subbase materials and construction contiguous with subdrainage elements by field measurements before proceeding with work.

C. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify the Construction Manager and Owner no fewer than three days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without the Owner’s written permission.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit the work to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

PART 2 - PRODUCTS

2.1 DRAINAGE CONDUITS

A. Single-Pipe Drainage Conduits: Prefabricated geocomposite with perforated corrugated core molded from HDPE complying with ASTM D 3350 and wrapped in geotextile filter fabric.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:

2. Basis-of-Design Product: Subject to compliance with requirements, product or comparable product by one of the following, or approved equal:

a. Advanced Drainage Systems, Inc.; N-12 T IB Dual Wall – HDPE Pipe

1) Shall have a smooth interior and annular exterior corrugations.
2) 4- through 10-inch pipe shall meet AASHTO M252, Type S or SP.
3) Joint Performance: Pipe shall be joined using a bell & spigot joint meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306. The joint shall be soil-tight and gaskets for diameters 12- through 60-inch, shall meet the requirements of ASTM F477. For diameters 4- through 10-inch, the joint shall be soil-tight using an engaging dimple connection. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
4) Fittings: Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a spun-on or welded bell and valley or saddle gasket meeting the soil-tight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.
5) Material Properties: Material for pipe and fitting production shall be high density polyethylene conforming with the minimum requirements of cell classification 424420C for 4- through 10-inch (100 to 250 mm) diameters, and 435400C for 12- through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 4%. The 12- through 60-inch (300 to 1500 mm) pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 9.5 and 5.1 of AASHTO M294 and ASTM F2306, respectively.
6) Minimum In-Plane Flow: 30 gpm at hydraulic gradient of 1.0 when tested according to ASTM D 4716.

3. Filter Fabric: PP geotextile.

4. Fittings: HDPE with combination NPS 4 and NPS 6 outlet connection.

5. Couplings: Corrugated HDPE band.

B. Slow release orifice: To be set in inlet or outlet structures as noted on the Drawings.
   1. Assembly:
      a. Dual Wall Cleanout – Nyoplast Dwg. #0874Ag or as required for pipe sizes, or approved equal.
      b. End Plug with gasket and recessed handle – ADS Product #0833AA, or approved equal.
      c. Drilled orifice opening, diameter per the Drawings.

2.2 DRAINAGE PANELS (NOT USED)

2.3 SOIL MATERIALS

A. Soil materials are specified in Section 312000 "Earth Moving."

2.4 GEOTEXTILE FILTER FABRICS

A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

B. Structure Type: Nonwoven, needle-punched continuous filament.

   1. Survivability: AASHTO M 288 Class 2.

   2. Styles: Flat and sock.

C. Geotextile Filter Fabrics
   1. Provide Mirafi 180N 8oz Non-Woven fabric, or approved equal, at locations of reinforced subgrade below manholes as indicated on the Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect existing utilities, sidewalks, structures, pavements, and other facilities to remain free from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Foundation soil shall be excavated to the line and grades as shown on the construction drawings or as directed by the Engineer. Over-excavated areas shall be filled with compacted backfill material as per project specifications or as directed by the Engineer. As a minimum, the foundation soil shall be proof rolled prior to backfill and geosynthetic placement.

C. Clear, grub, and excavate to the design subgrade elevation, stripping topsoil, deleterious debris and unsuitable material from the site.

D. Smooth grade and compact the soils using appropriate compaction equipment. Very soft soils (CBR < 0.5) may be difficult to compact. In these instances, create a surface that is as uniformly smooth as possible.

E. Drainage and dewatering, excavation, grading, subbase and base course coordination shall be per Section 312000 – Earthwork.

3.2 EXAMINATION

A. Examine surfaces and areas for suitable conditions where subdrainage systems are to be installed.

B. If subdrainage is required for landscaping, locate and mark existing utilities, underground structures, and aboveground obstructions before beginning installation and avoid disruption and damage of services.

C. Verify that drainage panels installed as part of foundation wall waterproofing is properly positioned to drain into subdrainage system.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

3.4 FOUNDATION DRAINAGE INSTALLATION (NOT USED)

3.5 UNDERSLAB DRAINAGE INSTALLATION (NOT USED)

3.6 LANDSCAPING DRAINAGE INSTALLATION

A. Provide trench width to allow installation of drainage conduit. Grade bottom of trench excavations to required slope, and compact to firm, solid bed for drainage system.

B. Lay flat-style geotextile filter fabric in trench and overlap trench sides.

C. Place supporting layer of drainage course over compacted subgrade and geotextile filter fabric, to compacted depth of not less than 4 inches.

D. Install drainage conduits as indicated in Part 3 "Piping Installation" Article for landscaping subdrainage with horizontal distance of at least 6 inches between conduit and trench walls. Wrap drainage conduits without integral geotextile filter fabric with flat-style geotextile filter fabric before installation. Connect fabric sections with adhesive or tape.

E. Add drainage course to top of drainage conduits.

F. After satisfactory testing, cover drainage conduit to within 12 inches of finish grade.

G. Install drainage course and wrap top of drainage course with flat-style geotextile filter fabric.

H. Place layer of flat-style geotextile filter fabric over top of drainage course, overlapping edges at least 4 inches.

I. Fill to Grade: Place satisfactory soil fill material over drainage course. Place material in loose-depth layers not exceeding 6 inches. Thoroughly compact each layer. Fill to finish grade.

3.7 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.

1. Retaining-Wall Subdrainage: When water discharges at end of wall into stormwater piping system, install piping level and with a minimum cover of 12 inches unless otherwise indicated.

2. Landscaping Subdrainage: Install piping level with a minimum cover as indicated on the Drawings

3. Lay perforated pipe with perforations down.

4. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.

C. Install thermoplastic piping according to ASTM D 2321.

3.8 GEOSYNTHETIC INSTALLATION

A. Geosynthetic shall be laid at the proper elevation and orientation as shown on the construction drawings or as directed by the Engineer. Correct orientation of the geosynthetic shall be verified by Contractor.

B. Geosynthetic may be temporarily secured in-place with staples, pins, sand bags or backfill as required by fill properties, fill placement procedure or weather condition, or as directed by the Engineer.

C. Unroll the geosynthetic in the direction of travel so that the long axis of the roll is parallel with channelized traffic patterns. For very soft subgrades (CBR < 0.5), unrolling geogrid transversely or perpendicular to the roadway embankment alignment, may be preferred, particularly if lateral spreading and separation of overlaps is a concern.

D. Overlap geosynthetics in accordance with manufacturer’s recommendations.

E. Cut and overlap geogrid to accommodate curves. Cutting may be done with sharp shears, a knife-like implement or handheld power (i.e., “cutoff”) saws. Cut grid to conform to manhole covers and other immovable protrusions.

F. Geomembranes to conform to protrusions per details provided in the Drawings.

3.9 PIPE JOINT CONSTRUCTION

A. Join perforated PE pipe and fittings with couplings according to ASTM D 3212 with loose banded, coupled, or push-on joints.

B. Join perforated PVC sewer pipe and fittings according to ASTM D 3212 with loose bell-and-spigot, push-on joints.

C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.10 CLEANOUT INSTALLATION

A. Comply with requirements for cleanouts specified in Section 334100 "Storm Utility Drainage Piping."

B. Cleanouts for Landscaping Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.

2. In vehicular-traffic areas, use NPS 4 cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches deep. Set top of cleanout flush with grade.

3. In nonvehicular-traffic areas, use NPS 4 PVC pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches deep. Set top of cleanout 1 inch above grade.

4. Comply with requirements for concrete specified in Section 033000 "Cast-in-Place Concrete."

3.11 CONNECTIONS

A. Comply with requirements for piping specified in Section 334100 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.12 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping. Comply with requirements for underground warning tapes specified in specified in Section 312000 "Earth Moving."

1. Install PE warning tape or detectable warning tape over ferrous piping.

2. Install detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling.

2. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

B. Drain piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.14 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600