

6 ■ STORMWATER IMPROVEMENTS

6.01 *General Requirements*

- a. In addition to the standards contained in this Land Development Standards Manual, the design of stormwater systems is also governed by several ordinances and regulations.
 - (1) Projects falling under the City of Belmont Watershed Protection Ordinance shall include water quality measures and buffers as established therein.
 - (2) Projects lying outside of the designated Watershed Protection Ordinance zones shall be designed in conformance of the Gaston County Stormwater Ordinance and are subject to review by the Gaston Natural Resources Department. Simultaneously with the submittal of a permit application to Gaston Natural Resources Department, the design professional shall submit copies of all permit application materials to the City, including calculations.
 - (3) Additional stormwater requirements may be applicable if wetlands and streams are impacted. These requirements are dictated by the US Army Corps of Engineers and the NC Division of Water Quality under the 404 permitting and 401 certification processes.
 - (4) Furthermore, North Carolina riparian buffer rules as contained in 15A NCAC 02B.0243 and 15A NCAC 02B.0244 apply to the Catawba River Basin including Lake Wylie and the South Fork of the Catawba in Belmont.
- b. The design professional shall complete a downstream stormwater impact analysis to demonstrate by calculations that the project stormwater discharge points and offsite drainage systems are adequate to handle the runoff flow from the development without damaging downstream property owners.
- c. The design professional shall submit complete calculations for all drainage features including erosion control measures, the piped drainage system, and detention/water quality measures. These calculations shall be contained in a design report that is signed and sealed by a Professional Engineer, Professional Land Surveyor, or Professional Landscape Architect as applicable per state law. At a minimum, the report must contain:
 - (1) Cover and table of contents.
 - (2) Narrative describing the project, its location, river and stream basins affected, method of calculation, and design professional's conclusion regarding the pre-development and post-development discharge rates from the project.



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- (3) Vicinity map indicating project location, downstream water course and river basin designation.
- (4) Drainage map with sub-basins delineated for each corresponding to drainage system components.
- (5) Design calculations for all channels, pipes, water quality measures, and detention facilities.

6.02 *Location of Drain Pipes and Inlets*

- a. All public storm sewers shall be installed in rights of way or easements. Minimum easement widths shall be 20 feet for pipes up to and including 36 inches in diameter, and 30 feet for pipes 42 inches in diameter or greater. The easement width shall be increased in width by 2 feet for every foot of pipe cover depth over 6 feet.
- b. If off-site drainage improvements are necessary, easements must be obtained by the Developer and recorded at the Gaston County Register of Deeds prior to plan approval.
- c. Easements shall be provided for on-site drainage improvements that are not in public rights of way. These easements shall be dedicated by subdivision final plat if applicable, or if a subdivision plat is not required, by documents recorded at the Register of Deeds.
- d. Easement areas shall be graded flat with little or no cross slope.
- e. No fences, trees, large shrubbery, accessory buildings, pools, patios, overhanging structures, or yard structures are permitted in the easement.
- f. The City will not replace walks or driveway pavements within easements when they must be removed for pipe repairs.
- g. Discharge points for drain pipes shall be a minimum of 20 feet downhill from any building envelope. Drainage pipes between building envelopes shall be provided with a 30 foot wide easement extending to the lot lines at both ends.
- h. The City shall only maintain storm sewer systems within City maintained rights of way and easements. All others shall be maintained by the property owner and labeled as "Private" on the plans.
- i. Drainage inlets shall be spaced to intercept roadway flow at the uphill turnout of intersections unless the street design provides a continuous downhill grade around the radius and down the intersecting street. The minimum grade around curb returns is 0.50%. The slope around all curb returns shall be indicated on the plans.



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- j. Drainage inlets shall not be placed within travel areas of roadways or in cross walks.

6.03 *Sizing Criteria for Drainage System*

- a. Storm drainage facilities shall be designed to limit the discharge from the site to the rate for the 1 year, 24 hour storm that existed prior to development of the site. For projects that are redeveloping a developed site, the discharge will be limited to that which occurs before any new development. The type and location of the discharge will be as occurred before the current development unless the discharge is to a manmade conveyance system.
- b. Stormwater systems shall be designed based on the 10 year storm for roadside ditches and street drainage pipe sizing, and the 25 year storm for cross-street drainage.
- c. Curb inlets shall be spaced to provide a maximum spread of 8 feet for the design storm. Systems shall be designed based on rainfall intensities of 4 inches per hour for street inlet spacing. In areas of heavy pedestrian traffic, the maximum allowable spread may be decreased by the City Engineer.
- d. 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 for the Charlotte region.
- e. Time of concentration (tc) shall be determined using the Kirpich Equation (Bureau of Reclamation, 1974, p.71), and the storm duration shall equal tc.
- f. Pipes 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 during the 2 year storm.
- g. Culverts shall be sized in accordance with the Energy Equation and applicable nomographs to carry the design flow and to provide a velocity of at least 2 fps during the 2 year storm.
- h. The minimum pipe diameter shall be 12 inches where the inlet is grated and 15 inches where the inlet is not grated.
- i. Pipe shall be installed to provide a true line and grade between structures.
- j. Structures shall be installed at each deflection of line and grade.
- k. The maximum length between access points shall be 400 feet for all pipe sizes.



- l. No inaccessible storm drainage structures shall be allowed.
- m. Channels and ditches shall be designed to carry the design flow at non-erosive velocities. Calculations indicating design velocities shall be provided along with typical channel cross-sections in the design report. The maximum allowable design velocity in grass channels is 4 feet per second.
- n. If requested by City Engineer, a hydraulic grade line 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.
- o. Stream crossings requiring double culverts will necessitate a back water study on the 25-year storm.
- p. No more than two pipe culverts per crossing are allowed. If additional capacity is required that is greater than double pipe culverts can provide, box culverts shall be provide with no more than two barrels,.
- q. A 100 year storm shall be routed through the development using both the piped drainage system and surface flow route. The 100 year storm must be able to flow through the development without flooding structures. A surface flow route between buildings shall be designed on the basis that the piped drainage system is clogged. An easement for surface flow paths is required.

6.04 *Pipe Materials*

- a. All drainage pipes to be maintained by the City shall be reinforced concrete pipe conforming to ASTM C76, Table III or Table IV. Joints shall be sealed with a plastic cement putty meeting Federal Specification SS-S-00210, such as Ram-Nek or a butyl rubber sealant. If there is a potential for the pipe to surcharge, “O” ring rubber gaskets meeting ASTM C425 shall be provided.
- b. High Density Polyethylene (HDPE) Corrugated Pipe shall be used only in areas outside of public rights of way and easements. When used in private locations, pipe material shall be indicated on the plans. Installation of HDPE pipe shall adhere to specifications provided by the project design professional. Pipe material shall meet the product specifications of ASTM F667. 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. Installation shall adhere to the specification of ASTM D2321. HPDE pipe may be used in a public right of way for a driveway culvert provided that the adjacent property owner is responsible for maintaining and replacing the culvert and that this responsibility be



specifically enumerated in the Homeowners Association's Covenants Conditions and Restrictions (CCR's).

- c. Polyvinyl Chloride (PVC) Pipe shall be used only in areas outside of public rights of way and easements. When used in private locations, pipe material shall be indicated on the plans. Installation of PVC pipe shall adhere to specifications provided by the project design professional. Pipe material shall meet the product specifications of ASTM F949-93a.

6.05 *Structure Materials*

- a. All storm drainage structures such as manholes, inlets, junction boxes, and catch basins shall be constructed of precast concrete.
- b. Structures shall meet the requirements of NCDOT Standard Specifications for Roads and Structures and the dimensional requirements set forth in the NCDOT Roadway Standard Drawings.
- c. Joints between sections of structures shall be sealed with plastic cement putty such as Ram-Nek or a butyl rubber sealant.
- d. Headwalls may be constructed in accordance with NCDOT details or precast concrete with wing walls and apron by a manufacturer as approved by the City Engineer. Installation of precast headwalls and endwalls shall be in accordance with the manufacturer's recommendations. Precast headwalls and endwalls shall only be installed at single pipe culverts.
- e. Frame, grate, and hood for catch basins and inlets shall be cast iron and meet the requirements set forth in the NCDOT Standard Specifications for Roads and Structures and the dimensional requirements set forth in the NCDOT Roadway Standard Drawings.
- f. Hoods shall be stamped "Drains to River". Lettering shall be ¾ inches in height and shall be clean, crisp and free of defects.

6.06 *Installation*

- a. Stormwater pipe trenches shall be backfilled and compacted in accordance with Appendix C – Utility Trench Testing Requirements.
- b. Pipes may enter through the corner of structures except for precast concrete "waffle" boxes.
- c. A reinforced concrete slab may be used for oversized structures to adjust an inlet to standard dimensions. The slab shall be designed to meet H-20 loading conditions.



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- d. The minimum cover for storm sewer pipe shall be 2 feet to finished subgrade under roads and 1 foot to finished grade in non-load bearing areas.
- e. Pipe shall not project into a drainage structure, but shall be finished flush with the inside of the structure.
- f. 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.
- g. Each drainage structure shall have an invert constructed from concrete and shaped to conform to the pipe internal diameter, 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.
- h. Precast concrete structures may be installed only to depths certified as acceptable by the manufacturer.
- i. Curb inlets shall be installed such that the rear of the inlet grate is aligned with the back of curb.

6.07 *Inlets and Outlets*

- a. Headwalls, endwalls or flared end sections shall be installed at all discharge points and inlets where there is not a structure.
- b. Flared end sections shall be installed on single pipe culverts up to and including 60 inches in diameter, and on double pipe culverts up to and including 36 inches in diameter.
- c. Headwalls and endwalls shall be installed on single pipe culverts greater than 60 inches in diameter, and on double pipe culverts greater than 36 inches in diameter.
- d. Energy dissipaters shall be installed at all discharge points and shall be properly sized to ensure that stormwater is released at a non-erosive velocity.
- e. A fabric barrier shall be installed between dissipation pads and the natural ground.
- f. The system shall include scour protection for drainage ways.

