This Sample Specification for Storm Drainage Utilities below must be coupled with standard trench details which matches the information in this document. Sample Trench Drawings are available upon request.

SECTION XXX - STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.02 WORK INCLUDED

A. Installation of storm drainage systems.

1.02 REGULATORY REQUIREMENTS

A. Comply with requirements of authorities having jurisdiction for materials and installation of work of this Section.

B. Referenced National Specifications or Standards – GDOT Specification 550 and associated Specifications referenced in 550, GDOT Standard Drawings 1030D and 1030P, ASTM C76, ASTM C 506, ASTM C507, AASSHTO M274, AASHTO M36, AASHTO M196, AASHTO M294, ASTM C990, ASTM C1619, ASTM C443, ASTM F477. ASTM D3212, ASTM D1056, ASTM C478, ASTM C913, ASTM C923, ASTM C1478, ASTM F2510, ASTM A48, ASTM A615, ASTM D4101, ASTM C32, ASTM C55, ASTM C33, AASHTO R73, ASTM C 1479, ASTM A798, ASTM D2321

[Once Specification below is completed, insert/delete appropriate referenced Standards above]

PART 2 PRODUCTS

2.01 PIPE MATERIALS DESIGN

A. Design for Pipe Materials - Structural system strength design and Hydraulic capacity confirmation must be completed for all pipe materials and for every project and shall be signed, sealed, and submitted to the [City/County] by a registered Engineer of the State of Georgia.

B. Structural design shall be based upon the specific pipe material design requirements set forth in the AASHTO LRFD Bridge Design Specification. When plastic pipe (HDPP or HDPE) is considered for use the Engineer shall consider the wet weather ground water conditions anticipated and the effects of such in their structural calculations or fill height table development as well as a job site confirmation plan to confirm structural backfill materials and compaction requirements assumed in their structural design will be met. If corrugated metal pipe (CMP) is to be used the Engineer shall consider the effects of Ph, resistivity of soil, ground water, storm runoff, and anticipated abrasion levels to confirm the correct gauge (thickness) of the metal pipe wall and if any other special protection that they feel is needed on a site-by-site basis. The metal pipe base materials and gauges (thicknesses) noted in section below are the minimum gauges that are acceptable regardless of the engineer's design confirmation.

C. Hydraulic Design Capacity Engineers/Designers shall utilize the following Manning's "n" coefficient for closed system storm water systems - 0.012 for RCP, 0.017 for HDPE, HDPP, and 0.024 for CMP. Otherwise, the hydraulic analysis and pipe capacities shall be based upon all hydrology requirements set by the (city county). If the (City/County) does not have

Hydraulic/Hydrology design standards, then the Engineer shall follow GDOT Manual on "Drainage Design for Highways".

2.02 PIPE MATERIAL SELECTION AND APPLICATION

[Section 2.02 Pipe Materials Applications has two options (1 or 2) for Pipe Materials Allowed, user should read carefully, then select appropriately.]

[Option 1]

A. Reinforced Concrete Pipe (RCP) shall be used in all areas within the ROW and within all Public Utility and or Drainage Easements. Flexible Pipe (CMP, HDPP, and HDPE) may be used in areas outside the ROW. CMP, HDPP & HDPE is not allowed in ROW or within public utility or drainage easements. CMP is not allowed for use in intermittent or continuous flow streams. See plans for pipe materials required for each location on project.

B. Any Alternate pipe materials to those shown as noted above may only be allowed for use on any project when hydraulic calculations and structural design calculations are submitted and stamped by a registered civil Engineer of Georgia, and their use is pre-approved by [City/County] Engineer prior to bid opening.]

[Option 2]

A. Reinforced Concrete Pipe is allowed for use within the ROW and within all Public Utility and or Drainage Easements. HDPP or CMP may be used in the ROW and under pavement in streets with 250 ADT or less with maximum pipe size of 36" and only in street locations where more than 36" (inches) of cover can be met but less than 12' (feet) of cover as shown on the plans.] When HDPP or CMP pipe is used in ROW it shall be inspected during installation and after installation to confirm deflection limitations have not been exceeded and proper structural support has been provided by the installed flexible pipe system. (See Section 3.05 Field Quality Control for inspection requirements].

B. Any Alternate pipe materials to those shown as noted above may only be allowed for use on any project when hydraulic calculations and structural design calculations are submitted and stamped by a registered civil Engineer of Georgia, and their use is pre-approved by [City/County] Engineer prior to bid opening.]

2.03 PIPE MATERTIALS

A. Reinforced Concrete Pipe (RCP): Reinforced concrete pipe shall be Class II, III, IV, or V to ASTM C76 as specified on the project plans. Horizontal elliptical concrete pipe (HERCP) shall conform to C507, Arch Pipe (ARCP) shall comply to ASTM C506, and strength class as specified on the project plans.

B. Corrugated Metal Pipe (CMP): CMP Pipe materials allowed include CACMP and CAAP meeting the following material requirements; Aluminum coated (Type 2) (CACMP) steel pipe shall comply with AASHTO M274 for the coating and AASHTO M36 for the pipe fabrication. Aluminum alloy pipe (CAAP) shall comply with AASHTO M196 for material and fabrication. Pipe diameters of 15-inches or smaller shall be 14-gauge minimum. Pipe diameters from 18-inch to 48-inch shall be 12-gauge minimum. Pipe diameters of 54-inch or greater shall be 10-gauge minimum. The use of Zinc Coated (Galvanized) CMP and Spiral Ribbed Aluminized Pipe are prohibited.

C. Dual wall High Density Polypropylene (HDPP) shall comply to ASTM F2764 or AASHTO M330. The use of recycled or reground material in HDPP is not allowed. High Density Polyethylene Pipe

(HDPE) pipe and appurtenances shall be high density polyethylene conforming to the requirements of AASHTO M294. The pipe shall have a smooth interior and annular-corrugated exterior or profile wall pipe smooth interior for large diameter pipe. The use of recycled or reground materials in HDPE pipe is not allowed.

D. The Contractor shall require the manufacturer or supplier to furnish a certification that all materials furnished meet the above listed standards and materials specifications and further certify that the manufacturer is currently on the GDOT approved Producers list for the product(s) supplied.

2.04 JOINT MATERIALS:

[Note to Reviewer – Utilize AASHTO R82 “Standard Practice for Pipe Joint Selection for Highway Culvert and Storm Drains” for furthers details on joint material selection or others sources as deemed acceptable.].

A. Joints for RCP: Unless otherwise noted on the plans all joints for RCP shall be soil tight joints. Soil-Tight joints for RCP shall be accomplished by using a preformed flexible sealant or rubber gasket in the joint. The butyl mastic joint material shall meet the requirements of ASTM C990. The rubber gaskets shall meet the Physical requirements of ASTM C1619. All RCP joints utilizing butyl mastic for joint seal shall also have an exterior filter fabric wrap installed on the exterior of pipe at each joint.

B. Leak resistant joints for RCP: Leak resistant joints shall be used when specified on the plans. The bell and spigot or the tongue and groove of the pipe shall be specially manufactured and prepared for the type of rubber gasket used. The rubber gaskets shall meet the Physical requirements of ASTM C1619. Rubber Gasket Joint performance criteria shall meet ASTM C443. Any RCP installation required to be leak-resistant will be noted on the plans. A plant proof of design test shall be completed and submitted to the Engineer for approval to ensure joint design/performance can meet ASTM C443.

C. Joints for HDPP: Joints shall consist of an integral bell and spigot which meets ASTM F2736 or F2881 and shall be supplied with a rubber gasket meeting ASTM F477. The bell shall be reinforced with a polymer composite band installed by the manufacturer. If HDPP is to be utilized for a leak resistant application a plant proof of design test shall be completed and submitted to the Engineer for approval to ensure joint design/performance can meet ASTM D3212.

D. Joints for HDPE: Joints shall consist of a bell and spigot type joint with a rubber gasket meeting the physical requirements of ASTM F477. All HDPE installations will require a rubber gasket meeting the above requirements. If HDPE is to be utilized for a leak resistant application a plant proof of design test shall be completed and submitted to the Engineer for approval to ensure joint design/performance can meet ASTM D3212. Any HDPE pipe installation required to be leak-resistant will be noted on the plans.

E. Joints for CMP: Couplings Bands for CMP: Couplings shall be a minimum 16-gauge thickness and of the same material as the pipe. Pipe ends shall be re-corrugated with annular corrugations to match the bands. Couplings shall provide enough longitudinal strength to preserve pipe alignment and prevent separation at the joints. Use “Hugger” type connecting bands with rubber “O” ring gaskets meeting ASTM D1056 for all CMP installations. CMP shall not be used for leak resistant applications.

2.04 STRUCTURES AND APPURTENANCES

A. Catch basins, manholes, and area drains shall be precast concrete as shown on the Plans or as otherwise directed by the Engineer. Round Precast concrete structures shall meet the applicable requirements of ASTM C478. Square and or Rectangular precast concrete structures shall meet ASTM C913 requirements for wall thickness, slab thickness, concrete strength, and steel reinforcement requirements.

B. Pipe to Structure Connections: Flexible-leak resistant connections shall be provided for all flexible pipe (CMP, HDPP, HDPE) to structure connections, connections shall be compression connector type or boots and shall conform to ASTM C923, ASTM C1478, and ASTM F2510. All structure connections with flexible pipe shall also be supplied and installed with an exterior filter fabric jacket.

C. RCP to structure connections can be made with a neat non-shrink grout connection unless the installation requires a leak resistant performance. When the RCP installation are required to be leak resistant the RCP to structure connection shall be made with a compression connector type or boot and shall conform to ASTM C923, ASTM C1478, and ASTM F2510.

D. Grates, Frames, and Curb Castings: Conforming to the requirements of ASTM A48, Class 30. Machining of contact surfaces will be required so that covers and grates rest securely on the frames.

E. Mortar: Shall be composed of one-part Portland cement and 2 parts sands (volumetric measure). Mortar that has been mixed for more than 30 minutes which has been retempered or which has "set" shall not be used in the work.

F. Brick (for grate grade adjustments): Grade SM, ASTM C32, or concrete brick conforming to the requirements of ASTM C55, Grade N-I.

G. Headwalls and End Sections: Shall be precast concrete as shown on the Plans or as otherwise directed by the Engineer.

H. Install Manhole and structures to meet ASTM C 1821.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavation is ready to receive work of this Section, and that excavations, dimensions and elevations are as indicated on the Drawings.

B. Before placing pipe in the trench, field inspect pipe for cracks, tears, dents, joint damage, or other defects; remove defective pipe from the construction site. Inspection, evaluation, and acceptance of RCP pipe prior to its placement shall be in accordance with AASHTO R73.

C. Do not install drainage structure until mass grading has resulted in rough sub-grade elevations through the work area or the embankment materials have been placed to an elevation of one foot above the top of the pipe to be placed.

3.02 PREPARATION

A. Prior to laying pipe,
    1. Confirm trench width meets trench standard drawing. Trench width must accommodate Pipe OD and enough room on each side of pipe to compact backfill material.

    2. Confirm the foundation is firm. If foundation is soft or groundwater encountered contact the Project Engineer of Record for corrective action required before installing pipe.

    3. Install 6” of well-graded (no particle size greater than 1”) granular bedding to the appropriate elevation and slope. Bedding material shall be Type 1 or Type 2 Foundation Backfill Material as specified in GDOT 812 Backfill Materials.

    4. Do not compact the bedding material prior to placing the pipe in the trench.

B. Swab the interior of the pipe to remove all undesirable material.

C. Prepare the bell end and remove undesirable material from the gasket and gasket recess.

3.03 INSTALLING STORM SEWER PIPE

[Note to User – National Installation Standards exist for RCP Installation - ASTM C1479, CMP Installation - ASTM A798, HDPE/PP Pipe Installation - ASTM D2321 and the following language regarding installation and the associated Trench details are consistent with those documents. Also please note we utilized GDOT terminology for clarity regarding bedding and backfill material and gradations on the companion Trench Details.]

A. Lay pipe in a straight line on a uniform grade from structure to structure. Lay pipe beginning at the downstream structure and progress upstream with the bell (groove) end facing upstream.

B. Support each section throughout its length and form a close concentric joint with the adjoining pipe. If pipe is supplied with a protruding bell the installer shall excavate a small area in the bedding to accommodate the protruding bell so that the entire barrel of the pipe will be supported throughout its length.

C. Once pipe is in place and prior to placing structural backfill, compact the bedding material on each side of the pipe.

D. Make junctions and turns with standard or special fittings.

E. Do not open more trench at any time than pumping facilities are able to dewater.

F. Whenever the work ceases, close the end of the pipe with a tight-fitting plug or cover.

G. Close all openings provided for future use and abandoned pipe with a tight-fitting plug sealed to avoid leakage.

H. When the pipe connects with structures, the exposed ends shall be placed or cut off flush with the interior face of the structure and satisfactory connections made.

I. Any pipe which is not in good alignment, or which shows any undue settlement or damage shall be taken up and re-laid without additional compensation.

J. Laying pipe and sealing joints shall be a continuous operation.

1. Construct the joints in such a manner that a soil-tight joint or leak-resistant joint (in locations as noted on plans) will result.

K. Joints for rigid pipe:

1. Install preformed flexible sealant or rubber gasket (soil-tight applications); fully wrap exterior of joint with filter fabric when flexible sealant is used.

2. Install rubber gasket for any noted leak-resistant applications (proper lubrication and equalization of the gasket is required per joint manufactures recommendations); or

3. Other types of joints recommended by the pipe manufacturer and approved.

a. When other type joints are permitted, install, or construct in accordance with the recommendations of the manufacturer.

L. Firmly join HDPP/HDPE utilizing the pre-installed rubber gasket.

M. Install CMP by utilizing coupling bands and rubber gaskets.

N. When strutting or vertical elongation of CMP is required, it shall be performed in accordance with the details shown on the Plans.

O. Leave ties and struts for CMP in place until the embedment is completed, unless otherwise specified.

P. Install and compact specified materials in the bedding, haunch, and structural embedment zone as shown on the trench details.

1. Install structural embedment backfill in 6” lifts and compact to springline (midpoint) of RCP.

2. Install structural embedment backfill in 6” lift and compact to 1’ above the pipe for all flexible pipe (CMP, HDPP, & HDPE) installations.

3. All pipe to be installed in roadway with 2’ (foot) or less of cover from top of pipe to bottom of pavement section shall be backfilled with structural embedment backfill in 8” (inch) loose lifts for the full depth of the trench.

Q. As the work progresses, clean the interior of all pipe in place.

R. Protect pipe from construction damage by placing 3 feet of compacted soil above the pipe prior to allowing heavy construction traffic to cross pipe installation.

S. Make connections to catch-basins, other structures, or by installing wyes or tees as shown on the Plans. Wyes and tees for future connections shall be installed as indicated.

3.04 INSTALLING CATCH BASINS, MANHOLES AND CLEANOUTS

A. Form bottom of excavation clean and smooth to correct elevation.

B. Place Precast concrete base, with provision for pipe entry.

C. Establish elevations and pipe inverts for inlets and outlets as indicated.

D. Mount lid and frame level in grout, secured to top cone section to elevations indicated. Set true to line and grade and such that the entire surface of the casting is in contact with the bearing surface of the structure.

E. All castings shall be set firm and snug and shall not rattle.

F. All catch basin, manhole and cleanout castings and boxes shall be adjusted to final grade upon completion of the paving operations. Final adjustment shall be made by the contractor that installed the respective utility line.

3.05 FIELD QUALITY CONTROL

A. Inspection During Construction (All Pipe types):

1. Prior to placing structural backfill, allow the Owner's Representative to observe installed pipe.

2. Inspect the pipe before any backfill is placed.

a. Joint gap for soil tight joints shall not exceed 3/4" width for any pipe type.

b. Joint Gap for any leak resistant joint shall not exceed ½."

c. During the placement of structural backfill the installer shall employ a geotechnical engineer to complete compaction test of the structural backfill. Compaction testing shall be completed on each 6" lift of structural embedment backfill for every 500 LF of pipe trench for all pipe installed. The structural embedment for RCP terminates at the springline of the pipe, and structural embedment for all metal and plastic pipe terminates 6" above the top of the pipe.

[Note to reviewer use if you allow the use of HDPE, HDPP or CMP (any flexible pipe) in ROW or Roadway - The required testing for each lift of structural embedment backfill for HDPE, HDPP or CMP pipe installation shall be established and as directed by third Party Engineer responsible for the inspection of and the installation of any HDPE, HDPP or CMP-pipe located within the ROW].

B. Post Installation Inspection

[Note to reviewer – Select one (or a combination) of the 3 options for Post Installation Inspection provided below]

Option 1

[Third-Party Testing for HDPE, HDPP or CMP used in the ROW and under pavement in streets. NOTE this is not needed if (city County) does not allow HDPE, HDPP, or CMP in ROW]

1. The [City/County _____] is approving and requiring the use of third-party inspection firms for inspection of flexible pipe installations based on the conditions and requirements of this document. There is not an alternative option for City/County staff to perform these inspections.
2. A professional engineer licensed in the state of Georgia will be responsible for the completion of The Post Installation Certification Statement found in Exhibit 1 below, certifying the conditions and requirements within this document have been met prior to street acceptance and bond release with respect to HDPE, HDPP or CMP installations. <u>The certifier should note that some of the checklist items herein pertain to certification of items and require inspections prior to, during, and after construction.</u>

3. Third Party Inspection Requirements:

    a. Inspections shall be performed by a licensed, competent third-party inspection firm and the inspections shall be directed or performed by a Georgia Professional Engineer.

    b. The third-party inspection firm shall have no ownership or financial interest in the development other than that created by being retained as a third-party inspector and/or Engineer of Record.

    c. All HDPE, HDPP or CMP pipes must be inspected and approved by a third-party inspector prior to backfill being placed. An identifying label/sticker/marking on the pipe shall have the following information:
        i. AASHTO or ASTM Designation
        ii. The date of manufacture
        iii. Name or trademark of the manufacturer
        iv. Clear marking the HDPE, HDPP pipe contains <u>NO</u> Recycled or reground materials.

4. All backfill material shall be approved by the third-party inspector prior to placement of the material within the trench.

5. The third-party inspector must be present during the backfilling operations within the right of way. The inspector shall be present during the final trench preparation, backfilling of the haunch, soil lifts, compaction of soils up to the finished grade, and to verify that adequate cover over the pipe has been provided prior to heavy equipment being allowed to operate over the pipe.

6. The Engineer overseeing the inspection activities is responsible for specifying the rate and type of physical testing of soils and compaction that is to be performed by the third-party to verify the conditions of this document have been met.

7. Provide to the City/County an Engineer's report prior to requesting a final inspection. The report shall include:

    a. Documentation

        i. Inspection reports and delivery tickets

        ii. Mandrel, laser profile, or direct measurement results

iii. PACP compliant pipe video and pipe video inspection reports

b. Pipe video and video inspection reports should be included on a single flash drive.

iv. Post Installation certification statement

8. Deflection criteria – 0-5% deflection is acceptable. Pipe with Deflection greater than 10% must be removed, replaced, and reinspected to confirm deflection does not exceed 5%.

9. Reduced payment option – Pipe deflected over 5% but less than 7.5% and no other signs of wall distress may be accepted by the [City/County_____] Engineer but a reduction in payment of 25% for the entire line (structure to structure) of pipe where any location along that line is in excess of 5%. Pipe deflected between 7.5% and 10% and no other signs of wall distress may be accepted with a reduction in payment of 50% of the installed cost of the entire line (structure to structure).

Option 2

[Inspection Language for consideration. NOTE this is not needed if (City/County) does not allow HDPE, HDPP, or CMP in ROW

1. Contractor shall provide Video, Laser Video, Mandrel, or manway inspections for all HDPE, HDPP or CMP (any other plastic or metal pipe allowed) within ROW or Public Easement.

2. The installed pipe shall be inspected no less than 30 days after all backfill has been placed.

3. Video measurement technology must be certified by the company performing the work to meet the requirements of GDOT GDT136.

4. The inspection subcontractor shall be certified as a NASSCO PACP provider.

5. The inspection shall be made with CCTV equipment to capture a video of the installed pipelines.

6. The inspection of all flexible pipe will also include a deflection confirmation test. Deflection testing can be accomplished with a laser deflectometer or a nine-vane mandrel.

7. The mandrel shall be constructed to a diameter of 92.5% of the diameter of actual certified diameter of the pipe being tested.

8. Any HDPE, HDPP or CMP (any other plastic or metal pipe allowed) pipe exhibiting structural distress (wall bucking, inverse curvature, or excessive deflection) shall be removed and replaced.

9. Any HDPE, HDPP or CMP (any other plastic or metal pipe allowed) pipeline with any portion of the line exhibiting deflection greater than 7.5% shall be removed and replaced with new pipe at the contractors' expense. Re-rounding of flexible pipe is not allowed.]

Option3
[Post Installation Requirements and Acceptance for Storm Drains following GDOT PII requirements.

1. Contractor shall provide Video, Laser Video or Manway physical inspection on projects that have more than 500 linear feet of storm drainpipe and on roadways with an AADT greater than 250 vehicles.

2. Conduct video inspection in accordance with the requirements of this Specification and GDOT GDT136, current edition, on 20% of all storm drainpipe and 10% of all side drain driveway pipe installations.

3. Unless the Engineer directs otherwise, schedule the inspections for the selected locations no sooner than 30 days after completing pipe installations to be tested.

4. Before post installation inspection, dewater installed pipe (if necessary) and provide the Engineer with a post installation inspection schedule.

5. Notify the Engineer at least seven days in advance of beginning inspection.

6. Perform post installation inspections once compacted backfill has reached a depth of 8 feet or after completion of the pipe installation and final cover, which includes the embankment and all non-asphalt bases and/or subgrades.

7. Notify the Engineer if distresses or locations of improper installation are discovered.

8. When camera testing shows distresses or improper installation in the installed pipe, the Engineer may require corrective action or adjustments in payment per GDOT Section 550.5.01 Adjustments, dated November 21, 2019, or current edition.

9. Video (RCP and HDPE, HDPP, CMP) and laser profiling (for HDPE, HDPP, CMP) measurement technology must be certified by the company performing the work to meet the requirements of GDOT GDT136.

10. Manual post installation inspection allowed for pipe diameters greater than 48 inches.

11. Acceptance and payment of RCP and HDPE, HDPP, CMP is per GDOT 550, current addition, Section 550.5.01 Adjustments.]

END OF SECTION