SECTION 8000
STORM DRAINAGE

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8010 DESIGN

A. Location

1. All public and private storm sewers shall be installed in right-of-way or easements. Minimum easement widths shall be 20 feet for pipes up to and including 48 inches in diameter, and 30 feet for pipes greater than 48 inches in diameter. For pipes deeper than 10 feet, the easement width shall be specified by Cary staff.

2. See Sections 6000, 6500, and 7000 for horizontal and vertical separation requirements between storm drainage pipe, water lines, and sanitary sewer lines.

3. Cary shall maintain only the storm sewer systems within Cary maintained right-of-way and on Cary property. All others shall be maintained by the property owner(s).

4. Discharge points shall be a minimum of 10 feet downhill from the building envelope.

5. Structures shall be spaced to intercept flow at the uphill turnout of intersections unless the street design provides a continuous downhill grade around the radius and down the intersecting street.

6. Stormwater inlets shall not be placed within travel areas of roadways, driveways, or parking lots.

B. Sizing

1. Systems shall be designed based on rainfall intensities of 4 inches per hour for street inlet spacing, the 2-year storm for side ditches, the 10-year storm for street drainage pipe sizing, the 25-year storm for cross-street drainage, and the 100-year storm for floodplain areas.

2. Curb inlets shall be spaced to provide a maximum spread of 8 feet for the design storm. In areas of heavy pedestrian traffic, the maximum allowable spread may be decreased by applicable Cary official as laid out in Cary ordinances.

3. Runoff rates shall be calculated by the Rational Method (for drainage areas less than 2 square miles), SCS Method (for drainage areas greater than 2 square miles), or other acceptable procedure. Runoff computations shall be based on rainfall data published by the National Weather Service NOAA Atlas 14 for this area.

4. Time of concentration (t_c) shall be determined using standard acceptable methods and the storm duration shall equal t_c.

5. Pipe shall be sized in accordance with the Manning Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 feet per second (fps) during the 2-year storm.

6. Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity between 2-10 fps during the 2-year storm.

7. The minimum design slope of a pipe or culvert shall be 0.5 percent.

8. The minimum pipe diameter shall be 12 inches where the inlet is grated and 15 inches where the inlet is not grated.

9. Structures shall be installed at each deflection of line, grade, and/or change in pipe material.

10. No inaccessible storm drainage structures shall be allowed.

11. Drop inlet structures require the ponding elevation of 100-year storm to be calculated and delineated on recorded maps. A building restriction line 2 feet above the 100-year ponding elevation shall also be recorded.

12. The maximum length between access points shall be 400 feet for all pipe sizes.

13. Channels and ditches shall be designed to carry the design flow at nonerosive velocities. Calculations indicating design velocities shall be provided along with typical channel cross-sections. The maximum allowable design velocity in grass channels is 4 fps.

14. A Hydraulic Grade Line (HGL) study shall be performed for all storm drainage systems. The study shall include profiles that show invert slopes, proposed finished grade and hydraulic grade line. Hydraulic grade line shall be required to stay within pipe to ensure no surcharge on system. ASTM Standard C443 (O Ring or Single Offset) flexible watertight sealed pipe shall be used in cases where it is not practicable.

15. Stream crossings will necessitate a backwater study on the 100-year storm.

16. The 100-year backwater shall be delineated on all plans and a backwater easement provided. A building restriction line two feet above the 100-year backwater elevation shall also be delineated on all maps for recording.

17. In cases where more than one pipe is required for a stream crossing, a maximum of three pipes or box culverts consisting of one primary and two overbank conveyances, shall be provided. A two pipe or box culvert crossing with primary and overbank conveyance may be approved with proper justification. Crossing geometry should mimic the natural channel.

8020 MATERIALS

A. Pipe Materials

1. Reinforced Concrete Pipe shall conform to ASTM C76, Table III or Table IV. Joints shall be sealed with a plastic cement putty meeting ASTM C990 (preformed flexible sealant).

2. Reinforced Concrete Box Culvert shall conform to ASTM C1433, ASTM C1504, or ASTM C1786. Joints shall be sealed in conformance with ASTM C990 (preformed flexible sealant) and/or C877 (external sealing bands), based on manufacturer's recommendations for the specific application.

3. Aluminized Steel Type 2 Pipe shall be 36 inches in diameter or greater and be bedded and manufactured according to ASTM A 929 (Manufacturing), 760 (Coating), 796 (Structural Design) and 798 (installation).

4. Corrugated Aluminum Pipe shall conform to ASTM B744 and design standard ASTM B790. Installation and backfill shall comply with standards ASTM B788 and AASHTO M145. The corrugated aluminum pipe shall meet or exceed HS20 loading requirements and NCDOT approvals.

5. High Density Polyethylene (HDPE) Corrugated Pipe shall be used only in areas outside of public right-of-way and easements. When used in private locations, pipe material shall be rated on approved plans and include the submission of design criteria. Installation of HDPE pipe shall adhere to design criteria standards. Pipe material shall meet the product specifications of ASTM F667 and shall have a smooth interior. Pipe joints shall consist of an integral bell and spigot type joint with "O" ring rubber gasket meeting ASTM F477 placed on the spigot end. At least two (2) corrugations of the spigot end must insert in the bell end. Installation shall adhere to the specification of ASTM D2321 and be certified by an engineer. HDPE pipe, 24" or under may be used outside the right-of-way only.

6. Polyvinyl Chloride (PVC) Pipe shall be used only in areas outside of public right-of-way and easements. When used in private locations, material pipe shall be rated on approved plans and include the submission of design criteria. Installation of PVC pipe shall adhere to design criteria standards. Pipe material shall meet the product specifications of ASTM F949-93a and shall have a smooth interior. PVC pipe, 24" or under may be used outside the right-of-way only.

7. Recycled High Density Polyethylene (HDPE) Corrugated Pipe shall be used only in areas outside of public right-of-way and easements. When used in private locations, pipe material shall be rated on approved plans and include the submission of design criteria. Installation of HDPE pipe shall adhere to design criteria standards. Pipe material shall meet the product specifications of ASTM F2648 and shall have a smooth interior. Pipe joints shall consist of an integral bell and spigot type joint with "O" ring rubber gasket meeting ASTM F477 placed on the spigot end. At least two (2) corrugations of the spigot end must insert in the bell end. Installation shall adhere to the specification of ASTM D2321 and certified by an engineer. HDPE pipe, 24" or under may be used outside the right-of-way only.

B. Structure Materials

All storm drainage structures such as manholes, inlets, junction boxes and catch basins shall be constructed of either solid brick, solid block, or precast concrete.

1. Clay Brick shall be solid, rough, sound clay brick conforming to ASTM C32, Grade MS. The brick shall be laid with full shove joints, filling up the joints with mortar. The thickness of the joints shall not exceed 3/8 of an inch.

2. Concrete Block or brick shall be solid and conform to ASTM C139 as to design and manufacture. The block or brick shall be embedded in a mortar bed to form a 1/2-inch mortar joint.

3. Precast Concrete Manholes shall meet ASTM C478 as to design and manufacture. All manhole cones shall be the eccentric type. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant. All external joints shall be wrapped with 6-inch minimum width rubberized mastic joint wrap.

4. Precast Concrete Box Structures shall meet ASTM C913 as to design and manufacture. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant. All external joints shall be wrapped with 6-inch minimum width rubberized mastic joint wrap.

5. Manhole Frames and Covers shall be as specified in Section 7000, with “STORM SEWER”, “CARY” and the Cary Seal stamped on the cover and two 1-inch holes.

6. Steps shall meet the material, strength, and installation requirements as specified in Section 7000. Location of steps for storm drainage shall be per Detail 8000.6. Manholes shall have one step at the top and one step at the bottom of the structure in the public right-of-way.

7. Headwalls and Endwalls shall be constructed in accordance with NCDOT details, or precast concrete with wing walls and apron by an approved manufacturer. Installation of precast headwalls and endwalls shall be in accordance with the manufacturer's recommendations. Design shall include provision for relief of hydraulic pressure. Voids shall be filled with non-shrink grouting. Gabion basket shall not be allowed.

8. Stormwater Control Measure (SCM) outlet structures shall be cast in-place or precast concrete or aluminum ~~pipe~~ only.

9. Frame, Grate & Hood shall be cast iron and meet the ASTM requirements set forth in the latest edition of the NCDOT “Standard Specifications for Roads and Structures” and the dimensional requirements set forth in the latest edition of the NCDOT “Roadway Standard Drawings #840.03”. Grate shall be stamped with the NCDOT Specification number as evidence of satisfying the above requirements.

   Hoods and drop inlet grates shall be stamped “Drains to River”. Lettering shall be ¾” height and shall be clean, crisp and free of defects.

C. Installation

1. Pipe may enter through the corner of all structure material types except precast concrete "waffle" boxes.

2. A reinforced concrete slab designed by an engineer may be used at oversized structures to adjust an inlet to standard dimensions. They must meet H-20 loading.

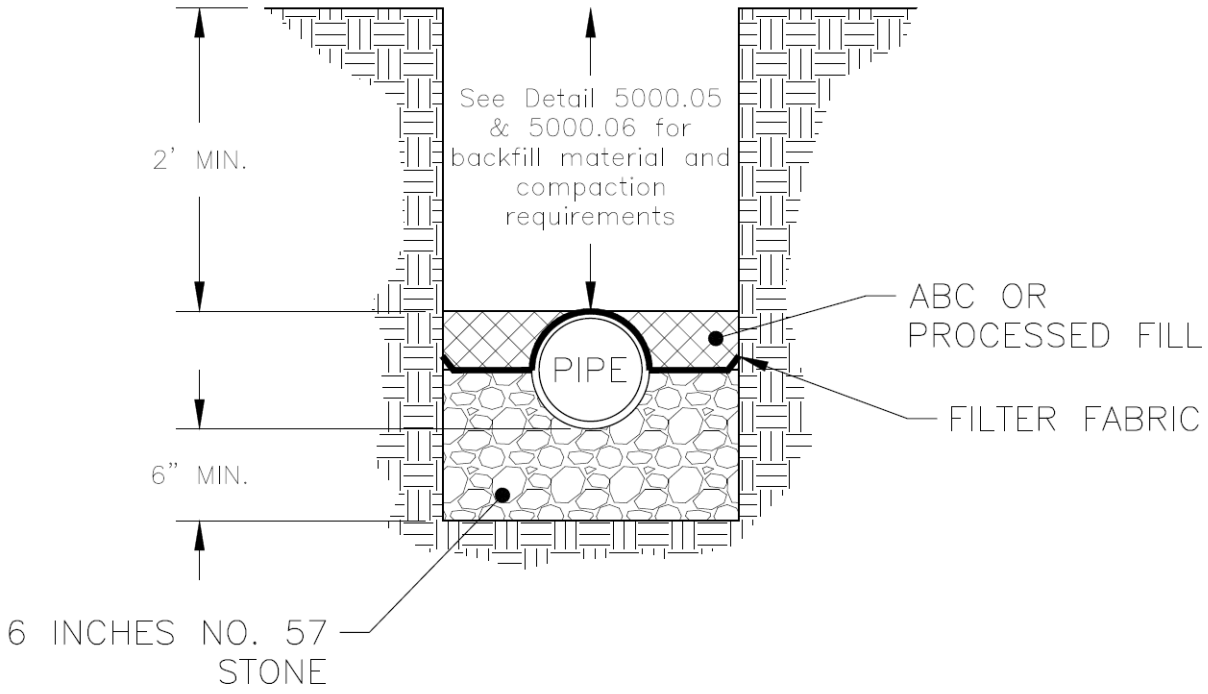
3. Pipe shall be installed to provide a true line and grade between structures.

4. The minimum cover for storm drain pipe shall be 2 feet to finished subgrade under roads and 1 foot to finished grade in non load-bearing areas. Trench excavation and backfilling shall be in accordance with Section 5000 of the Specifications unless more stringent installation requirements are listed with specific material type and certified by an

engineer. However, storm drain trench width shall be the pipe OD plus 36-inches per detail drawings 5000.05 and 5000.06.

5. Dam and Stormwater Control Measures' pipe outlet trench through a dam shall not be bedded in stone and at a minimum include an appropriately designed filter diaphragm, full length concrete cradle, or anti-seep collar per detail 5000.04. Natural ground installations through a dam or SCM bedding shall be at the direction of a licensed professional geotechnical engineer.

6. The trench bottom shall provide a firm and uniform support for the pipe. Where bell and spigot type is used, recesses shall be excavated to receive the pipe bell.



STANDARD STORMWATER INSTALLATION

7. Pipe shall be bedded in No. 57 stone to the center of the pipe and extending a minimum of six inches under the pipe. Filter fabric shall be placed at the interface of the No. 57 stone/top of pipe and the fill material within the pipe trench. Fill material compaction above filter fabric shall meet the compaction requirements outlined in Section 5020 A. 2. and the Standard Stormwater Trench Installation detail 5000.05 and the New Development Stormwater Trench Installation under Asphalt pavement and

in the Right-of-Way. Backfill in natural ground shall be in accordance with Section 5020 A. 2. and Standard Detail 5000.05.

8. In instances where compliance with compaction requirements is questionable as determined by the Inspector, testing shall be provided by the Contractor and a licensed Geotechnical Engineer to verify compliance.

9. The minimum trench width shall be one pipe diameter plus 18 inches on each side of the pipe.

10. Pipe shall not project into a drainage structure but shall be finished flush with the inside of the structure. Voids shall be filled with non-shrink grouting. The exterior annulus between the box and the pipe shall be filled with non-shrink grout and wrapped with an approved joint seal material.

11. All external manhole or box joints shall be wrapped with an approved joint seal material.

12. Catch basins between 5 and 20 feet in depth shall have minimum interior dimensions of 4 feet by 4 feet, and those over 20 feet in depth shall have minimum interior dimensions of 5 feet by 5 feet.

13. Each drainage structure shall have an invert constructed from concrete and shaped to conform with the pipe ID, and a bench with a maximum 5:1 slope. The bench shall begin at a height of one-half the pipe diameter for 12- to 24-inch pipe, one-third the pipe diameter for 30- to 48- inch pipe, and one-fourth the diameter for pipe greater than 48 inches in diameter. Precast headwalls and endwalls shall only be installed at single pipe culverts.

14. Precast concrete structures may be installed only to depths certified as acceptable by the manufacturer.

15. Each curb's inlet must be installed such that the front wall is straight and aligned with the curb and gutter.

D. Inlets and Outlets

1. Headwalls, endwalls or flared end sections shall be installed at all discharge points, and inlets where there is not a structure.

2. Flared end sections, headwalls or endwalls shall be installed on single pipe culverts up to and including 60 inches in diameter, and on multiple pipe culverts up to and including 36 inches in diameter.

3. Headwalls and endwalls shall be installed on single pipe culverts greater than 60 inches in diameter, and on multiple pipe culverts greater than 36 inches in diameter.

4. Energy dissipaters shall be installed at all discharge points and shall be properly sized to ensure that stormwater is released at a nonerosive velocity.

5. A filter fabric barrier shall be installed between dissipation pads and the natural ground.

6. The system shall include scour protection for drainage ways.

9. Weep holes shall be required on all headwalls and endwalls.

8. Details and design of headwalls, endwalls and flared end sections shall be in accordance with NCDOT standard detail requirements. These details shall be shown on plan submissions.

9. Additional information on the impact of stormwater discharge onto adjacent properties may be required by Cary.

8030 INSPECTION AND TESTING

The Contractor shall furnish all materials, labor, and equipment to perform inspections of storm drainage system.

A. Video Assessment and Cleaning

1. As a final measure required for acceptance, the Contractor shall clean and televise all newly installed storm drain systems to include all pipe public and any portions that are to remain privately maintained. The Contractor shall televise all the junction boxes and storm drains 12-inch and larger installed from the upstream to downstream junction box with no reverse setups or cutaways. Throughout shooting, the camera shall be panned and tilted for a complete view of the junction box and storm drain at each joint. Additionally, any pipe defects or damage shall be videoed appropriately to assess potential repair. Lighting shall be adequate to view the entire storm drain system from beginning to end.
2. All CCTV inspections shall be submitted in accordance with the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP).
3. The video inspection shall be submitted to the Infrastructure Field Technician on a Cary approved storage device and formatted with software compatible and readable by Cary. Cary shall not be responsible for purchasing additional software necessary to view the storage devices.

4. The camera shall be advanced at a uniform rate not to exceed 20 feet per minute that allows a full and thorough inspection of the new storm drain. The camera shall be a color, pan and tilt camera capable of producing a five-hundred-line resolution picture. Lighting for the camera shall be sufficient to yield a clear picture of the entire periphery of the pipe. The picture quality shall be acceptable and sufficient to allow a complete inspection with no lapses in coverage. The length of the storm drain shall be measured and recorded on the video screen. The distance counter shall be calibrated before shooting the inspection video.

5. The Contractor shall clean the storm drain system ahead of video inspection with a high-velocity water jet. The video inspection shall take place within 2-hours of cleaning operations as witnessed by the Infrastructure Field Technician. All construction debris shall be collected in the downstream junction box and shall not be released into any stormwater control measure or outfall.

6. The Infrastructure Field Technician shall be present throughout the cleaning and televising of the storm drain system to verify that the video work complies with the Specifications.

7. Prior to submitting the storage devices to the Infrastructure Field Technician, the Contractor shall label the submittal with the following information:

- Name of the Project/Development.
- Name and contact information of responsible party.
- Date of televising.
- Box identification as shown on the design plans.

8. Upon Cary's staff review of the CCTV footage that indicates a repair is required due to a defect, the As-Built/Record Drawing including Engineer's Certification, and CCTV shall reflect such repair.

END OF SECTION 8000