

Appendix B Stormwater Management Design

(Revised 4/30/2020)

This appendix is intended to summarize design requirements for the stormwater management and conveyance features of public and private development projects in the City of Lynchburg. These requirements reflect current Virginia Department of Environmental Quality (DEQ) regulations including Erosion and Sediment Control and Stormwater Management Regulations, Virginia Approved Stormwater BMP Standards and Specifications, and Virginia Department of Transportation (VDOT) regulations.

The City of Lynchburg is responsible for the implementation of an Erosion and Sediment Control Program and a Stormwater Management Program as part of its Municipal Separate Storm Sewer System (MS4) permit. The City is responsible for meeting the requirements of VDOT to ensure funding reimbursement for its road system.

Most requirements are included by reference to statewide regulations with additional City requirements added. This appendix is not intended to replace statewide regulatory documents and alone this appendix is not sufficient to guide designers. The absence of a reference to any DEQ, VDOT or other requirement does not exempt the designer from any such regulation. Alternative design methods may be considered, however such alternatives must be approved in advance by the appropriate approving City authority.

1.0 PLAN APPROVING AUTHORITY

The Stormwater Management Program Administrator or their designee and the Erosion and Sediment Control Program Administrator or their designee shall be responsible for the interpretation of the requirements of the sections of this appendix relating to stormwater plan submittals, stormwater management structures, and Erosion and Sediment Control plans and implementation. The City Engineer shall be responsible for the interpretation of the requirements of the sections of this appendix relating to stormwater conveyance within and from the city right-of-way including but not limited to inlet, culvert, and channel design.

1.1 CITY OF LYNCHBURG CODE

Section 16.1 of the Lynchburg City code details requirements for erosion and sediment control activities in the City of Lynchburg. Section 16.2 of the Lynchburg City code details requirements for stormwater management in the City of Lynchburg. The entire Lynchburg City Code is available on the web at www.lynchburgva.gov under the Quick Index heading: City Code.

It is the policy of the City of Lynchburg that all developed land within the City Limits has adequate stormwater facilities and controls to ensure the protection and safety of life and property. The City may accept stormwater management systems for maintenance if the system provides drainage for streets that have been accepted for maintenance by the City and have been designed and constructed in accordance with the provisions of the Stormwater Management and Erosion & Sediment Control Codes of the City Code (also located on the City of Lynchburg website) and the City's Engineering Division.

1.2 VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY REGULATIONS

Virginia Department of Environmental Quality regulations are available on the web at www.deq.virginia.gov/programs/water/laws.regulations.guidance.aspx. These regulations should be consulted by all designers of real property development in the City of Lynchburg.

2.0 PLAN SUBMITTALS

See **Appendix C – RWS Plan Submittal Procedures**.

2.1 DESIGN INFORMATION SUBMITTAL

All stormwater management and erosion and sediment control features included on development plans submitted to the City of Lynchburg shall be documented in the format prescribed by the Central Virginia Erosion and Sediment Control Committee, which consists of Erosion and Sediment Control and Stormwater Managers, Plan Reviewers, and Inspectors from Amherst, Appomattox, Bedford and Campbell Counties and the City of Lynchburg. This information can be located at <http://www.lynchburgva.gov/zoning-natural-resources>

A summary table documenting the following information for each stormwater BMP installed shall be completed and located on the cover sheet for the plan set:

- A. Type of BMP installed,
- B. Latitude and longitude of BMP,
- C. Acres treated by the BMP,
- D. Pervious and impervious acreage,
- E. 6th order hydrologic unit code,
- F. Name of receiving water body, and
- G. Date BMP was brought on-line.

2.2 ADDITIONAL REQUIREMENTS

Approval of Stormwater Management Plans and Calculations by the City of Lynchburg does not complete the City of Lynchburg review process. All other applicable City Departments, State, and Federal agencies must also approve the plan as warranted. It shall be the sole responsibility of the Owner/Developer/Designer to acquire all applicable approvals.

3.0 HYDROLOGIC ANALYSIS

The purpose of this section is to establish standard procedures and criteria for the performance of hydrologic analyses in the City of Lynchburg.

3.1 VIRGINIA RUNOFF REDUCTION METHOD

Compliance with the water quality design criteria set out in subdivisions A1 and A2 of 9VAC25-870-63 shall be determined by utilizing the Virginia Runoff Reduction Method or another equivalent methodology that is approved by the board. See DEQ's 2013 Virginia Stormwater Management Handbook (Second Edition) for the methodology. Designers wishing to use an alternative design technique shall consult the Stormwater Program Administrator and Stormwater Engineer prior to design.

3.2 RATIONAL METHOD

It is generally recommended that in the Rational Method be used for areas of less than 200 acres. See the DEQ's 2013 Virginia Stormwater Management Handbook, (Second Edition) for methodology. Designers wishing to use an alternative design technique shall consult the Stormwater Program Administrator and Stormwater Engineer prior to design.

4.0 OPEN CHANNEL DESIGN

The purpose of this section is to establish standard procedures and criteria for Open Channel Design for the City of Lynchburg.

4.1 DESIGN FREQUENCIES FOR OPEN CHANNEL DESIGN

Open channels, where allowed, shall be designed for the peak runoff produced by a 10-year frequency storm and analyzed for the 25-year frequency storm, i.e. roadway overtopping, and where applicable, as determined by the Program Administrator and City Engineer, analyzed for the 100-year frequency storm, i.e. adjacent building structures. The designer's calculations shall include the runoff from the property being developed and the runoff from contributing off-site areas, assuming ultimate development in accordance with the current zoning regulations and the **Comprehensive Land Use Plan**. Designs shall include sufficient freeboard to provide for adequate drainage of lateral storm sewers. The drainage system shall be adequate and properties over which the surface waters are conveyed, from the development site to discharge point, shall not be adversely affected.

4.2 OPEN CHANNEL MODIFICATIONS

In those cases where channel modifications are necessary to control increased flow from proposed development, proposed water surface profiles are restricted such that the 100-year flood profile under existing conditions shall not be increased. If the capacity of the existing channel downstream of the project is less than the 100-year design discharge, consideration shall be given for more frequent events to ensure that the severity and frequency of down stream flooding are not increased.

4.3 CHANNEL FLOW VELOCITIES

Excessive flow velocities in open channels can cause erosion and destabilize side slopes, and may pose a threat to safety. Velocities, which are too low, may allow the deposition

of sediment and subsequent channel clogging. Table 4.01 provides desirable average and maximum allowable velocities based on 10-year flow rates.

Table 4.01 Allowable Flow Velocities for Channel Design

Channel Description	Average Velocity (Feet Per Second)	Maximum Velocity (Feet Per Second)
Grass Lined: Predominantly Clay Soils	3.0	5.0
Grass Lined: Predominantly Sand Soils	2.0	4.0
Rip-Rap Lined	5.0	8.0
Concrete Lined	6.0	10.0

4.4 CHANNEL FLOW-LINE SLOPE

Slope of the channel flow-line (invert) is generally governed by topography and the energy head required for flow. Since flow-line slope directly affects channel velocities, channels should have sufficient grade to prevent significant siltation. However, slopes should not be so large as to create erosion problems. In the City of Lynchburg, the minimum recommended longitudinal slope shall be 0.5 percent (0.005). The use of flatter slopes must be approved by the City Engineer. The maximum channel invert slope will be limited by the maximum flow velocities given in Table 4.01. Appropriate channel drop structures may be used to limit channel invert slopes in steep areas.

4.5 CHANNEL SIDE SLOPE

In grass-lined channels, the normal maximum side slope will be 3 horizontal to 1 vertical (3:1), which is the practical limit for mowing equipment. In some areas, local soil conditions may dictate the use of side slopes flatter than 3:1 to ensure slope stability.

4.6 CHANNEL BOTTOM WIDTH

In grass-lined channels, the minimum channel bottom width shall be three (3) feet. In concrete-lined channels, the minimum bottom width shall be two (2) feet.

4.7 CHANNEL EROSION CONTROL

Erosion protection is necessary to insure that channels maintain their capacity and stability and to avoid excessive transport and deposition of eroded material.

All erosion and sediment control measures shall be designed in accordance with the DCR's Virginia Erosion and Sediment Control Law. The Designer is to reference the *Virginia Erosion and Sediment Control Handbook, latest edition*. This manual contains valuable information and tools for developing plans to minimize soil erosion and prevent sedimentation pollution associated with land-disturbing activities.

5.0 PIPE AND CULVERT DESIGN

The purpose of this section is to establish standard procedures and criteria for pipe and culvert design for the City of Lynchburg.

5.1 INTRODUCTION

Private and public drainage culverts and pipes shall be designed for the peak runoff produced by a 10-year storm and analyzed for the 25-year storm event.

The designer's calculations shall include the runoff from the property being developed and the runoff from contributing off-site areas, assuming ultimate development in accordance with the current zoning regulations and the **Comprehensive Land Use Plan**.

5.2 INLET DESIGN

The inlet design procedure shall be as written in the VDOT Drainage Manual, latest revision.

Curb inlets shall be designed for a gutter spread limited to $\frac{1}{2}$ the travel way plus the gutter width or 8 to 10 feet from the face of the curb whichever is less, for a rainfall intensity of 3.5 inches per hour.

All inlets tops shall be labeled to inform the public that the inlet drains to the natural environment. Labeling shall be as specified in Section 02720- *Storm Drainage* of this manual.

5.3 CULVERT DESIGN

Culverts shall be aligned parallel to the longitudinal axis of the channel, as much as possible, to insure maximum hydraulic efficiency and to minimize erosion. In areas where a change in alignment is necessary, the change shall be accomplished upstream of the culvert in the open channel. Appropriate erosion protection shall be provided.

Culverts crossing beneath the roadway shall be designed to span from ditch line to ditch line.

All Culverts are required to have Flared End Sections or Headwall/Endwalls.

The minimum pipe culvert diameter shall be 15 inches to minimize clogging and maintenance for all pipe culverts within City of Lynchburg rights-of-ways and easements.

Pipes in public rights-of-way in the City of Lynchburg shall be reinforced concrete pipe or polypropylene pipe and shall be specified and installed per the City's Manual of Specifications and Standard Details. For culvert installations/designs involving polypropylene pipe smaller than 30-inch, only dual wall polypropylene pipe is allowed for culvert applications within the right of way. For culvert installations/designs involving polypropylene pipe 30-inch and larger, only triple wall PP is allowed within the right of way and immediately adjacent to the right of way for a distance of 50 feet.

The City of Lynchburg uses the design procedures of FHWA *HEC-5* for the design of pipe culverts. The *HEC-5* procedure uses nomographs and requires analysis for both inlet and outlet control.

5.4 PIPED SYSTEMS DESIGN

The minimum pipe diameter shall be 18 inches to minimize clogging and maintenance for all pipes within City of Lynchburg rights-of-ways.

Pipes in public rights-of-way in the City of Lynchburg shall be reinforced concrete pipe or

polypropylene pipe and shall be specified and installed per the City's Manual of Specifications and Standard Details.

5.5 EROSION CONTROL

Inlet and/or outlet protection is necessary to insure those channels upstream and downstream of pipe culverts maintain stability and to avoid excessive transport and deposition of eroded material.

All erosion and sediment control measures shall be designed in accordance with the DEQ's Virginia Erosion and Sediment Control Law. The Designer is to reference the *Virginia Erosion and Sediment Control Handbook, latest edition*. This manual contains valuable information and tools for developing plans to minimize soil erosion and prevent sedimentation pollution associated with land-disturbing activities.

6.0 STORMWATER BEST MANAGEMENT PRACTICES (BMPs)

The purpose of this section is to establish standard procedures and criteria for stormwater Best Management Practices (BMPs) design for the City of Lynchburg.

All regulated land-disturbing activities must meet either the new water quality design requirements as of July 1, 2014 (Part IIB) or the old technical criteria requirements (Part IIC) of the Virginia Stormwater Management Program (VSMP) Regulation (9VAC25-870). This regulation requires manufactured treatment devices (MTDs) that are used to meet the new water quality design requirements (Part IIB) be approved by the Department of Environmental Quality (DEQ). The MTD and the assigned pollutant removal efficiency will be listed on the Virginia Stormwater BMP Clearinghouse website. For MTDs that are used to meet the old technical criteria (Part IIC), the regulation allows the use of the MTDs listed in the 1999 Virginia Stormwater Management Handbook as well as other MTDs listed on the Virginia Stormwater BMP Clearinghouse website. In addition, under Part IIC, a local program administrator or DEQ may allow for the use of MTDs (innovative or alternate BMP).

All BMPs shall be designed in accordance with the approved BMP Standards and Specifications. The design shall include only MTDs listed as approved by DEQ on the Virginia Stormwater BMP Clearinghouse website.

7.0 RESPONSIBILITY

7.1 LIMITS OF PUBLIC OWNERSHIP AND MAINTENANCE RESPONSIBILITY

The City of Lynchburg assumes no liability or responsibility for adjudicating disputes between property owners regarding non-publicly generated storm water.

The following components of the drainage infrastructure will **not** be maintained by the City of Lynchburg:

- A. Drainage systems on private property that do not have dedicated easements.
- B. Drainage systems maintained by VDOT as part of its State highway system.
- C. **Detention/Retention/Water Quality Pond Areas:** The City will not accept these areas for maintenance; however, the City reserves the right to enter these areas and remove any debris a blockage that is adversely affecting the City's drainage system. This will be done in an emergency situation without notice. Under normal conditions, the City will contact the owner/developer to have said blockages removed. If unable to do so within a reasonable time, the City reserves the right to charge the owner/developer for any expense incurred by the City in doing so. For additional regulations/requirements regarding detention/retention ponds, see Section 16.2 of the City Code.
- D. Natural ditches, streams, creeks and rivers except to remove debris/blockages that are adversely affecting the City's drainage system.

7.2 LIMITATION OF CONSEQUENTIAL DAMAGE TO PRIVATE FACILITIES LOCATED ON PUBLIC EASEMENTS

All public stormwater easements shall be a minimum of 20 feet in width, except where pipes exceed 36 inches in diameter and/or exceed 8 feet in depth, an additional 10 feet of easement width may be required. The City reserves the right to require larger easements on a case by case basis. All public easements including storm sewer is to remain clear of obstructions. No buildings, fences, trees, shrubs or other obstructions shall be placed in any easement. Driveways, walkways, asphalt and parking lots may be permitted in easements; however, the City reserves the right to remove such asphalt, concrete, base course and sod as necessary to access its facility in the case of emergency. Pavement or concrete will be replaced with a patch. Sod will be replaced with Fescue or rye seeding. The City will not be responsible for replacing a property owners sod after repairing a drainage line.