

SECTION 33 4000
STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Storm sewers, storm structures, appurtenances.
- B. Related Sections:
 - 1. 31 00 01 "SITE PREPARATION AND GENERAL SITE WORK" for layout and construction staking.
 - 2. 31 22 00 "EARTHWORK" for trench excavation; trench safety; pipe bedding, backfill and compaction.

1.02 REFERENCE SPECIFICATIONS AND DOCUMENTS

- A. Georgia Department of Transportation (GDOT)
 - 1. Department of Transportation, State of Georgia Standard Specifications, Construction of Roads and Bridges, 2013 Edition. Unless otherwise noted, conform with GDOT Standard Specifications for work and materials for storm drain utilities. In the event of conflict apply the more stringent requirement.
- B. American Association of State Highway and Transportation Officials (ASHTO)
 - 1. AASHTO M36 – Standard specification for Corrugated Steel Pipe, Metallic-Coated, for Sewer and Drains.
 - 2. AASHTO M190 – Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - 3. AASHTO M170 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- C. American Society of Testing Materials (ASTM)
 - 1. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity – Flow Applications.

1.03 SUBMITTALS

- A. Product information including manufacturer instructions: pipe, fittings. Submit for approval prior to delivery of any material.
- B. Shop Drawings:
 - 1. Structures. Submit for approval prior to delivery of any material.
 - 2. CMP Underground systems, as applicable. Indicate all materials to be furnished, material standards, and design assumptions for structural analysis. Note all proposed deviations or alternatives from the site layout plans, include the compliance of applicable ASTM or AASHTO specifications for all deviations.
- C. Record Drawings: At project closeout, submit record drawings of installed site drainage piping (including lengths and slopes), underground systems as applicable, layout, inverts, top elevations, and products. As-built record drawings shall be prepared by a land surveyor licensed in the State of Georgia. Revisions or necessary approved field changes shall be flagged.

1.04 SITE CONDITIONS

- A. Keep a hard copy of GDOT Standard Specifications for reference at the job site at all times during construction.
- B. Comply with all applicable codes and ordinances of local authority.
- C. Clean all existing drainage systems which are tied into the work.
- D. Where applicable, engineering design and manufacturer of underground detention systems shall be by an established company with demonstrated experience in successful completion of a minimum of 5 similar underground systems and has been regularly performing such work for a minimum of 5 years.
- E. Maintain in operating condition all existing surface or subsurface utilities storm drainage systems in accordance with 31 00 01 "SITE PREPARATION AND GENERAL SITE WORK". Repair any damage done to existing utilities during the course of the work, due to construction.

PART 2 PRODUCTS

2.01 PIPE MATERIALS

- A. Concrete Pipe: Unless otherwise shown, concrete pipe shall be reinforced Class IV (ASTM C76, AASHTO M170) with bell and spigot joints with rubber gasket per ASTM C433.
- B. Corrugated Metal Pipe (CMP or AST2): Unless otherwise shown, CMP / AST2 is as follows:
 1. Material / Coating: Aluminized Steel Type 2 (AST2) per AASHTO M274 or ASTM A929.
 2. Corrugation Type: Corrugations per AASHTO M36, Type 1 (circular). Corrugations are either 1/2" deep or 1" deep depending on diameter in the tables below.
 3. 2-2/3" x 1/2" corrugations: minimum pipe gauges by pipe diameter.
- C.

14 Gauge Pipe Diameters	12 Gauge Pipe Diameters
15"	42"
18"	48"
24"	54"
30"	60"
36"	

1. 3" x 1" corrugations: minimum pipe gauges by pipe diameter.

12 Gauge Pipe Diameters	10 Gauge Pipe Diameters
60"-96"	78"-144"

- D. Spiral Rib Corrugated Metal Pipe: Unless otherwise shown, spiral rib CMP or spiral rib AST2 pipe is as follows.
 1. Material / Coating: Aluminized steel Type 2 (AST2) per AASHTO M274 or ASTM A929. [

2. Corrugation Type: Spiral rib corrugated per AASHTO M36, Type 1R (circular-spiral rib), $\frac{3}{4}$ " corrugations. The spiral rib pipe shall have a documented design manning's n of 0.012 from pipe manufacturer.
3. Minimum pipe gauges by pipe diameter:

14 Gauge Pipe Diameters	12 Gauge Pipe Diameters	10 Gauge Pipe Diameters
18"	54"	90"
24"	60"	96"
30"	72"	102"
36"	84"	108"
42"		

- E. Unless otherwise shown, downspout and roof rain leader pipe shall be schedule 40 polyvinylchloride pipe with matching solvent welded fittings.
- F. High Density Polyethylene (HDPE) corrugated pipe and fittings: Unless otherwise shown, conform with the following:
 1. For 4 to 10 inch diameters, smooth interior and annular exterior corrugated HDPE Pipe per AASHTO M252, Type S.
 2. For 12 to 48 inch diameters, smooth interior and annular exterior corrugated HDPE Pipe per AASHTO M294, Type S.
 3. For 54 to 60 inch diameters, smooth interior and annular exterior corrugated HDPE Pipe per AASHTO MP7-97, Type S.
- G. Pipe and fittings shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. Joints shall meet or exceed the "soil tight" joint performance criteria of AASHTO Standard Specifications for Highway Bridges, Division II.

2.02 CMP UNDERGROUND DETENTION SYSTEM

- A. Unless otherwise shown, CMP pipe shall be aluminized steel type II per AASHTO M274 or ASTM C929. Corrugations and pipe type are in accordance with AASHTO M36.
- B. Pipe size, gauge and corrugations are shown on plans. Barrel spacing, number of barrels, stone base thickness are shown on the plans.
- C. Manhole access, minimum 24" diameter shall be provided to allow access to system.
- D. Pipe joints:
 1. Minimum joint spacing is 10 ft.
 2. Performance requirements = soil tight, gravity flow joints per AASHTO M36 and ASTM A760.
 3. Do not overlap pipes and utilize banding consistent with the pipe of type being joined.
- E. Integral End Sections:
 1. Each barrel of the CMP system shall be connected to a fitting composing a manifold for hydraulic distribution or have an integrated bulkhead to resist loading at the end / start of the barrel. End cap sections are not permitted.
 2. Unless otherwise approved by the design professional, bulkheads/end sections and fittings shall be fabricated prior to delivery on site.

2.03 CLEANOUTS

- A. Unless otherwise provided on the plans, cleanouts where shown shall meet the following:
 - 1. Cast iron cleanout flush with finish grade with a countersunk brass plug.
 - 2. Center the cleanout in a 4 inch depth concrete pad. Minimum size of concrete pad shall be sufficient to provide 6" of clearance from the edge of cleanout to the edge of concrete, but shall not be less than 18" x 18". Construct the concrete pad with a 1/4" to 3/8" radius rounded edge.

2.04 APPURTENANCES MATERIAL

- A. Concrete shall have a minimum compressive strength of 3,000 psi.
- B. Mortar for masonry work in storm sewer structures shall be 1:2 cement sand mix. Cement shall be High Early Strength American Portland cement. Sand shall be clean and sharp, free from all deleterious substances and shall contain not more than 5% by volume of material passing No. 100 sieve.
- C. Brick shall be clay or shale Hard No. 1 building brick.
- D. Castings: All castings shall be gray iron per Georgia DOT Specifications. Casting, grates, frames and other storm drainage appurtenances shall be on site prior to storm drainage installation. Maintain a snug fit between grates, lids, etc., and frame. All castings shall be heavy-duty, bicycle safe type.
- E. Other materials required to completely install storm sewers in accordance with these specifications shall conform to all applicable articles and paragraphs of Georgia DOT Specifications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Verify lines, grades, and construction stakes before commencing any excavation for storm drainage pipes or structures.

3.02 EXCAVATION

- A. Perform trench and structure excavation in accordance with 31 25 00 "Grading" and in accordance with all OSHA Excavation Standards.

3.03 PIPE BEDDING

- A. Unless otherwise shown on the Drawings, construct all bedding in accordance with 31 25 00 "Grading". Where incompressible soils or rock are encountered, excavate in accordance with 31 25 00 "GRADING".

3.04 CONCRETE PIPE INSTALL

- A. Concrete pipe: lay section in a prepared trench with socket ends pointing upstream. Join sections, including rubber gaskets in accordance with manufacturer recommendations.
 - 1. Install concrete anti-seep collars at all pipe joints for reinforced concrete pipe within the limits of the stormwater management facility dike. Concrete anti-seep collars shall meet the following:
 - a. Extend 12 inches, minimum, beyond the outer dimension of the pipe in each direction.
 - b. Minimum 12 inches in thickness measured parallel to the concrete pipe.
 - c. Reinforced with No. 3 bars at perimeter of concrete anti-seep collar. Maintain 2 inches clearance from outer dimension of anti-seep collar.

3.05 CORRUGATED METAL PIPE AND PIPE ARCH INSTALLATION.

- A. CMP and pipe arches: lay sections in prepared trench, with outside laps of circumferential joints pointing upstream and longitudinal joints at the sides. Join the sections with coupling bands, fastened by 2 or more bolts. Before backfilling repair any damaged coating or exposed base metal.

3.06 HDPE AND PVC PIPE INSTALLATION

- A. Install in accordance with ASTM D 2321.

3.07 CMP UNDERGROUND DETENTION SYSTEM

- A. For perforated underground systems, prepare subgrades as specified in Section 31 22 00 "Grading", to bring subgrade to $\pm \frac{3}{4}$ inch of the specified elevation shown on the Plans, except that:
1. The subgrade shall be uniformly compacted to a relative density of 90% (ASTM D698).
 2. Excavation and grading of the pervious pavement area shall be accomplished using low impact (wide tracked) earth moving equipment.
 3. Scarify the surface of the subgrade to a depth of $\frac{1}{4}$ to $\frac{1}{2}$ ".
 4. Do not over-compact the subgrade. Do not store materials or equipment on completed subgrade.
 5. Immediately in advance of placing base rock or geotextile fabric check subgrade and regrade, recompact, and rescarify as necessary.
- B. Install CMP in accordance with manufacturer's recommendations and ASTM A798.
- C. For operation of temporary construction vehicles over the CMP system provide temporary cover of compacted gravel over the top of pipe as follows:

Minimum Cover (ft) Requirements

Pipe Span (inches)	Axle Loads (kips)			
	18 - 50	50 - 75	75 - 110	110 - 150
12 - 42	2.0	2.5	3.0	3.0
48 - 72	3.0	3.0	3.5	4.0
78 - 120	3.0	3.5	4.0	4.0
126 - 144	3.5	4.0	4.5	4.5

- D. Unless otherwise specified, place backfill material in 8 inch loose lift and compact to 90% of maximum density (per standard proctor).

3.08 APPURTENANCES

- A. Headwalls and aprons shall conform with the Plans.
- B. Curb Inlets, Weir Inlet, Drop Inlets, and Manholes: Refer to plans for location and type.
- C. Connect all downspout and rain leader lines to storm drainage system as shown.
- D. Line Tracers: Wrap all non-metallic pipes with metallic tracer tape prior to backfill.
- E. Line Markers: During back filling of site drainage systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade.
- F. All joints between pre-cast base, risers, and round-2-square adapters shall be keyed. All joints shall be grouted inside and out.
- G. Stormwater Quality Control Devices (when applicable) shall be installed as recommended by the manufacturer.

- H. Leave 2" diameter PVC temporary opening at subgrade in drainage structures for surface drainage. Opening shall be grouted up after finish grading and paving is completed. Contractor shall provide for temporary surface drainage removal to allow timely construction.

3.09 BACKFILLING

- A. Check vertical and horizontal alignment of the pipe, culvert, or storm drain by sighting along the crown, invert, and sides of pipe. Check for sagging, faulting, and invert heaving. Repair any issues before backfilling pipe.
- B. Backfill in accordance with 31 22 00 "EARTHWORK".

3.010 VIDEO INSPECTION

- A. Video surveillance may be conducted by the Owner on storm drain installations after completion of all activities that may damage the pipe but prior to the placement of the base and paving when applicable. If video surveillance indicates problems such as pipe deformation, cracking, or joint separation, the Contractor shall be responsible for repairing or replacing these pipes at no cost to the Owner.

3.011 TESTING- QUALITY ACCEPTANCE

- A. Perform compaction testing in accordance with 31 22 00 "EARTHWORK".
- B. A minimum of 25% of the installed length of smooth lined corrugated polyethylene (PE), High Density Polyethylene (HDPE) or PVC pipe, selected by the Design Professional, shall be tested for deformation by the Contractor using a nine point mandrel.
 - 1. The mandrel shall have an effective diameter equal to 95% of the base inside diameter.
 - 2. Provide the Design Professional with a proving-ring to verify mandrel size.
 - 3. Smooth lined corrugated polyethylene or PVC profile wall drain pipe installations shall have a maximum of 5% deflection when checked after completion of all construction activities that may damage the pipe but prior to placement of the base and paving when applicable.
 - 4. If mandrel testing indicates that problems exist, the Design Professional may determine that up to 100% of the storm drain installation be checked for deformation.
 - 5. Pipe with over 5% deflection shall be removed and replaced at no cost to the Owner.

3.012 MAINTENANCE AND PROTECTION

- A. Before any traffic over a culvert is allowed, provide an adequate depth and width of compacted backfill to protect the structure from damage or displacement. Any damage or displacement that may occur after installing and backfilling shall be repaired or corrected at the Contractor's expense.
- B. Remove any debris or silt that constricts the flow through a pipe as often as necessary to maintain drainage throughout the life of the Contract.

3.013 CLEANUP

- A. Upon completion of work, all forms, equipment, protective covering, and rubbish resulting therefrom shall be removed from the premises.
- B. Carefully clean all pipes, culverts, structures, and appurtenances of dirt, rubbish, and surplus mortar before the work is accepted.

END OF SECTION 33 4000