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15.9 DRAINAGE AND STORMWATER SEWERS

All stormwater drainage systems must be separate and independent from any wastewater sewer.

A. Accessibility to Public Stormwater Sewers

1. Where a public storm sewer is accessible, generally within 300 feet, the developer must install connections to stormwater sewer facilities. Stormwater sewer lines must be extended through and to the end of the development as determined by the City Engineer.
2. If a connection to a public stormwater sewer will be provided eventually, as verified by the City Engineer, the developer must make arrangement for future stormwater disposal by that public system at the time the plat receives final approval. Provisions for such connection must be incorporated into the performance bond required for the final plat.
3. All underground stormwater conveyances will be inspected by the City to ensure proper installation prior to acceptance by the City. All DVD recording, or other electronic format acceptable to the City, and inspection must be performed by the developer for verification.
4. All underground stormwater conveyances that are found to be contaminated with sediment must be cleaned by equipment suitable for the work performed and by the Public Works Director and all material or installation defects must be repaired to the satisfaction of the City at the developer's expense. All final work will be re-verified by pipe camera inspection on DVD recording, or other electronic format acceptable to the City, by the developer.
5. If no access to public stormwater sewers are within a reasonable distance, adequate provision must be made for the disposal of stormwater, in compliance with the Storm Water Management Ordinance.
6. Storm sewer lines must be extended through and to the end of the development when requested by the City Engineer to service future development.
7. Public stormwater sewer pipe must be installed in public rights-of-way or public dedicated easements. Pipe or other stormwater structures must be placed in the center of easements and no closer than five feet from the edge of any public right-of-way.
8. Surface swales draining multiple lots cannot flow over sidewalks or curbs. Surface water flow must be intercepted by area drains or headwalls and piped to the nearest underground storm sewer system.

B. Storm Water Drainage Calculations Specifications

All stormwater drainage calculations must be submitted to the City Engineer as part of the plan approval process for site plans, preliminary plats, and planned developments. Calculations must include the following:

1. Surface water drainage calculations for each drainage sub-basin within the development. This must include the 100-year and 25-year maximum discharge in accordance with Title 18 of the Municipal Code. Other information must include runoff coefficients and time of concentration for each drainage sub-basin associated with stormwater inlets or other conveyance systems to channel and or intercept surface water flows.
2. Inlet capacity of stormwater inlets along with any storm water bypass. Inlets capacity calculations must include the clogging factor used by the engineer in the design.
3. Width of surface water spread on streets prior to interception of flows by inlets.
4. Maximum flow capacity for each stretch of stormwater sewer pipe between manholes along with the HGL associated with anticipated flows.
5. Pipe roughness coefficient used for design.
6. Sub-basin characteristics such as max flow, runoff coefficients, time of concentration, peak discharge.
7. Hydrological methods used for surface water calculations must follow the methodologies and practices outlined in the Tennessee Department of Transportation Division Drainage Manual, except where design standards are otherwise described in this article.

C. Dedication of Drainage Easements

1. Where a subdivision is traversed by a watercourse, drainage way, channel, or stream, either a stormwater easement or drainage way conforming substantially to the lines of such watercourse, and of appropriate width and construction, must be provided. Where open drainage ways are utilized, they must be designed for a 25-year flood. In addition, the 50-year and 100-year storm events must be evaluated by the developer's engineer to determine if additional capacity is necessary due to the potential of flooding during high intensity storm events.
2. Where topography or other conditions within a 25-year, 50-year and/or 100-year stormwater conveyance make the inclusion of drainage facilities within a public way impractical, perpetual unobstructed easements are required. Such easements must be a minimum of 20 feet wide. Easements containing storm sewer, sanitary sewer and or water lines must have a minimum width that is adequate to provide for a ten foot separation between pipelines and allow ten feet from the centerline of the outside pipes to the easement boundary. Easements must be indicated on the preliminary and final plats. Drainage easements must be carried from the public way to a natural watercourse or other drainage facilities.
3. When a new drainage system is to be constructed that will carry water across private land outside the subdivision, appropriate drainage rights and easements must be secured and indicated on the plat.
4. The applicant must preserve an area, parallel to the watercourse, containing a width equal to and not less than two times the water course width (as measured from top-of-bank to top-of-bank). This area will be designated as a water quality buffer zone easement and cannot be disturbed by the proposed development. Details of this requirement are located within the City's Water Quality Buffer Zone Policy.
5. Along watercourses, low-lying lands within any floodway, as determined by the Planning Commission whether or not included in areas for dedication, must be preserved and retained in their natural state as drainage ways.

D. Accommodation of Upstream Drainage Areas

A culvert or other drainage facility must be large enough to accommodate potential runoff from its entire upstream drainage area, whether inside or outside the subdivision. Necessary facilities will be sized based on the construction specifications and assuming conditions of maximum potential watershed development permitted by any zoning regulations.

E. Effect on Downstream Drainage Areas

The Planning Commission will also study the effect of each subdivision on existing downstream drainage facilities outside the area of the subdivision. Where it is anticipated that the additional runoff incident to the development of the subdivision will overload an existing downstream drainage facility, the Planning Commission may withhold approval of the subdivision until provision has been made for adequate improvement of such drainage facilities in such sum as the

Planning Commission determines. No subdivision will be approved unless adequate drainage is provided to an adequate drainage watercourse or facility.

F. Spring or Surface Water On Site

The developer may be required by the Planning Commission to transport by pipe or open ditch any spring or surface water that may exist prior to or as a result of the subdivision. Such drainage facilities must be located in the public way, where feasible, or in perpetual unobstructed easements of appropriate width, and must be constructed in accordance with the storm water construction specifications.

1. When a solid style fence is installed in a Public Utility Drainage Easement ("PUDE"), a minimum four inch (4") separation between the bottom of the fence and the approved finished grade is required. If the fence has vertical gapped slats that would allow for water flow (as shown in the example below), the separation is not required. If the fence is not located within a PUDE, the separation is not required.



2. For fences located within or adjacent to drainage easements, floodplains, or areas necessary for stormwater conveyance, the Public Works Director or their designee may require greater clearance as necessary to maintain adequate stormwater flow and access for maintenance activities.
3. Failure to maintain the required clearance that allows the unrestricted flow of stormwater shall constitute a violation of this code and may require modification or removal of the fence at the property owner's expense.
4. An inspection will be conducted and an inspection fee will be assessed in accordance with the City's adopted fee schedule.

G. Floodplain Areas

The Planning Commission may prohibit, when it deems it necessary for the health, safety, or welfare of the present and future population of the area or necessary to the conservation of water, drainage, and sanitary facilities, the subdivision of any portion of the property that lies within the floodplain of any stream or drainage course. The regulatory floodway must be preserved from any and all destruction or damage resulting from clearing, grading, or dumping of earth, waste material, or stumps.

H. Areas of Poor Drainage

Whenever a plat is submitted for an area which is subject to flooding, the Planning Commission may approve such subdivision provided that the applicant fills the affected floodway fringe area of said subdivision so that public right-of-way elevations are at no less than two feet above the regulatory flood elevation and first floor elevations (including basements) at no less than two feet above the regulatory flood elevation. The plat of such subdivision must provide for a floodway along the bank of any stream or watercourse of width sufficient to contain or move the water of the regulatory flood, and no fill may be placed and no building nor flood-restrictive structure may be erected or placed in the floodway.

I. Design Standards

1. Detention Volume

The required detention volume must be that volume necessary, given the hydraulic characteristics of the primary outlet structure, to attenuate the post-development of mass outflow of water from the structure from hour 11 to hour 18 of the 24-hour storm to a level not to exceed the pre-development mass outflow for the same time period for both the 2-year and 5-year 24-hour storms. Detention storage volume must be drained within 72 hours.

2. Maximum Release Rate

The release rate from any detention pond must be for the site for the same storm prior to the proposed development. The peak outflow rate from the 2-year 24-hour storm, 10- year 24-hour storm, and 25-year 24-hour storm cannot exceed that of the site prior to development. Detention facilities must have a primary discharge

structure capable of accommodating the 24-hour storms up through the 25-year with an emergency overflow capable of handling at least the 100-year 24-hour post development discharge unless waived by the Planning Commission.

3. Storm Sewer Design Requirement

Design storm frequency for land use/development type for storm systems must be as follows:

- a. Residential 25-year storm
- b. Commercial/Business/Industrial 25-year storm
- c. For drainage swales, lined channels and natural channels, the system must be designed to carry the 100-year storm and have the capacity to convey storm runoff without life hazard or property damage.

4. Existing Water Facilities

- a. Existing streams, lakes, and wetland cannot be modified for use as stormwater detention or retention ponds.
- b. On-stream impoundments are prohibited.

5. Stream Buffer Requirements

No stormwater management facilities may be located within streamside buffers, nor can they be detrimental to such buffers, unless a plan with appropriate mitigation is authorized by the City Engineer.

6. Stormwater Detention and Surface Infiltration Basins

Stormwater detention and surface infiltration basins must be design as naturalized basins for multiple uses, including stormwater detention, habitat enhancement and passive recreation use. Basins cannot be designed solely for stormwater detention purposes.

- a. Stormwater basins must be designed and incorporated into usable open space, accessible and open to the public.
- b. Water level fluctuations between the normal and high water level cannot exceed 18 inches for the 2-year design event and cannot exceed five feet for the 100-year design event.
- c. If fish are to be supported at least 25% of the permanent pool of water must be a minimum of ten feet in depth.
- d. Detention and outlet structure must be located at opposite ends of the basin to maximize water quality benefits.
- e. For wet detention basins, water entry slopes between one foot above and one foot below cannot exceed ten to one (10:1) to minimize shoreline erosion. Shallow entry angle will improve water quality treatment and increase aquatic habitat.
- f. Drainage area for wet detention ponds is a 15 acre minimum, to ensure hydrologic input sufficient to maintain permanent pool. Ten acres or less may be acceptable, particularly if the groundwater table is intercepted and a water balance indicates that a permanent pool can be sustained.

7. Stormwater Inlets

- a. Stormwater Inlets must be John Bouchard 3103 V Curb inlet or 3300-V Curb Inlet.
- b. Clogging factor for design and spacing must be 50%.
- c. Inlets cannot be spaced in the pathway or ADA ramps and must intercept surface water before ADA ramps.
- d. All stormwater inlet boxes must be precast with inlet and outlet pipes grouted inside and outside to make the joint water tight

8. Stormwater Manholes

- a.** Manholes must be installed at the end of each line, at all changes in grade, size or alignment at all sewer main intersections and at distances not greater than 400 feet apart for sewers 18 inches in diameter and not greater than 450 feet apart for sewer greater than 18 inches in diameter.
- b.** Floor troughs must be furnished for all sewers entering manholes. A larger diameter manhole must be utilized in order to properly construct floor troughs where the incoming sewer inverts are substantially higher than the outgoing sewer invert. At all manholes with a change of direction, a drop from the entrance to the outlet of at least 0.1 feet must be provided to account for head loss through the manhole. Additional drop in elevation may be required for sewer mains 12 inches and larger. Inverts must be U-shaped to the pipe crown before sloping at a one to twelve (1:12) slope to the manhole walls.
- c.** Four foot diameter manholes can be used for pipes up to 18 inches. Five foot diameter manholes must be used for pipes 21 inches in diameter and larger.
- d.** Manhole frame and cover must be John Bouchard 1111 or approved equal.

9. Stormwater Pipe, Manholes, Catch basins, Inlets and Pipe End Walls, and Bedding Aggregate

- a.** Reinforced concrete pipe must conform to the minimum standards for Class III, ASTM C76, and must be utilized under roadways and all paved areas whether public or private development. All RCP stormwater pipe and structure joints and connections must be grouted with non-shrink grout and/or otherwise sealed both inside and out. Butylene gasket materials must also be utilized within pre-cast manholes and structures to further seal the joints and connections.
- b.** Concrete and HDPE storm piping connections must be sealed with proper collar rings when applicable and directed by the City.
- c.** Dual wall polypropylene (PP) storm drainage pipe (18" to 60") is also allowed for use within paved areas (public and private) only if the installation requirements and backfill materials are utilized as recommended by the manufacturer. Dual walled smooth interior PP pipe must be in accordance with AASHTO HB Section 30, T-341, R-16 and MP-21-11 along with ASTM C969, C1103, D2321, D3212, F477, F1417, F2487, F2736, and F2881. Detectable warning tape must be utilized in the trench of the PP pipe when installed.
- d.** HDPE pipe is permitted outside of paved areas as long as its installation is in accordance with the manufacturer's recommendations.
- e.** All stormwater piping must have a minimum velocity of three feet per second.
- f.** All pipe headwall must be of TDOT Class A Concrete. Poured in place headwalls cannot be less than 12 inches thick for pipes 18 inches through 30 inches. Precast discharge structures must meet the requirements of TDOT standard drawings.
- g.** Nyloplast (H20) structures is permitted in turf areas.

10. Excavation, Bedding, and Backfill

- a.** A minimum cover of two feet is required on all PP pipe. Six inches of pipe bedding of TDOT No. 67 stone is required for all PP pipe.
- b.** A minimum cover of two feet is required for all storm drainage pipe installation whether RCP or PP pipe. Approved backfill soil material, free of any rock material great than two inches or total depth backfill with TDOT No. 67 stone allowed. Approved soil backfill must be at maximum lifts of eight inches compacted to 98% density.
- c.** Where in public or private roadway, if soil backfill is utilized an additional two year maintenance bond is required above the standard one year maintenance bond to assure no settlement or pipe failures occur.
- d.** Pipe bedding for HDPE must be as per manufacturer's requirements. Backfill for HDPE pipe must be free of rocks. Minimum cover above HDPE pipe is two feet.

11. Roadway Drainage Systems

Drainage structures to be constructed within streets and driveways are to be installed prior to construction of the pavement base. Roadway drainage systems must provide adequate capacity so that the spread of water in the roadway:

- a. Be limited so that not more than one traffic lane is inundated in either direction for arterial roadways.
- b. Leave at least one lane free of water in each direction for collectors.
- c. Be limited so as to maintain a minimum of one lane (eight feet total) free of water for local roads.

12. Culverts

The design flow for culverts is based on the following return frequencies:

- a. 100-year, 24-hour for residential collector and commercial road crossings.
- b. 25-year, 24-hour for residential roads and crossings.

13. Drainage Ditches

- a. Through lot drainage ditches must be built to a grade that will provide positive drainage, and in no case may the slope of the ditch be less than 0.5% slope with a preferred slope of 1%.
- b. Stormwater cannot be directed in such a manner that it flows outside of the designated easements or rights of way during a 25-year rainfall event.
- c. If excessive grades or elevations dictate, gutters and downspouts must be directed in a manner to prevent stormwater drainage onto neighboring property at lower elevations.
- d. All drainage ditches must be stabilized to prevent erosion as indicated by the protection shown in the Table 15-1: Erosion Protection.

Table 15-1: Erosion Protection			
Upstream	Seed	Sod	Concrete Lined
18" pipe	Grades less than 3%	Grades 3 to 12%	Grades greater than 12%
21" to 24" pipe	Grades less than 1.5%	Grades 1.5% to 7%	Grades greater than 7%
30" to 36"	Grades less than 1%	Grades 1% to 4%	Grades greater than 4%
42" and greater	Not applicable.	Grade 1% to 2.5%	Grades greater than 2.5%

- e. Ditches that require lining with concrete must be lined to a height above the bottom of the ditch no less than one-half the diameter of the nearest culvert (upstream). However, in no case can the lining extend less than one foot above the bottom of the ditch.
- f. Lined ditches must be constructed of TDOT Class A. Concrete
- g. Ditches that require sodding must be sodded to the top of the slope of the ditch. The sod must consist of a live, dense, well rooted growth of permanent grasses free from Johnson grass and other objectionable grasses, and suitable for the soil in which it is to be placed.