

**SECTION 33 40 00  
STORM DRAINAGE UTILITIES**

**PART 1 GENERAL**

**1.1 SYSTEM DESCRIPTION**

- A. The South Florida Water Management District shall approve drainage system and finish floor elevation.
  - 1. Do not set finish floor elevation of a new building lower than the existing buildings on the campus without written permission of the Building Official.
  - 2. Keep buildings and sports-fields a minimum of 12" above adjacent roads and perimeter roads.
- B. Design the storm water system like a sanitary sewer system with wye fittings and not with tees and elbows for pipe diameters less than 10 inches.
  - 1. Yard drains may replace fittings when deemed appropriate by the design engineer.
- C. All drainage systems shall have an outfall to a retention pond, canal, city storm sewer, etc.
  - 1. Provide storm water branches to roof leaders (8" dia, 1% min. slope).
  - 2. Storm catch basins shall not be located within ten feet of a sidewalk.
  - 3. Provide a traffic cover as required, place the word "STORM" on the manhole cover.
  - 4. All storm drain lids to be secured.
- D. Interconnect all drainage retention/detention ponds.
- E. Connect condensate pipes with backflow valves to the storm drainage system.
- F. Contractor shall utilize construction methods and devices such as turbidity curtains and floating silt barricade when necessary to comply with state and local water quality standards.
- G. No exfiltration trenches permitted in a municipal or county wellfield.
- H. Provide perimeter berms as shown on plan to prevent storm water draining on to adjacent property.
- I. Install only concrete pipe below paved areas.

**1.2 REFERENCES**

- A. AASHTO M145 – Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
- B. AASHTO M252 – Standard Specification for Corrugated Polyethylene Drainage Pipe
- C. AASHTO M294 – Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in) Diameter
- D. AASHTO T180 – Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop
- E. ASTM A48/A48M – Standard Specification for Gray Iron Castings
- F. ASTM C76 – Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
- G. ASTM C131 – Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- H. ASTM C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
- I. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections
- J. ASTM C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
- K. ASTM C1450/C1450M – Standard Specification for Non-Asbestos Fiber-Cement Storm Drain Pipe

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- L. ASTM C1479 – Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
- M. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- N. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- O. ASTM D3034 – Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- P. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- Q. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
- R. ASTM C1840 – Standard Practice for Inspection and Acceptance of Installed Reinforced Concrete Culvert, Storm Drain, and Storm Sewer Pipe

1.3 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submit shop drawings with manufacturer’s catalog cuts, technical data, certificate(s) of compliance or certified analysis in accordance with applicable standards on the following:
  - 1. Pre-cast concrete structures and catch basins
  - 2. Frames and grates
  - 3. Pipe
  - 4. Test reports
  - 5. Plastic filter fabric
- C. Submit complete “as-built” information in the form of Project Record Documents.
  - 1. Maintain accurate, clear, legible, and complete records forming a true representation of the Work completed and in progress.
  - 2. Provide drawing and specification documentation relative to:
    - a. Catch basins, manholes, valves, services, and fittings
    - b. The vertical and horizontal locations of all storm drainage structures, drainage lines, and connection points
    - c. Pipe length, size, and material type
  - 3. Registered Surveyor shall be measure, record all horizontal and vertical information, and include the information in the project Record Documents.
  - 4. Project Record Documents: Signed and sealed by the preparing professional Land Surveyor registered in the State of Florida.
  - 5. Final pipe inspection, including mandrel inspection, and Engineer of Record review.

1.4 QUALITY ASSURANCE

- A. Applicable Codes and Jurisdictional Authorities:
  - 1. Florida Building Code
  - 2. Occupational Safety and Health Administration (OSHA)
  - 3. Manual of Uniform Traffic Control Devices (MUTCD)
  - 4. South Florida Water Management System, Volume IV
  - 5. Palm Beach County Department of Natural Resource
  - 6. Palm Beach County Engineering Department
- B. Inspections: The Builder shall notify the municipal or county, Architect, and Owner at least 48 hours prior to arrange the required inspection of the system.
- C. Survey Data: All elevations on the plans or referenced in the specifications are based on National Geodetic Vertical Datum (NAVD '88).

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- D. Provide a copy of the SFWMD application for the "Surface Water Management Permit."
- E. Set parking lot and roadway minimum elevations at the ten-year, one-day storm event.
- F. Set playing fields minimum elevations for elementary, middle, and high schools at the ten-year, one-day storm event.
- G. If wetland mitigation and/or dredge and fill are required, submit a joint permit application as required by the Florida Department of Environmental Protection and the U.S. Army Corps of Engineers, along with a preliminary mitigation plan.

1.5 RELATED WORK

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work in this section.
- B. Section 31 20 00 – Earthwork.

**PART 2 PRODUCTS**

2.1 POLYETHYLENE PIPE AND FITTINGS

- A. Provide high-density corrugated polyethylene smooth interior pipe with annular exterior corrugations.
  - 1. Provide pipe fittings and accessories of same material and weight/class as pipes, with adjoining method as indicated.
  - 2. Connect all roof drain with a pre-manufactured welded tee fitting.
  - 3. Per FDOT SSRBC Section 948-2.3.1, post-consumer and post-industrial recycled resins are not allowed.
- B. All materials shall comply with AASHTO M294 Type S, AASHTO M252, ASTM D3350, and ASTM D2321. Joints shall be watertight in compliance with ASTM D3212.
- C. All pipe and fittings shall be "HI-Q SURE-LOK" as manufactured by Hancor, Inc. or as approved by the Architect.
  - 1. Fittings shall have wye configuration and long radius bends to meet sanitary sewer system dimensional requirements.
- D. Do not use polyethylene pipe:
  - 1. Below pavement.
  - 2. Within 5 feet of a major structure.
  - 3. Where structural bearing loads, other than normal burial loads, may be transferred to the pipe.
- E. Minimum cover for all pipe 10 inches and larger shall be the greater of 36 inches, or one pipe diameter, per ASTM D2321 Sec. 7.6.

2.2 STORM SEWER PIPE: POLYVINYL CHLORIDE PIPE

- A. 6" to 8" diameter shall be PVC: SDR 35 conforming to ASTM D3034, with push-on rubber gasket joints.
- B. 10" to 12" diameter and larger PVC: PS 10 Perma-Lock with push-on rubber gasket joints similar to those as manufactured by J-M Manufacturing Company, Inc.
- C. Polyvinyl-chloride pipe for use in storm sewers connections to building drains shall conform to the requirements of ASTM D1785, for Type II grade 1, Schedule 40.
  - 1. All PVC pipe used for storm sewer or storm leaders shall be white in color.

2.3 REINFORCED CONCRETE PIPE

- A. Conform to ASTM C76, Table 3, Class III, Wall B.
- B. Provide all pipes with modified tongue and groove joints, and have rubber gaskets. Gaskets and joints shall comply with ASTM C443.
- C. Install only concrete pipe below pavement.

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#### 2.4 PLASTIC FILTER FABRIC

- A. Conform to Section 985 of the FDOT Standard Specifications.
- B. Provide filter fabric similar to Carthage Mills Filter X or Mirafi.

#### 2.5 CEMENT MORTAR

- A. Provide mortar for manhole construction with one part cement and two parts clean sharp sand, may add lime in the amount not over twenty-five percent (25%) volume of cement.
- B. Dry mix and then wet mortar to proper consistency for use.
- C. Do not use mortars that have stood for more than one hour after mixing.

#### 2.6 CASTINGS

- A. Castings for inlets and other items: Conform to the ASTM A48/A48M, Class 25.
- B. Provide castings true to pattern in form and dimensions and free of pouring faults and other defects in positions, which would impair their strength or otherwise make them unfit for the service intended.
- C. Plugging or filling, not allowed

#### 2.7 BALLAST ROCK AND PEA ROCK

- A. Rock shall be clean and free of salinity or any other residue.
- B. When subjected to ASTM C131 tests, loss shall not exceed 40%.
- C. ½" ballast rock: fall within the ½" to ¾" range.
- D. ¾" ballast rock: fall within the ¾" to 2½" range.

#### 2.8 STORM SEWER MANHOLES

- A. General: Provide pre-cast reinforced concrete storm sewer manholes as indicated, complying with ASTM C478.
- B. Top shall be pre-cast concrete, of concentric cone, eccentric cone, or flat slab top type, as indicated.
- C. Base shall be pre-cast concrete, with base riser section and integral floor, as indicated.
- D. Frame and Cover: Ductile-iron, 26"- diameter cover, heavy-duty, indented top design, with lettering cast into top reading "STORM SEWER."

#### 2.9 CATCH BASINS

- A. General: Provide pre-cast reinforced concrete catch basins as indicated.
- B. Basin: Provide pre-cast reinforced concrete, in accordance with FDOT Standard Specification Section 425, standard index drawings and ASTM C478.
  - 1. If above water table, provide sump and drain holes in bottom of catch basin.
- C. Frame and Grate: As indicated on drawings, meeting FDOT Standard Specification Section 425
- D. Pipe Connectors for plastic pipe shall be resilient, complying with ASTM C923 and ASTM D2321 Sec. 7.10.

#### 2.10 OUTFALLS

- A. Construct of cast-in-place or pre-cast concrete as indicated, with reinforced headwall, apron, and tapered sides.
  - 1. Plastic pipe shall use concrete end treatments as required by "FDOT HDPE Pipe Fire Risk Evaluation" and FDOT Standard Plans 430-020 – 022, for fire resilience.
  - 2. Provide riprap as indicated to prevent washout of outfall discharge.
- B. Backfilling: Provide backfilling under provisions of Section 31 20 00 - Earthwork
- C. Fill Material
  - 1. Satisfactory fill material: local sand and rock mixture free of organic material placed in 12" thick loose lifts and thoroughly compacted to a density of not less than 98% of maximum density as determined by the AASHTO Method T 180.

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2. The maximum size rocks used in the roadway fill: Classified as A-1, A-2-4, or A-3 conforming to AASHTO M-145 and not containing material, which will pass sieve No. 200 by 10% of its total weight.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

##### **A. Existing Utilities:**

1. Provide temporary support, adequate protection, and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work.
2. Permanently support, relocate, remove, or reconstruct existing utility structures (such as conduits, ducts, and pipe branch connections to main sewers, main drains, or other structures).
  - a. Deviations from the required line or grade not permitted.
3. Contact the Sunshine State One Call Center and verify existing utility field locations at least 48 hours prior to beginning any excavation.
4. Verify the size, locations, elevation, and materials of all existing utilities within the area of construction.

#### **3.2 UNLOADING MATERIALS**

- A. Exercise care in unloading and handling pipe, valves, fittings, and all other material.
- B. Follow manufacturer's requirements.
- C. Inspect concrete pipe before installation in accordance with AASHTO R73 requirements.

#### **3.3 EXCAVATION**

- A. Excavate pipe trenches to required depths.
- B. In general, pipes shall have a minimum of 36" cover.
- C. Excavate to a minimum of 6" below bottom of pipe, and backfill trench when encountering rock.
- D. Excavation will be wide enough to allow workers to perform all operations incidental to constructing the pipeline.
- E. Provide hand dug bell holes to permit proper joint making.
- F. Pipe bearing on rock not permitted.
- G. Provide trenching under provisions of Section Earthwork.
- H. Pipe Trench Width
  1. Provide maximum clear width of trench measured at the spring line, without undercutting the banks, in accordance with the following table.

<b>Pipe Size Inches</b>	<b>Trench Width (Reinforced Conc. Pipe) (Inches) per AASHTO Section 27 (O.D. + 24")</b>	<b>Trench Width (Thermoplastic Pipe) (Inches) per AASHTO Section 30 (1.5 x O.D. + 12")</b>
6	*	24
8	*	36
10	*	36
12	40	36
15	44	39
18	47	44
21	*	*

<b>Pipe Size Inches</b>	<b>Trench Width (Reinforced Conc. Pipe) (Inches) per AASHTO Section 27 (O.D. + 24")</b>	<b>Trench Width (Thermoplastic Pipe) (Inches) per AASHTO Section 30 (1.5 x O.D. + 12")</b>
24	54	54
27	*	*
30	61	66
36	68	75
42	75	84
48	82	94
54	90	*
60	96	113
66	103	*
72	110	*
78	117	*

2. Minimum width of trench: Leave at least 6" clear space between the bell of pipe and the sheeting or the sides of the trench where no sheeting is used on each side of the bottom without under-cutting the banks.
3. For plastic pipe installed adjacent to poor soils (blow count <10), then trench width shall be three times pipe diameter per ASTM D2321 Sec. X1.10.

#### 3.4 PREPARATION OF TRENCH BOTTOM

- A. While preparing the trench bottom or installing pipe, keep water out of trenches.
- B. Carefully prepare trench bottom to make a firm, unyielding base.
- C. Then place bedding material and install pipe at true line and grade.
  1. Sand, crushed rock, gravel or pea rock used as bedding material to support the pipe.
    - a. Loosely place un-compacted bedding materials in the trench bottom 4" minimum below the bottom of the pipe.

#### 3.5 INSTALLATION

- A. PVC Pipe Installation:
  1. In accordance with the Uni-Bell Plastic Pipe Association's "Recommended Practice for Installation of PVC Sewer Pipe."
  2. Grout PVC drainage pipe in place at catch basin walls.
- B. Drain and Culvert Pipe:
  1. Comply with FDOT Standard Specifications for Road and Bridge Construction, Section 125 and 430, with exceptions as noted herein.
  2. Protect pipe during handling against impact shocks and free falls.
    - a. Keep pipe clean at all times, and do not use pipe that does not conform to the specifications.
  3. Install RCP under paved areas per ASTM C1479 Type 1 Standard Installation using A-1, A-2, A-3, or A-4 materials. For RCP installed outside of paved areas, trench embedment shall be per ASTM C1479 Type 3 standard installation. Use insitu soils as embedment if soil classifications meet ASTM C1479 Type 3.
  4. Plastic pipe embedment shall consist of ASTM D2321 Class I or II soils compacted to 95% standard proctor density.
  5. Lay pipe with ends abutting and true to line and grade. Carefully center pipes and lay with a uniform invert.

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6. Accurately lay pipe to the line and grade required for fully functional system.
    - a. Prior to making pipe joints, clean and dry all pipe surfaces being joined.
    - b. Use lubricant, primers, adhesives, etc., as recommended by the pipe or joint manufacturer's specifications.
  7. Place, fit, joint, and adjust jointing materials or factory-fabricated joints in such a manner as to obtain a watertight line.
    - a. Provide sufficient backfill material along each side of the pipe to prevent movement of pipe off line and grade.
    - b. Compact the backfill in accordance with the manufacturer's guidelines to ensure adequate structural support for the pipe. Refer to ASTM C1479 and D 2321.
  8. Install all gravity flow pipes manufactured with bell and spigot joints so the spigot ends point in the direction of flow.
- C. Exfiltration Trench: (Not allowed in well fields)
1. Excavate trench to depths required for drainage capacity.
  2. Place filter fabric and ballast rock to the level of the proposed pipe.
  3. After pipe is placed and accepted, place ballast rock carefully to avoid displacement of pipe and tamp carefully.
  4. Fill trench to level indicated on drawings with ballast rock of size or sizes indicated.
  5. Install filter fabric at top, bottom, and sides, overlapping two feet on top.
  6. Backfill and compact in accordance with requirements of Section 31 20 00 Earthwork.
- D. Catch basins: Install per manufacturer's recommendations.
- E. Fill and Embankment:
1. Place roadway fill to within 1/10 (.1) foot of the required elevation.
  2. If improperly, fill or settlement, remove fill, refill with new material, compact, smooth, and make to conform to grade.
- F. Drainage and Culvert Pipe:
1. Install at elevation and line to provide working system.
- 3.6 FIELD QUALITY CONTROL
- A. Temporary Drainage During Construction
1. Construct and maintain temporary drainage facilities that may be required to provide drainage relief for the new construction without causing abnormal or adverse flooding impacts to the existing or new facilities.
  2. Temporary facilities may include swales, pipe, etc. as necessary.
- B. Restoration of Surfaces and/or Structures:
1. Restore and/or replace paving, curbing, sidewalks, fences, sod, survey points, or other disturbed surfaces or structures to a condition equal to that before start of work.
  2. Restoration of surfaces and/or structures outside the Owner's property line: comply with requirements of the applicable governing agencies.
- C. Cleaning Up:
1. Remove surplus pipeline material, tools, temporary structures, etc.
  2. Dispose of all dirt, rubbish, and excess earth shall be disposed of offsite.
- D. Quality Assurance
1. Provide a visual inspection of the installed system via "lamping" or other method.
  2. Provide mandrel test of all flexible piping systems using a mandrel with an effective outside diameter of at least 95% of the actual pipe inside diameter.
    - a. Test will occur 30 days or more after the pipe trench is backfilled.
  3. Repair all visible infiltration regardless of flow rate.

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4. Dig-up all pipes that fail the mandrel test, replace and relay the pipe and re-backfill then retest the pipe.
5. Provide a written summary of test results to the Architect and Owner per Section 1.3, above.

END OF SECTION