CHAPTER 9

STORMWATER MANAGEMENT PLAN REQUIREMENTS

9.1 INTRODUCTION

The Virginia Stormwater Management Program (VSMP) Act and Regulations require that Henrico County adopt a local program to administer the requirements. The requirements are addressed in a stormwater management plan that is required for certain regulated land-disturbing activities and applies the technical criteria to address all sources of surface runoff, as well as subsurface and groundwater flows that will be converted to surface runoff.

9.2 APPLICABLITY

In accordance with Sec. 10-35 of the Henrico County Code, the requirements of this chapter apply to all VSMP land-disturbing activities and Chesapeake Bay Preservation Act (CBPA) land-disturbing activities. For help determining the land disturbance activity type, please refer to Chapter 3 of this Manual.

The requirements of this chapter for construction on single-family residential lots may be addressed by submittal of an Agreement in Lieu of a SWM plan (see Appendix J).

9.3 STORMWATER TECHNICAL CRITERIA

Stormwater management (SWM) plans for VSMP land-disturbing and CBPA land-disturbing activities (including linear development projects that are either VSMP land-disturbing or CBPA land-disturbing activities) must be developed to address the criteria in the following sections. *Please note that grandfathered projects or projects that have obtained initial GCP coverage prior to July 1, 2014 may be developed in accordance with the Technical Criteria in Chapter 14 in lieu of the criteria found in Sections 9.3.2, 9.3.3, 9.3.4, and 9.3.5.*

9.3.1 GENERAL CRITERIA

Projects which will be submitted in phases (Section A, Section B, etc.) must address stormwater quality and quantity (where applicable) for the entire development as part of the first phase submittal. SWM facility calculations, location(s), and design option(s) must be identified on an overall development plan and approved by the Department of Public Works prior to any phase plan approval.

When calculating pre-development runoff, all pervious lands on the site must be considered to be in good hydrologic condition in accordance with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) standards, regardless of the existing conditions at the time the calculations are performed.

Pre- and post-development site conditions and hydrology must be verified by site inspections, topographic surveys, available soil mapping or studies, and calculations consistent with good engineering practices.

All hydrologic analyses must be based on the ultimate development condition of the upstream drainage area (in accordance with the Planning Department's Comprehensive Land Use Plan) and the ultimate development condition of the proposed project.

Proposed residential, commercial, or industrial subdivisions shall apply these stormwater management criteria to the development as a whole. Individual lots in new subdivisions shall not be considered separate development projects, but rather the entire subdivision shall be considered a single development project.

SWM plans for proposed residential subdivisions may not include SWM facilities on individual lots or that treat runoff solely from individual lots. The SWM facilities must also be designed and installed/constructed as part of the subdivision plan along with the roads, utilities and other improvements.

In residential subdivisions, all areas that are not contained in required environmental buffers (RPA, SPA) or jurisdictional wetlands to remain must be considered either impervious area or managed turf.

Hydrologic parameters shall reflect the ultimate development and shall be used in all engineering calculations.

9.3.2 STORMWATER QUALITY CRITERIA

In order to protect the quality of state waters and to control the discharges of stormwater pollutants from VSMP land-disturbing activities and CBPA land-disturbing activities, the following standards must be met. The applicable standard depends on whether or not the development project occurs on an undeveloped site or a prior developed site. In either case, the stormwater quality design criteria must be addressed for the entire site unless a site drains to more than one 6th Order Hydrologic Unit Code (HUC). In that case, the stormwater quality design criteria must be applied independently to each HUC and compliance must be demonstrated on a HUC basis.

NEW DEVELOPMENT

The total phosphorus load for new development projects cannot exceed 0.41 pounds per acre per year. Loadings associated with new development projects must be calculated using the Virginia Runoff Reduction Method New Development worksheet.

DEVELOPMENT ON PRIOR DEVELOPED LANDS

1. For VSMP land-disturbing activities and CBPA land-disturbing activities disturbing greater than or equal to one acre that result in no net increase in impervious cover from the predevelopment condition, the total phosphorus load shall be reduced at least 20% below the predevelopment total phosphorus load.
2. For VSMP land-disturbing activities and CBPA land-disturbing activities disturbing less than one acre that result in no net increase in impervious cover from the predevelopment condition, the total phosphorus load shall be reduced at least 10% below the predevelopment total phosphorus load.
3. For VSMP land-disturbing activities and CBPA land-disturbing activities that result in a net increase in impervious cover over the predevelopment condition, the design criteria for new development shall be applied to the increased impervious area. Depending on the area of disturbance, the 10% or 20% reduction criteria of items 1 or 2 shall be applied to the remainder of the site.
4. The total phosphorus load for a linear development project occurring on prior developed lands must be reduced 20% below the pre-development total phosphorus load.
5. In no case shall the total phosphorus load be required to be reduced to below the applicable standard for new development.

Loadings for development of prior developed lands must be calculated using the Virginia Runoff Reduction Method Redevelopment worksheet.

The Virginia Runoff Reduction Method spreadsheets can be found at: http://www.deq.virginia.gov/Programs/Water/Laws,Regulations,Guidance/Guidance/StormwaterManagementGuidance.aspx

9.3.3 STORMWATER QUALITY COMPLIANCE

Compliance with the stormwater quality design criteria set forth in this chapter must be demonstrated in accordance with the following:

A. Virginia Runoff Reduction Method

The Virginia Runoff Reduction Method must be used to evaluate proposed site conditions and to calculate pollutant loadings generated by the site. This method

must also be used to evaluate proposed SWM facilities to demonstrate compliance with pollutant load reduction requirements.

B. Stormwater Management Facilities

The SWM facilities described in Section 9.4 have been approved by the State for use as necessary to reduce the phosphorus load and runoff volume in accordance with the Virginia Runoff Reduction Method. Additional County-specific design requirements for these SWM facilities are also included in that section.

C. OFF-SITE COMPLIANCE

The following off-site methods may be used in certain situations to demonstrate compliance with the required pollutant load reductions:

1) Nutrient offsets generated in accordance with Section 62.1-44.15:35 of the Code of Virginia;
2) Any other off-site options approved by a state agency or board; and
3) Off-site stormwater management facilities on properties owned by the Operator and located in the same HUC or an HUC located upstream from the land disturbing activity or within the same watershed as the land disturbing activity.

However, off-site options are not allowed:

a. Unless the off-site option achieves the necessary nutrient reductions before the Operator's land disturbing activity begins. (For phased projects, the Operator may acquire or achieve the off-site nutrient reductions prior to the commencement of each phase of the project.) or
b. In contravention of local water quality-based limitations at the point of discharge that are:

   i. consistent with the determinations made pursuant to subsection B of §62.1-44.19:7 of the Code of Virginia,
   ii. contained in a municipal separate storm sewer system (MS4), **OR**
   iii. as otherwise may be established or approved by the Virginia Soil and Water Conservation Board.

Additionally, nutrient offsets or other off-site options approved by a state agency or board can only be used under any of the following conditions:

a. The project results in less than five acres of land disturbance,
b. The post-construction phosphorus nutrient reduction requirement is less than 10 pounds per year; **OR**
c. At least 75% of the required phosphorus nutrient reduction requirement is achieved on-site. If at least 75% of the required phosphorus nutrient reduction requirement cannot be met on-site, the Operator may use off-site compliance (in whole or in part) provided the Operator can adequately demonstrate that:

   i. Alternative site designs have been considered that may accommodate on-site best management practices,
   ii. On-site best management practices have been considered in alternative site designs to the maximum extent practicable,
   iii. Appropriate on-site best management practices will be implemented, **AND**
   iv. Full compliance with post-development non-point nutrient runoff compliance requirements cannot be practicably met on-site.

9.3.4 CHANNEL PROTECTION CRITERIA

Concentrated stormwater flows that (i) contain runoff from the land-disturbing activity, (ii) are created as a result of the land-disturbing activity, or (iii) are increased as a result of the land-disturbing activity must be released into a stormwater conveyance system and must meet the applicable channel protection criteria of this section. The applicable criteria depend on the type of conveyance system or systems (manmade, restored, and/or natural) that are downstream from the project within the required limits of analysis. Unless compliance with the energy balance criteria associated with natural stormwater conveyance systems is demonstrated, the limits of analysis below each point of discharge must extend to a point where either:

a. The site's contributing drainage area is less than or equal to 1.0% of the total watershed area; **OR**
b. The site's peak flow rate from the one-year 24-hour storm is less than or equal to 1.0% of the existing peak flow rate from the one-year 24 hour storm prior to the implementation of any stormwater quantity control measures.

Please note that if a natural stormwater conveyance system exists within the limits of analysis listed above, compliance with the energy balance criteria is required.

Compliance with these standards must be addressed at each point of discharge and is deemed to satisfy the requirements of Minimum Standard 19 of the Virginia Erosion and Sediment Control Regulations.

A. DISCHARGES TO MANMADE STORMWATER CONVEYANCE SYSTEMS

A manmade stormwater conveyance system is a pipe, ditch, vegetated swale, or other stormwater conveyance system constructed by man, except for restored stormwater conveyance systems. Discharges to manmade stormwater conveyance systems must:

a. Convey the post-development peak flow rate from the two-year 24-hour storm event without causing erosion of the system ($V_{2\ post}$ must be non-erosive). The entire stormwater conveyance system must be analyzed until it reaches the limits of analysis, and the supporting drainage calculations must be included in the plans. The information from the most restrictive portion of the conveyance system must be included in the Criteria A portion of the Channel Protection Compliance Summary Table found on the Henrico County standard sheet entitled "Erosion and Sediment Control – Standard Details/Calcs." Stormwater detention or downstream improvements may be incorporated into the SWM plan to meet this criterion*;* **OR**
b. Satisfy the peak discharge requirements for discharges to natural stormwater conveyance systems (Energy Balance).

B. DISCHARGES TO RESTORED STORMWATER CONVEYANCE SYSTEMS

A restored stormwater conveyance system is a stormwater conveyance that has been designed and constructed using natural channel design concepts. Restored stormwater conveyance systems include the main channel and the flood-prone areas adjacent to the main channel. Discharges to restored stormwater conveyance systems must:

a. Be consistent (in combination with other stormwater runoff) with the design parameters of the restored stormwater conveyance that is functioning in accordance with the design objectives; **OR**
b. Satisfy the peak discharge requirements for discharges to natural stormwater conveyance systems (Energy Balance).

C. DISCHARGES TO NATURAL STORMWATER CONVEYANCE SYSTEMS

A natural stormwater conveyance system is the main channel of a natural stream and the flood-prone area adjacent to the main channel. Discharges to natural stormwater conveyance systems must satisfy the following Energy Balance requirements for the peak flow rate and volume from the one-year 24-hour storm:

$$(Q_{developed} \times RV_{developed}) \leq IF \times (Q_{pre\text{-}developed} \times RV_{pre\text{-}developed})$$

where:

IF (Improvement Factor) = 0.8 for sites >1 acre
0.9 for sites ≤ 1 acre

$Q_{developed}$ = the allowable peak flow rate of runoff from the developed site.

$RV_{developed}$ = the volume of runoff from the site based on developed conditions

$Q_{pre\text{-}developed}$ = the peak flow rate based on pre-developed conditions

$RV_{pre\text{-}developed}$ = the volume of runoff based on pre-developed conditions

Please note that $Q_{developed}$ cannot be greater than $Q_{pre\text{-}developed}$, nor can $Q_{developed}$ be required to be less than $(Q_{forest}*RV_{forest})/RV_{developed}$ where:

Q_{forest} = the peak flow rate from the site based on forested conditions

RV_{forest} = the volume of runoff based on forested conditions

9.3.5 FLOOD PROTECTION CRITERIA

Concentrated stormwater flows must meet the applicable flood protection criteria of this section. The applicable criteria depend on whether or not localized flooding exists downstream from the project within the required limits of analysis.

Unless the post-development flow rate from the 10-year 24-hour storm is less than the pre-development peak flow rate from the 10-year 24 hour storm event, the limits of analysis below each point of discharge must extend to a point where either:

a. The site's contributing drainage area is less than or equal to 1.0% of the total watershed area;
b. The site's peak flow rate from the 10-year 24-hour storm is less than or equal to 1.0% of the existing peak flow rate from the 10-year 24 hour storm prior to the implementation of any stormwater quantity control measures; **OR**
c. The stormwater conveyance system enters a mapped floodplain, the RPA, the SPA, or any other dedicated riparian buffer. Each of these features must be shown to contain the 10-year storm. Other dedicated riparian buffers (not RPA or SPA) must extend downstream and connect to a floodplain, RPA, or SPA.

Concentrated stormwater flows to stormwater conveyance systems that do not currently experience localized flooding during the 10-year 24-hour storm event must be confined to the stormwater conveyance system. Stormwater detention or downstream channel improvements may be incorporated into the project to meet this criterion.

Concentrated stormwater flows to stormwater conveyance systems that currently experience localized flooding during the 10-year 24-hour storm event must either:

a. be confined within the stormwater conveyance system to avoid localized flooding. The entire stormwater conveyance system must be analyzed until it reaches the limits of analysis, and the supporting drainage calculations must be included in the plans. The information from the most restrictive portion of the conveyance system must be included in the Criteria A portion of the Flood Protection Compliance Summary Table found on the Henrico County standard sheet entitled "Erosion and Sediment Control – Standard Details/Calcs." Detention or downstream channel improvements may be incorporated into the project to meet this criterion; **OR**
b. be released at a rate that is less than the pre-development peak flow rate from the 10-year 24 hour storm event.

9.3.6 50/10 DETENTION CRITERIA

Stormwater detention facility needs were initially identified during the late 1970's as a part of a comprehensive county-wide stormwater drainage study. Stormwater detention facilities are required to be provided as a part of plans of development in those watersheds where downstream flooding problems are known to occur or if existing homes are located within the 50-year flood plain. These detention facilities must be designed so that the post-developed peak flow from the site for the 50-year storm does not exceed the pre-developed peak flow rate for the 10-year storm.

These standards apply to the watersheds identified on Map 9-1 at the end of this chapter. However, the standards do not apply to (i) subdivisions or plans of development for single-family, detached residential structures, (ii) where it is demonstrated that there are no existing homes located within the 50-year floodplain downstream of the proposed development, or (iii) linear development projects.

9.3.7 INCREASED VOLUMES OF SHEET FLOW

Increased volumes of sheet flow resulting from the land-disturbing activity must be identified and evaluated for potential impacts to downstream properties or resources. Increased sheet flow volumes that will cause or contribute to erosion, sedimentation, and/or flooding of downstream properties or resources, as determined by the Administrator, must be diverted to a stormwater management facility or stormwater conveyance channel that conveys the runoff without causing erosion, sedimentation, or flooding. If all runoff from a point of discharge is converted to sheet flow by using the ***Sheetflow to Vegetated Filter or Conserved Open Space*** practice identified in

Section 9.4.2 of this Manual and the conditions of this section are met for that point of discharge, no further water quantity controls are required at that point of discharge.

9.3.8 DESIGN STORMS AND HYDROLOGIC METHODS

Unless otherwise specified, the prescribed design storms are the 1-year, 2-year, and 10-year 24-hour storms using the site specific rainfall precipitation frequency data recommended by the U.S. National Oceanic and Atmospheric Administration (NOAA) Atlas 14. Partial duration time series shall be used for the precipitation data.

The U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) synthetic 24-hour rainfall distribution and models must be used to conduct the hydrologic analyses. These include, but are not limited to TR-55 and TR-20, hydrologic and hydraulic methods developed by the U.S. Army Corps of Engineers, or other standard hydrologic and hydraulic methods.

The Rational Method may be used to evaluate peak discharges for drainage areas of 200 acres or less.

The Modified Rational Method may be used for evaluating volumetric flows to stormwater conveyances for drainage areas of 200 acres or less.

9.4 STORMWATER MANAGEMENT FACILITIES

The SWM facilities listed in Table 9.1 are approved for use to address stormwater quality, stormwater quantity, and 50/10 detention requirements described above.

The design, construction, and maintenance of these SWM facilities are governed by the design specifications, specific standards and limitations referenced in the following sections as well as the site constraints in Table 9.2 and the additional design criteria included in Table 9.3. Review checklists have been developed for each SWM facility type that will be used during the review of the SWM plan. Please note that the checklists only identify the information and details that must be included in the SWM plan.

Other approved SWM facilities may be found on the Virginia Stormwater BMP Clearinghouse Website at https://www.swbmp.vwrrc.vt.edu/. SWM facilities that are not listed on the BMP Clearinghouse website must be reviewed and approved by the Director of DEQ in accordance with procedures established by DEQ.

TABLE 9.1 – APPROVED SWM FACILITIES

SWM Facility Designation	SWM Facility Type	DEQ Spec. #	Stormwater Application		
			Quality	Quantity	50/10
100	Rooftop Disconnection	1	✓	✓	
105	Sheetflow to Conserved Open Space 1	2	✓	✓	
106	Sheetflow to Conserved Open Space 2		✓	✓	
110	Grass Channel	3	✓	✓	
120	Soil Amendments	4	✓	✓	
125	Vegetated Roof 1	5	✓	✓	
126	Vegetated Roof 2		✓	✓	
130	Rainwater Harvesting	6	✓	✓	
135	Permeable Pavement 1	7	✓	✓	
136	Permeable Pavement 2		✓	✓	
140	Infiltration 1	8	✓	✓	
141	Infiltration 2		✓	✓	
145	Bioretention 1	9	✓	✓	
146	Bioretention 2		✓	✓	
147	Urban Bioretention		✓	✓	
150	Dry Swale 1	10	✓	✓	
151	Dry Swale 2		✓	✓	
155	Wet Swale 1	11	✓		
156	Wet Swale 2		✓		
160	Filtering Practice 1	12	✓		
161	Filtering Practice 2		✓		
165	Constructed Wetland 1	13	✓	✸	✸
166	Constructed Wetland 2		✓		
170	Wet Pond 1	14	✓	✸	✸
171	Wet Pond 2		✓	✸	✸
175	Extended Detention Pond 1	15	✓	✸	✸
176	Extended Detention Pond 2		✓	✸	✸
177	Dry Detention - Pond			✸	✓
178	Dry Detention - Underground			✸	✓

✸ *Can be addressed with additional design modifications*

TABLE 9.2 – SITE CONSTRAINTS APPLICABLE TO ALL SWM FACILITIES	
Site Constraint Number	Site Constraints
1	SWM facilities must meet minimum front yard setback requirements from the public right of way. The setback for the SWM facility is measured as the distance from the highest continuous contour elevation inside the SWM facility to the ultimate right of way line. These setbacks are identified below: a. Residential Zoned Districts (all "R" Districts including A-1) - The SWM facility must honor the setback specified for the primary dwelling. b. Non-residential Zoned Districts - The SWM facility must honor a minimum setback of 25 feet from the ultimate right of way.
2	A distance equivalent to the rear yard setback in residential development must be provided from the rear of the buildable area to the highest continuous contour elevation inside the SWM facility.
3	SWM facilities must be located outside all transitional or proffered buffer areas or planting strip easements.
4	Regional wet ponds and existing ponds are not allowed in residential developments unless the following conditions are met: a. The pond must be located in a common area, b. There must be a minimum of 50 feet between any buildable area and the normal pool elevation of the pond, c. All access and easement requirements must be met, d. The pond must be an amenity for the entire subdivision, and In order to use an existing wet pond as a SWM facility: 1. The pond must meet the design criteria included in Minimum Design Standard 14.05, and 2. A letter from the U.S. Army Corps of Engineers must be submitted stating the pond can be maintained as a BMP and that either a permit would not be required or a permit would be issued for such maintenance activity.
5	SWM facilities cannot be located within the 100' RPA buffer or the SPA buffer unless an exception has been granted.
6	SWM facilities may be located within the 100-year floodplain, however, they must be located outside the 25-year floodplain.
7	SWM facilities in a proposed residential subdivision shall be located in common area controlled and maintained by a homeowners association. The highest continuous contour on the inside of the SWM facility must be a minimum of 20 feet from the side of any principal structure.
8	SWM facilities are not allowed within the public right of way limits unless specifically approved by the Director of Public Works.
9	The Director of Public Works reserves the right to deny approval of any SWM facility in a single family residential development which is deemed to be a potential nuisance or hazard.

TABLE 9.2 (Continued)
SITE CONSTRAINTS APPLICABLE TO ALL SWM FACILITIES

Site Constraint Number	Site Constraints
10	There must be a minimum of 50 feet between the buildable area of any single-family residential structure and the highest normal pool elevation of any pond used as a SWM facility.
11	There must be a minimum of 100 feet between any well and the normal pool elevation of any SWM facility.
12	The SWM facility must be located as follows: • The highest continuous contour on the inside of the SWM facility must be located at least 25' from the ultimate right-of-way in the side yard in residential development. • The SWM facility must be located outside of all transitional or proffered buffer areas or planting strip easements. • The SWM facility must be located to the rear of all single-family residential units, not located on any lot(s), and in common area that is controlled and maintained by a Homeowners Association.
13	Underground detention is not allowed in single-family residential subdivisions.

TABLE 9.3 – ADDITIONAL DESIGN CRITERIA APPLICABLE TO ALL SWM FACILITIES

Additional Design Criteria Number	Additional Design Criteria
1	SWM facilities that are visible from the right-of-way must be effectively screened from the public right-of-way or less intense uses of adjacent properties. Examples of acceptable screening include fencing, landscaping, or a combination of these features.
2	For development incorporating an existing SWM facility, the engineer must certify that the facility is in good working order and meets the current design criteria. Supporting calculations and information necessary to verify this information must be submitted as part of the plan review package.
3	The treatment volume (T_v) of any SWM facility may not be stored in any County maintained easements or rights-of-way. It is recommended that privately maintained systems consider using O-ring pipe in situations where the storm sewer will be temporarily inundated. O-ring pipe must be installed on non-County maintained storm sewer systems that will permanently hold the T_v.
4	Access easements for SWM facilities shall be provided to the County that adequately contain the 10-year ponding level (plus six inches of freeboard), embankment, outlet structures, and an appropriate width (minimum 12 feet) of maintenance area around the 10-year ponding area that permits access to the dam, outlet structures, and embankments.

TABLE 9.3 (Continued)
ADDITIONAL DESIGN CRITERIA APPLICABLE TO ALL SWM FACILITIES

Additional Design Criteria Number	Additional Design Criteria
5	SWM facilities must be designed to provide the following for adequate access for maintenance activities: • An access area at least 20 feet in width must be provided to the SWM facility from a public road. • An access area 20 feet in width must be provided around the SWM facility that encompasses the highest continuous contour within the SWM facility, embankment, principal spillway outlet, emergency spillway and exit channel. • The access areas must either be in common area or located completely on an individual lot. • The access areas cannot contain any obstacles, or vegetation that would prevent access of maintenance equipment. • The access areas shall not exceed a grade or cross-slope of 12:1. • The access area to the SWM facility must be constructed of load bearing materials. • The access area must provide sufficient turn-around area.
6	The access areas identified above must be in an easement that provides access to the County for SWM facilities located in single-family residential developments.
7	Prior to final acceptance, the County will determine whether the SWM facility has been built in accordance with the approved plans. If discrepancies between the design and the record drawing exist, they must be addressed before the ESC bond is released and the GCP is terminated. If these discrepancies cannot be corrected in accordance with the approved plan, a revised plan may be required.
8	The SWM facility must contain any features necessary to eliminate safety concerns for the public. For example, guardrail may be required due to the proximity of the BMP to vehicular traffic.
9	Fountains are required for all permanent pools deeper than 3 feet.
10	The minimum allowable top width for any embankment is 12 feet unless a greater width is required by the Virginia Dam Safety Regulations.
11	4:1 or flatter side slopes are required for all permanent pools.
12	Compliance with the Dam Safety Regulations must be demonstrated, where applicable.
13	For embankments greater than 3 feet in height, a geotechnical certification must be submitted in accordance with Section 3-14 of the Henrico County Design Manual stating that construction compaction requirements have been achieved. This must be submitted as part of the SWM facility record drawing prior to Environmental Compliance Bond release.

TABLE 9.3 (Continued)
ADDITIONAL DESIGN CRITERIA APPLICABLE TO ALL SWM FACILITIES

Additional Design Criteria Number	Additional Design Criteria
14	All County maintained SWM facilities must have outlet structures constructed of reinforced concrete pipe (RCP), Class III or better, with a minimum diameter of 15 inches.
15	Self-cleaning trash racks are required for all outlet structures, including dewatering orifices. Trash racks may have flat tops if the top of the rack is above the 100-year storm elevation.
16	To minimize clogging, an orifice plate is required for all outlet control structures that are 3 inches in diameter or smaller.
17	The 10-year post-development flow must be passed by the principal outlet structure and contained within the SWM facility.
18	The 100-year post-development flow must be contained within the basin and passed through the principal and/or emergency outlet structure.
19	Emergency spillway side slopes can be no steeper than 3:1
20	At least 6 inches of freeboard is required between the 10-year storm elevation and the emergency spillway elevation.
21	Forebays are required at each incoming storm sewer discharge point and must be constructed as a separate cell.
22	All forebays with permanent pools deeper than 18 inches must be equipped with a 5' wide aquatic bench around the perimeter, ranging in depth from 0" at the water's edge to 6" deep at the deepest point of the aquatic bench.
23	Landscaping of the basin slopes that requires mulching, spraying, etc. must be limited to areas above the elevation of the top of the principal outlet structure elevation and must be done in a manner that does not inhibit maintenance access.
24	The perimeter of all permanent pool areas deeper than 18 inches must be surrounded by an aquatic bench (below the permanent water surface elevation) that is: • 10 feet wide if the permanent pool is less than 10 feet deep. • 20 feet wide if the permanent pool is 10 feet or more deep.
25	The perimeter of all pool areas deeper than 18 inches must be surrounded by a safety bench (above the permanent water surface elevation) that is at least 8 feet wide and is no steeper than 20:1. Safety benches are not required if the side slopes are 5:1 or flatter.
26	Water quality perforations (dewatering orifices) must be evenly spaced.
27	Wire mesh and #3 stone (or larger) must be placed in front of the water quality perforations.

9.4.1 ROOFTOP DISCONNECT

This strategy involves managing runoff close to its source by intercepting, infiltrating, filtering, treating or reusing it as it moves from the impervious surface to the drainage system. Two kinds of disconnection are allowed: (1) simple disconnection, whereby rooftops and/or on-lot residential impervious surfaces are directed to pervious areas, and (2) disconnection leading to an alternative runoff reduction practice(s) adjacent to the roof.

Practice Type	Design Specification
100	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%201_DISCONNECTION_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2	
None	None	
Total Phosphorus Load Removal (%)	**Type A/B Soils**	**Type C/D Soils**
	50	25

9.4.2 SHEETFLOW TO CONSERVED OPEN SPACE

This practice involves introducing runoff as sheet flow into conserved open space or vegetated filter strips, which slows runoff velocities and allows sediment and attached pollutants to settle and/or be filtered by the vegetation. Although two design variants are specified in the VA BMP Clearinghouse (filter strip or conserved open space), use of this practice in Henrico County must incorporate conserved open space. Stormwater must enter the conserved open space as sheet flow. If the inflow is from a pipe or channel, an engineered level spreader must be designed in accordance with the criteria contained herein to convert the concentrated flow to sheet flow.

Practice Types	Design Specification
105 (Level 1) 106 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%202_SHEET%20FLOW_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• As allowed by the BMP Clearinghouse, all level spreaders must be designed in accordance with Minimum Standard 14.01, which is identified as an alternate approach. • To avoid erosion, sedimentation, and/or flooding of downstream properties or resources, a Resource Protection Area, a Stream Protection Area, a floodplain and/or other conserved open space area contiguous to surface water must exist immediately below the level spreader or filter strip. • In accordance with the Virginia BMP Clearinghouse, the "other" Conserved Open Space (COS) listed above must be protected by a perpetual easement or deed restriction that identifies the *responsible party* and ensures that no future development, disturbance, or clearing may occur within the area. **Criteria for Discharges to "Other" COS** • The *responsible party* to which the perpetual easement or deed restriction is dedicated must be a third party (not Henrico County) that has no interest in the property other than enforcing the easement/deed restriction and preserving the COS. • The COS must be recorded, enforceable by the identified third party, and preserved in perpetuity. • The COS must, at a minimum, contain the 10-year storm limits (the 10-year storm limits must be delineated on the plat, as well as the construction plans) between the outfall (level spreader) and the existing COS (RPA, SPA, 100-year floodplain). • A long-term vegetation management plan must be prepared to maintain the COS in a natural vegetative condition as detailed in the Virginia BMP Clearinghouse. • The COS may contain jurisdictional wetlands if they are protected in such a manner that they are preserved in perpetuity.	• If used as a SWM facility to address stormwater quality and/or quality, level spreaders must be located in common area (not located on individual residential lots). • In residential subdivisions, all level spreaders used as an outfall device (not a SWM facility to address stormwater quality and/or quantity requirements) must be located beyond the rear of the buildable area.

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	75	50
	2	50	50

9.4.3 GRASS CHANNEL

Grass channels can provide a modest amount of runoff filtering and volume attenuation within the stormwater conveyance system resulting in the delivery of less runoff and pollutants than a traditional system of curb and gutter, storm drain inlets and pipes. The performance of grass channels will vary depending on the underlying soil permeability. Grass channels, however, are not capable of providing the same stormwater functions as dry swales as they lack the storage volume associated with the engineered soil media (see Practice Type 120). Their runoff reduction performance can be boosted when compost amendments are added to the bottom of the swale (see Practice Types 150 and 151). Grass channels can also be used to treat runoff from the managed turf areas of turf-intensive land uses, such as sports fields and golf courses, and drainage areas with combined impervious and turf cover (e.g., roads and yards).

Practice Type	**Design Specification**
110	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%203_GRASS%20CHANNELS_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	**Site Constraints in addition to those listed Table 9.2**
None	None

Total Phosphorus Load Removal (%)	**Type A/B Soils**	**Type C/D Soils**
	32	24

9.4.4 SOIL AMENDMENTS

Soil amendment provides enhancement to simple rooftop disconnections, filter strips, and grassed channels that is applied after construction to deeply till compacted soils and restore their porosity by amending them with compost. These soil amendments can reduce the generation of runoff from compacted urban lawns and may also be used to enhance the runoff reduction performance of downspout disconnections, grass channels, and filter strips.

Practice Types	**Design Specification**
120	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%204_SOIL%20AMENDMENT_Final%20Draft_v1-8_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	**Site Constraints in addition to those listed Table 9.2**
None	None

Total Phosphorus Load Removal (%)	**BMP Where Applied**	**Type A/B Soils**	**Type C/D Soils**
	Simple Rooftop Disconnection	See VRRM for benefit	See VRRM for benefit
	Filter Strip	See VRRM for benefit	See VRRM for benefit
	Grass Channel	See VRRM for benefit	See VRRM for benefit

9.4.5 VEGETATED ROOF

Vegetated roofs (also known as green roofs) are alternative roof surfaces that typically consist of waterproofing and drainage materials and an engineered growing media that is designed to support plant growth. Vegetated roofs capture and temporarily store stormwater runoff in the growing media before it is conveyed into the storm drain system. A portion of the captured stormwater evaporates or is taken up by plants, which helps reduce runoff volumes, peak runoff rates, and pollutant loads on development sites.

Practice Types	Design Specification
125 (Level 1) 126 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%205_VEGETATED%20ROOF_Final%20Draft_v2-3_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• Structural details must be approved by the Building Inspections Department.	None

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	45	45
	2	60	60

9.4.6 RAINWATER HARVESTING

Rainwater harvesting systems intercept, divert, store, and release rainfall for future use. Rainwater that falls on a rooftop is collected and conveyed into an above- or below-ground storage tank where it can be used for non-potable water uses and on-site stormwater disposal/infiltration. Non-potable uses may include flushing of toilets and urinals inside buildings, landscape irrigation, exterior washing (e.g. car washes, building facades, sidewalks, street sweepers, fire trucks, etc.), fire suppression (sprinkler) systems, supply for chilled water cooling towers, replenishing and operation of water features and water fountains, and laundry.

Practice Type	Design Specification
130	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%206_RAINWATER%20HARVESTING_Final%20Draft_v1-9-5_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• Any plumbing uses must be approved by the Building Inspections Department	• All underground structures must be located at least 10 feet from any building foundation.

Total Phosphorus Load Removal (%)	Type A/B Soils	Type C/D Soils
	Up to 90*	Up to 90*

**Credit is variable and determined using the Cistern Design Spreadsheet. Credit up to 90% is possible if all water from storms with rainfall of 1 inch or less is used through demand, and the tank is sized such that no overflow from this size event occurs. The total credit may not exceed 90%.*

9.4.7 PERMEABLE PAVEMENT

Permeable pavements are alternative paving surfaces that allow stormwater runoff to filter through voids in the pavement surface into an underlying stone reservoir, where it is temporarily stored and/or infiltrated. A variety of permeable pavement surfaces are available, including pervious concrete, porous asphalt and permeable interlocking concrete pavers. While the specific design may vary, all permeable pavements have a similar structure, consisting of a surface pavement layer, an underlying stone aggregate reservoir layer and a filter layer or fabric installed on the bottom.

Practice Types	Design Specification
135 (Level 1) 136 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%207_PERMEABLE%20PAVEMENT_Final%20Draft_v1-8_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• In addition to the construction record drawing, a certification must be provided stating that the media is functioning properly and is not clogged.	None

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	59	59
	2	81	81

9.4.8 INFILTRATION

Infiltration practices use temporary surface or underground storage to allow incoming stormwater runoff to infiltrate into underlying soils. Runoff first passes through multiple pretreatment mechanisms to trap sediment and organic matter before it reaches the practice. As the stormwater penetrates the underlying soil, chemical and physical adsorption processes remove pollutants.

Practice Types	Design Specification
140 (Level 1) 141 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%208_INFILTRATION_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
None	• Infiltration is not permitted in any single family residential development.

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	63	63
	2	93	93

9.4.9 BIORETENTION

Bioretention practices treat surface runoff by directing it into a shallow, landscaped depression that incorporates many of the pollutant removal mechanisms that are present in forested ecosystems. The primary component of a bioretention practice is the filter bed, which has a mixture of sand, soil, and organic material as the filtering media with a surface mulch layer. During storms, runoff temporarily ponds 6 to 12 inches above the mulch layer and then rapidly filters through the bed. A bioretention facility with an underdrain system is commonly referred to as a Bioretention Filter. Small-scale, or Micro-Bioretention, used on an individual residential lot is commonly referred to as a Rain Garden.

Practice Types	**Design Specification**
145 (Level 1) 146 (Level 2) 147 (Urban)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%209_BIORETENTION_FinalDraft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	**Site Constraints in addition to those listed Table 9.2**
None	None

Total Phosphorus Load Removal (%)	**Level**	**Type A/B Soils**	**Type C/D Soils**
	1	55	55
	2	90	90

9.4.10 DRY SWALE

Dry swales are essentially bioretention cells that are shallower, configured as linear channels, and covered with turf or other surface material (other than mulch and ornamental plants).

The dry swale is a soil filter system that temporarily stores and then filters the desired Treatment Volume (Tv). Dry swales rely on a pre-mixed soil media filter below the channel that is similar to that used for bioretention. Runoff is either infiltrated into the underlying soils or is returned to the conveyance system through an underdrain system. Dry swales may appear as simple grass channels with the same shape and turf cover, while others may have more elaborate landscaping. Swales can be planted with turf grass, tall meadow grasses, decorative herbaceous cover, or trees.

Practice Types	Design Specification
150 (Level 1) 151 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%2010_DRY%20SWALE_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
None	None

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	52	52
	2	76	76

9.4.11 WET SWALE

Wet swales can provide runoff filtering and treatment within the conveyance system and are a cross between a wetland and a swale. These linear wetland cells often intercept shallow groundwater to maintain a wetland plant community. The saturated soil and wetland vegetation provide an ideal environment for gravitational settling, biological uptake, and microbial activity. On-line or off-line cells are formed within the channel to create saturated soil or shallow standing water conditions (typically less than 6 inches deep).

Practice Types	Design Specification
155 (Level 1) 156 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%2011_WET%20SWALE%20_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• Side slopes must be 4:1 (horizontal to vertical) or flatter for single family residential development to allow for better maintenance. 3:1 side slopes are permissible for BMPs located in non-residential and multi-family developments.	None

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	20	20
	2	40	40

9.4.12 FILTERING PRACTICE

Stormwater filters are a useful practice to treat stormwater runoff from small, highly impervious sites. Stormwater filters capture, temporarily store, and treat stormwater runoff by passing it through an engineered filter media, collecting the filtered water in an underdrain, and then returning it back to the storm drainage system. The filter consists

of two chambers: the first is devoted to settling, and the second serves as a filter bed consisting of a sand or organic filter media.

Stormwater filters depend mainly on physical treatment mechanisms to remove pollutants from stormwater runoff, including gravitational settling in the sedimentation chamber, straining at top of the filter bed, and filtration and adsorption onto the filter media. Microbial films often form on the surface of the filter bed, which can also enhance biological removal. Filters are usually designed only for water quality treatment.

Practice Types	Design Specification
160 (Level 1) 161 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%2012_FILTERING%20PRACTICES_Final%20Draft_v1-8_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• A layer of filter fabric and at least 2" of stone (#5 or similar) must be placed on top of the sand layer (for sand filters). • Access hatches (no smaller than 4' x 4' and spaced 12' to 16' apart) must be provided over the filter chamber (for sand filters). • Manhole access must be provided over the sedimentation chamber and the clear well (for sand filters). • Observation wells (with threaded caps) are required in the filter chamber and must be located directly below the access manhole at the upper end of the structure (for sand filters). • The bottom of the sand filter must be graded toward the clear well at a one percent longitudinal slope. • When subject to traffic or significant earth loads, the concrete vault must be designed accordingly.	• Sand filters are not permitted in any single family residential development.

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	60	60
	2	65	65

9.4.13 CONSTRUCTED WETLAND

Constructed wetlands, sometimes called stormwater wetlands, are shallow depressions that provide water quality treatment for stormwater. Wetlands are typically less than 1 foot deep (although they have greater depths at the forebay and in micropools) and possess variable microtopography to promote dense and diverse wetland cover. Runoff from each new storm displaces runoff from previous storms, and the long residence time allows multiple pollutant removal processes to operate. The wetland environment provides an ideal environment for gravitational settling, biological uptake, and microbial activity.

Practice Types	Design Specification
165 (Level 1) 166 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%2013_CONSTRUCTED%20WETLAND_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• Permanent pool depths (including those in forebays) cannot exceed 3 feet in residential areas • All side slopes must be 4:1 or flatter, excluding the aquatic and safety benches.	

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	50	50
	2	75	75

9.4.14 WET POND

Wet ponds consist of a permanent pool of water that promotes gravitational settling, biological uptake and microbial activity. Runoff from each new storm enters the pond and partially displaces pool water from previous storms. The pool also acts as a barrier to re-suspension of sediments and other pollutants deposited during prior storms. When sized properly, wet ponds have a residence time that ranges from many days to several weeks, which allows numerous pollutant removal mechanisms to operate.

Wet ponds that are not covered by the Virginia Impounding Structure Regulations (Dam Safety) must, at a minimum, be engineered for structural integrity for the 100-year storm event.

Practice Types	Design Specification
170 (Level 1) 171 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/1DEQ%20BMP%20Spec%20No%2014_WET%20PONDS_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• All side slopes must be 4:1 or flatter, excluding the aquatic and safety benches.	• Wet ponds are not allowed in any single-family residential area unless the SWM facility treats runoff from multiple development projects or from a significant portion of a watershed and is designed to be an amenity for the entire subdivision.

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	50	50
	2	75	75

9.4.15 EXTENDED DETENTION POND

An Extended Detention (ED) Pond relies on 12 to 24 hour detention of stormwater runoff after each rain event. An under-sized outlet structure restricts stormwater flow so that it backs up and is stored within the basin. ED differs from stormwater detention, since it is designed to achieve a minimum drawdown time, rather than a maximum peak rate of flow (which is commonly used to design for peak discharge or flood control purposes and often detains flows for just a few minutes or hours). ED ponds rely on gravitational settling as their primary pollutant removal mechanism. Consequently, they generally provide fair-to-good removal for particulate pollutants, but low or negligible removal for soluble pollutants, such as nitrate and soluble phosphorus.

Practice Types	Design Specification
175 (Level 1) 176 (Level 2)	http://vwrrc.vt.edu/SWC/documents/2013/DEQ%20BMP%20Spec%20No%2015_EXT%20DETENTION%20POND_Final%20Draft_v1-9_03012011.pdf

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• Excluding aquatic and safety benches, basin side slopes must be 4:1 (horizontal to vertical) or flatter for single family residential development to allow for better maintenance. 3:1 side slopes are permissible for SWM facilities located in non-residential and multi-family developments. • Permanent pool depths (including those in forebays) cannot exceed 3 feet in residential areas.	

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	15	15
	2	31	31

9.4.16 DRY DETENTION - POND

Dry detention ponds that are not covered by the Virginia Impounding Structure Regulations (Dam Safety) must, at a minimum, be engineered for structural integrity for the 100-year storm event. These ponds can be used to meet the quantity controls required with the energy balance or 50/10 detention requirements but provide no pollutant removal.

Practice Types	Design Specification
177	

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• All dry detention ponds must have paved low-flow channels between all inlet points and the primary outlet structure. • Excluding aquatic and safety benches, basin side slopes must be 4:1 (horizontal to vertical) or flatter for single family residential development to allow for better maintenance. 3:1 side slopes are permissible for SWM facilities located in non-residential and multi-family developments.	None

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	0	0
	2	0	0

9.4.17 DRY DETENTION - UNDERGROUND

Dry detention – underground structures can be used to meet the quantity controls required with the energy balance or 50/10 detention requirements but provide no pollutant removal.

Practice Types	Design Specification
178	

Design Criteria in addition to those listed in Table 9.3	Site Constraints in addition to those listed Table 9.2
• Access (manhole size at a minimum) must be provided at the upper and lower end of all underground detention facilities to allow for maintenance access.	• Underground detention is not allowed in single family residential developments.

Total Phosphorus Load Removal (%)	Level	Type A/B Soils	Type C/D Soils
	1	0	0
	2	0	0

9.4.18 PROPRIETARY SWM DEVICES

Proprietary (or manufactured) SWM devices may only be used if they are included in the Virginia BMP Clearinghouse. They must be designed and installed in accordance with the approved specifications/standards found in the Clearinghouse and are subject to the applicable site constraints and design standards found in Tables 9.2 and 9.3.

Proprietary devices are subject to the record drawing requirements found in Section 9.6. Appropriate design information must be included on the construction plans that will allow the construction record drawing to be certified.

9.5 MAINTENANCE AGREEMENTS

In accordance with Sec. 10-45 of the Henrico County Code, provisions to ensure long-term maintenance of each permanent stormwater management facility must be considered. With one exception, this is accomplished through recordation of a maintenance agreement (see the Declaration of Covenants for the Inspection and Maintenance of Stormwater Management Facilities in Appendix B of this manual) that is executed between the owner of the SWM facility and the County.

The maintenance agreement must be in the form provided by the Administrator and:

1) Identifies the owner of the property as responsible party;

2) Runs with the land;
3) Provides for all necessary access to the property for purposes of maintenance and regulatory inspections;
4) Provides for inspections and maintenance by the owner and the submission of inspection and maintenance reports to the Administrator; and
5) Is enforceable by all appropriate governmental parties

The maintenance agreement must be submitted to the Administrator for review and approval prior to approval of the Environmental Compliance Plan. The maintenance agreement must be recorded prior to subdivision final plat recordation and prior to GCP termination for plans of development.

The exception to this requirement is for permanent stormwater management facilities designed to treat stormwater runoff primarily from an individual residential lot on which they are located. In lieu of requiring a maintenance agreement for these facilities, the Administrator will send educational material to the owners of these facilities once every five years. The educational material will explain the overall maintenance responsibilities and expectations and describe the maintenance activities the owner should anticipate depending on the type of SWM facility.

SWM facilities should be inspected by the owner or his/her representative at least once every two years to ensure that the SWM facilities continue to function as intended. In accordance with the recorded maintenance agreement, the owner must provide for an inspection at least once every five years and submit documentation of the inspection and associated maintenance to the Department of Public Works. Depending on the type of SWM facilities being inspected, the recorded maintenance agreement also specifies the person(s) that must conduct the required inspections. These requirements are summarized below:

1. For Vegetated Roofs, Permeable Pavement, Wet Ponds, and certain filtering and rainwater harvesting practices with enclosed/confined space chambers/components (such as sand filters and cisterns), the inspections required by the recorded maintenance agreement may be conducted by:
    i. a person who is licensed as a professional engineer, architect, landscape architect, or land surveyor pursuant to Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54:1;
    ii. a person who works under the direction and oversight of a licensed professional engineer, architect, landscape architect, or land surveyor; or
    iii. a person who holds an appropriate certificate of competence from the State Water Control Board.
2. For proprietary SWM devices, the inspections required by the recorded maintenance agreement may be conducted by:
    i. the manufacturer of the device;

ii. a person who is licensed as a professional engineer, architect, landscape architect, or land surveyor pursuant to Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54:1;
iii. a person who works under the direction and oversight of a licensed professional engineer, architect, landscape architect, or land surveyor; or
iv. a person who holds an appropriate certificate of competence from the State Water Control Board.

3. For all other SWM facilities, the inspections required by the recorded maintenance agreement may be conducted by:
   i. the owner or his/her representative;
   ii. a person who is licensed as a professional engineer, architect, landscape architect, or land surveyor pursuant to Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54:1;
   iii. a person who works under the direction and oversight of a licensed professional engineer, architect, landscape architect, or land surveyor; or
   iv. a person who holds an appropriate certificate of competence from the State Water Control Board.

To promote compliance with this requirement, the Administrator will periodically notify owners of their inspection responsibilities.

The owners of SWM facilities are also responsible for addressing any maintenance needs identified during the suggested and required inspections to ensure the SWM facility functions as intended. Routine maintenance performed on a regular basis can minimize or possibly eliminate the need for more costly maintenance in the future.

The County will perform long-term maintenance activities such as dredging and structural repair for SWM facilities in residential subdivisions (including zero lot line developments) for which the Administrator collected maintenance funds (either $100 per lot prior to July 1, 2014 or $100 per lot per SWM facility beginning July 1, 2014). The $100 per lot per stormwater facility applies to all SWM facilities shown on the overall SWM master plan. Short-term or regular maintenance activities such as cutting the grass, tree removal, and trash/debris removal are the owner's responsibility. Monies for long-term maintenance must be collected prior to subdivision plat recordation.

9.6 CONSTRUCTION RECORD DRAWINGS

In accordance with Sec. 10-47 of the Henrico County Code, a construction record drawing for each permanent stormwater management facility must be developed and submitted to the Administrator for review and approval prior to release of the Environmental Compliance Bond.

The construction record drawing must:

1) Be provided to Henrico County as a plan sheet and in Portable Document Format (pdf);
2) Accurately depict as-built details such as, but not limited to, inverts, lengths, depths, material types and sizes, grading, and the location of all required components.
3) Include a statement certifying the SWM facility was constructed in accordance with the approved Environmental Compliance Plan; and
4) Be sealed and signed by a professional registered in the Commonwealth of Virginia.

Construction record drawings are not required for stormwater management facilities located on residential lots that are designed treat stormwater runoff primarily from the lot on which they are located.

9.7 PLAN REQUIREMENTS

The following information and documentation are required elements of the SWM plan and must be submitted prior to approval of the ECP:

1. Information demonstrating that the technical criteria of this Chapter applies to the entire regulated land-disturbing activity;
2. Information demonstrating that all sources of surface runoff and all sources of subsurface and groundwater flows converted to surface runoff have been considered in the development of the SWM plan;
3. Identification of the type and location of all points of discharge from the site;
4. Identification of the type and location of features to which stormwater is being discharged;
5. Pre-development and post-development drainage areas to each point of discharge;
6. Contact information including the name, address, telephone number, and email address (if available) of the owner;
7. GPINs of the parcels on which the regulated land-disturbing activity will occur;
8. Identification of the pre-development and post-development site conditions;
9. Identification of the type, location (including geographic coordinates), acres treated, and the point of discharge for each proposed stormwater management facility;
10. Hydrologic and hydraulic computations, including runoff characteristics;

11. Documentation and calculations verifying compliance with the stormwater water quality, channel protection, flood protection, and 50/10 detention requirements of this Chapter;
12. Existing and proposed topography of the site;
13. Locations of existing streams, ponds, culverts, ditches, wetlands, other water bodies, and floodplains;
14. Identification of the type and location of A, B, C, or D soil types, forest cover, and other vegetated areas;
15. Identification of the locations of existing and proposed structures, roads, utilities and easements;
16. The limits of the regulated land-disturbing activity;
17. Tabulations of the areas devoted to impervious, forest/open and other vegetative cover based on both the existing and proposed site conditions;
18. A letter of availability from the off-site provider if offsite compliance measures are proposed to satisfy the stormwater quality technical criteria of this Chapter; and
19. Maintenance agreements in accordance with Section 9.5 of this Chapter for each proposed SWM facility.

Elements of the SWM plan that include activities regulated under Chapter 4 (§ 54.1-400 et seq.) of Title 54.1 of the Code of Virginia shall be appropriately sealed and signed by a professional registered in the Commonwealth of Virginia pursuant to Article 1 (§ 54.1-400 et seq.) of Chapter 4 of Title 54.1 of the Code of Virginia.

The specific information required to show compliance with each of these elements is detailed in the plan review checklists developed by the County (see Appendix C of this manual). County staff will use these checklists to review SWM plan submittals to determine if all applicable requirements have been met.

9.8 PLAN APPROVAL

All VSMP and CBPA land-disturbing activities must comply with the requirements of this chapter and be conducted in accordance with an approved ECP as discussed in Chapter 5. Therefore, prior to starting a VSMP or CBPA land-disturbing activity, an ECP must be submitted in accordance with Chapter 19 of this manual and approved by the Administrator. Once the ECP has been approved by the Administrator, a pre-construction meeting in accordance with Chapter 17 must be conducted prior to commencement of the land disturbing activity.

9.9 COMPLIANCE INSPECTIONS

In accordance with Sec. 10-54 of the Henrico County Code, the Administrator will conduct inspections to monitor compliance with the SWM requirements of an ECP. The inspections will be conducted at least once every three months. The inspection results, including noncompliance items and the actions necessary to correct these deficiencies, will be documented and delivered to the Responsible Land Disturber and/or Operator.

Various levels of enforcement actions, as outlined in Chapter 20, are available to the County for noncompliance with the SWM portion of the ECP. These actions include, but are not limited to, Notices to Comply and Stop Work Orders.

9.10 EXCEPTIONS

All requests for exceptions must be made in writing to the Administrator and submitted to the Public Works review staff. The request must identify the requirement from which relief is being requested and the reason for the request, including any supporting data.

The Administrator may grant exceptions to the technical criteria of Section 9.3 of this Manual. Exceptions to these criteria can be requested during the plan review process or after commencement of the land-disturbing activities.

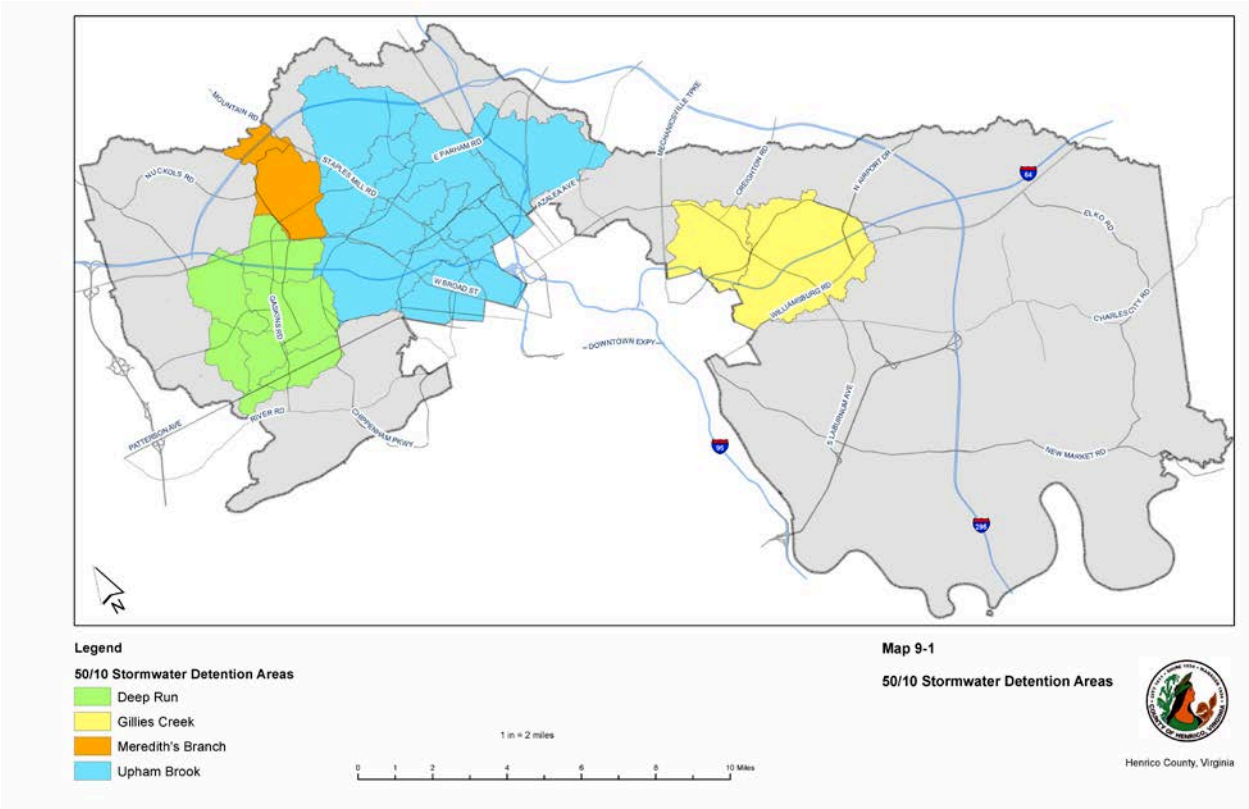
An exception to fully satisfying the required phosphorus reductions will not be granted unless offsite options have been considered and are not available.

An exception cannot be allowed for use of a SWM facility not found on the Virginia Stormwater BMP Clearinghouse Website, except where allowed in accordance with Chapter 14.

The request may be granted provided that the exception/variance is the minimum necessary to afford relief and reasonable and appropriate conditions are imposed as needed to preserve the purpose and intent of the requirements. Economic hardship alone is not a sufficient reason to grant an exception.

The Administrator will respond in writing either approving or disapproving the exception. If the request is not approved, the applicant or operator may resubmit an exception request with additional documentation.

MAP 9-1


MOUNTAIN RD
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CREIGHTON RD
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ELKO RD
WILLIAMSBURG RD
DOWNTOWN EXPY
CHARLES CITY RD
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NEW MARKET RD
PATTERSON AVE
RIVER RD
CHERRYDALE PKWY
Legend
50/10 Stormwater Detention Areas
Deep Run
Gillies Creek
Meredith's Branch
Upham Brook
1 in = 2 miles
0 1 2 4 6 8 10 Miles
Map 9-1
50/10 Stormwater Detention Areas
Henrico County, Virginia