

## **Module 5: Minimum Standard 19 Channel and Flood Protection**

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## Learning Objectives

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At the end of this module, you will be able to:

- State and discuss the regulatory requirements for post-development stormwater management (water quantity technical criteria) for all plans approved after July 1, 2014
- Apply the correct regulatory requirements to a site during the construction and post-development conditions
- Summarize the conceptual differences between the requirements for plans approved before and after July 1, 2014

## 5a. Overview of Minimum Standard 19

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Minimum Standard 19 (MS-19) regulates how stormwater runoff leaving a site must be managed, both during construction and after construction is completed, in order to protect downslope waterways and properties.

Changes to MS-19 and the stormwater regulations have led to significant changes and overlaps between the erosion and sediment control and stormwater management programs. As of July 1, 2014, MS-19 (**9VAC25-875-560**) incorporated the post-construction water quantity technical criteria of **9VAC25-875-600**. As a result, projects that meet the threshold for regulation under the erosion and sediment control program are required to demonstrate compliance with the water quantity regulations for post-construction stormwater management.

It should be noted that the definition of regulated land-disturbing activities (LDAs), or rather the trigger areas for erosion program and stormwater program requirements, may be different or the same in any given locality. The area threshold for erosion compliance within the state is 10,000 square feet, and the area threshold for stormwater compliance within the state is one acre, whether as one parcel of disturbance or as a common plan of development totaling an acre or more. A locality may have thresholds that are more stringent for either. The effective area thresholds must be reflected in a locality's ordinance.

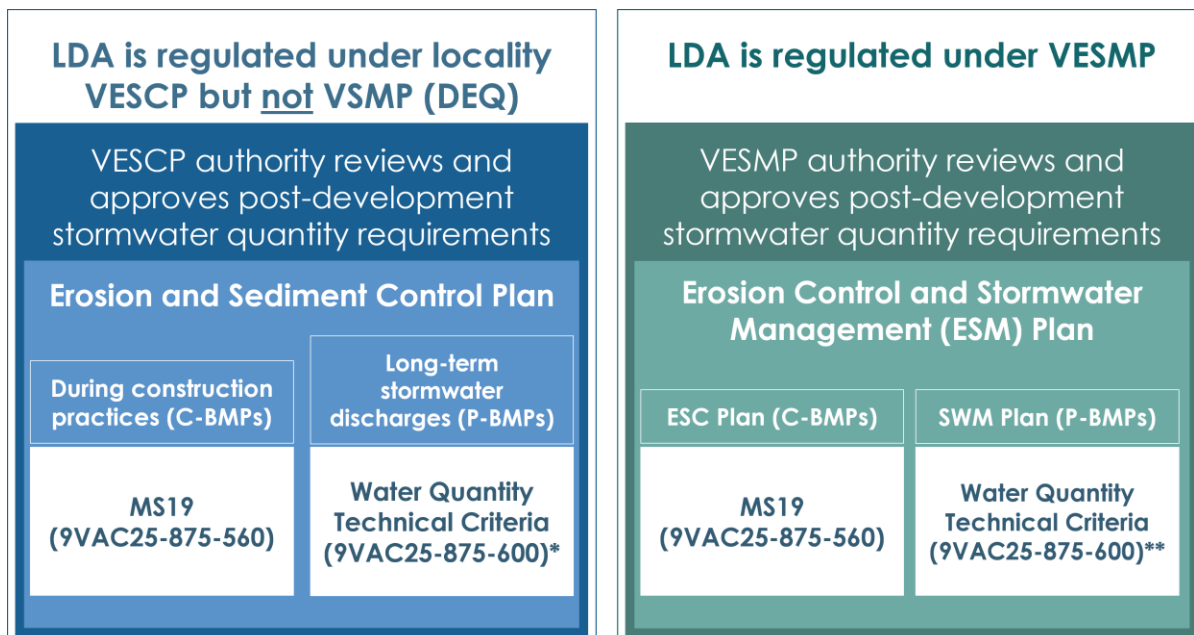
For a VESCP locality (left, blue side of graphic), for regulated LDAs over the erosion threshold of 10,000 square feet but less than an acre, at which DEQ would review a plan for stormwater compliance, the VESCP authority must review for post-construction stormwater quantity compliance, potentially with post-construction best management practices (P-BMPs). Practices used for compliance during construction (C-BMPs) must be evaluated for compliance with MS-19. Both C- and P-BMPs may or may not be included on the ESC plan specifically, but both types of practices must be reviewed for compliance.

For a VESMP locality (right, green side of graphic), for regulated LDAs over the authority's disturbance threshold, the locality must review both C- and P-BMPs for channel and flood protection compliance. As a reminder, Chesapeake Bay Preservation Area LDAs fall into this category and require compliance starting at 2,500 square feet of disturbance. These projects also have water quality compliance requirements discussed in our stormwater certification courses.

The graphic below shows these requirements. If an LDA is an exempt activity or is grandfathered, other requirements not discussed in the graphic may apply.

Additionally, according to 19.m and 19.n, a site design that satisfies the water quantity technical criteria of 875-600, will satisfy the requirements of MS-19.

### Post-development channel and flood protection:



\*Unless §62.1-44.15:55.F applies

\*\*Unless 9VAC25-875-490 or §62.1-44.15:34.F-G apply

LDA: Land-disturbing activity

VESCP: Virginia Erosion and Sediment Control Program

VSMP: Virginia Stormwater Management Program

VESMP: Virginia Erosion and Stormwater Management Program

## 5b. Managing Water Quantity

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### DURING CONSTRUCTION & POST-DEVELOPMENT PLANS APPROVED PRIOR TO JULY 1, 2014

Plans must address runoff leaving the site both during construction and in the post-development condition. ESC plans must comply with the requirements listed below for runoff that is discharged from the site during construction, i.e. sediment basin discharges. These requirements also applied to the post-development condition for plans that were approved prior to July 1, 2014.

These requirements, as detailed in MS-19, and listed as Part V, Article 4 of the VESM Regulation (Water Quantity and Water Quality Technical Criteria for Grandfathered Projects and Time Limits of Applicability Projects), are as follows:

### WATER QUANTITY GENERAL PROVISIONS

#### (9VAC25-875-560)

Parts of MS-19 provide general provisions for managing runoff, including the assumptions and practices that must be used to demonstrate compliance with the technical criteria:

- All hydrologic analyses must be based on existing watershed characteristics and ultimate development condition of the subject project. *(9VAC25-875-560.19.e)*
- Maintenance plans for stormwater detention practices, approved by the VESCP/VESMP authority, are required. *(9VAC25-875-560.19.f)*
- Detention facilities must discharge to a receiving channel and, as necessary, have energy dissipaters placed at their outfalls for a stabilized transition. *(9VAC25-875-560.19.g)*
- On-site channels must be verified to be adequate. *(9VAC25-875-560.19.h)*
- Individual lots or parcels that form a development must be considered a single project for the purposes of stormwater management. Hydrologic parameters that reflect the ultimate development condition must be used in all engineering calculations. *(9VAC25-875-560.19.j)*

- Compliance with the water quantity technical criteria covered in Part V, Article 3 (9VAC25-875-600) are deemed to satisfy the requirements of MS-19. (9VAC25-875-560.19.n)

The Virginia Stormwater Management Handbook (VSWHB) provides guidance for compliance reviews of stormwater discharges, including recommended stormwater engineering practices.

The remaining provisions of MS-19 are covered in the following sections. Section 5d of this module provides an overview of MS-19 (pre- and post-2014).

## CONCENTRATED RUNOFF

**Concentrated runoff** discharged from development sites must be directed to:

1. An adequate natural channel (a natural channel that will not erode nor flood during 2-year storms); *or*
2. An adequate man-made channel (a man-made channel that will not erode during 2-year storms nor flood during 10-year storms); *or*



### Natural Channel

- 2-year storm (erosion and capacity)



### Man-Made Channel

- 2-year storm (erosion)
- 10-year storm (capacity)



### Stormwater Infrastructure (pipes)

- 10-year storm (capacity)

3. An adequate pipe or storm sewer system with a stable outfall (an adequate pipe or storm sewer system will be able to contain 10-year storms).

#### 2-year storms?

Storms that have a moderate rainfall volume and occur on average once every 2 years or alternatively have a 50% chance of occurring in any given year.

#### 10-year storm?

Storms that have a large rainfall volume and occur on average once every 10 years or alternatively have a 10% chance of occurring in any given year.

If existing channels or pipes are NOT adequate, the requirement is to:

1. Improve channels so that:

- the 10-year storm will not cause flooding, and
- the 2-year storm will not cause channel erosion; **OR**

2. Improve the pipe or pipe system so that 10-year storms are contained;

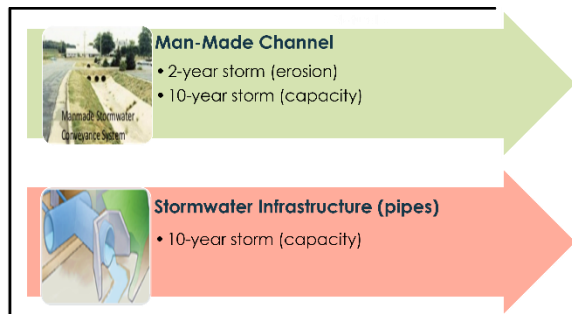
**OR**

3. Develop a site design:

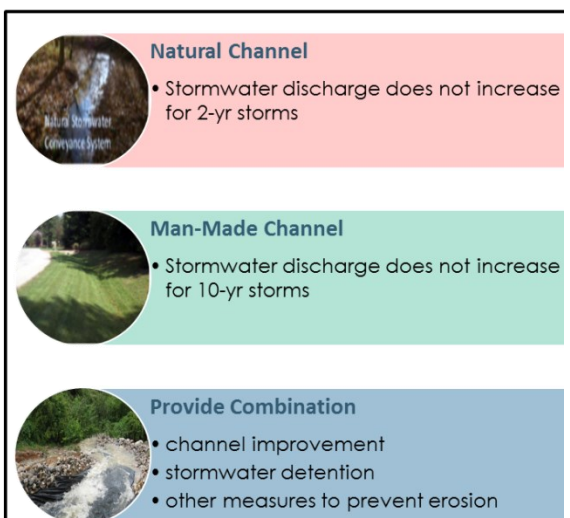
- For natural channels, the peak stormwater runoff discharge rate will not increase for the 2-year storm; or
- For man-made channels, the peak stormwater runoff discharge rate will not increase for the 10-year storm; **OR**

4. Provide a combination of channel improvement, stormwater detention, or other measures satisfactory to the VESCP or VESMP authority to prevent downstream erosion.

### IMPROVE



### DEVELOP SITE DESIGN



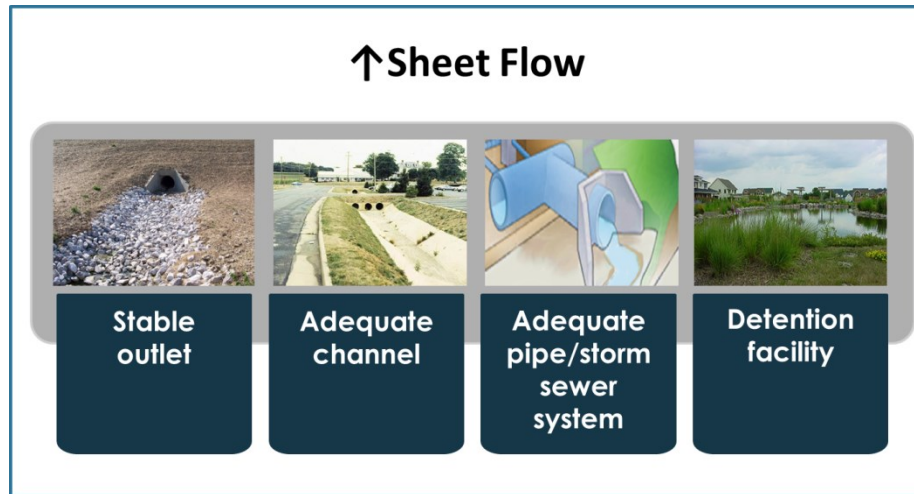
### As a plan reviewer...

It is important to ensure that the plan details any channel or pipe/pipe system improvements (including stormwater detention practices) and that appropriate notes are included to guide inspections.



## **SHEET FLOW**






Increased volumes of sheet flow that could cause erosion or sedimentation on adjacent properties are required to be diverted to a stable outlet, adequate channel, pipe or pipe system, or detention facility. Plan reviewers should be looking for areas where sheet flow could potentially become a problem in terms of erosion and/or flooding.





## 5c. Post-Development Requirements for Plans Approved After July 1, 2014

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Plans approved after July 1, 2014 (except if grandfathered)	LDA*:	
	Water Quantity Part V, Article 3 Energy Balance + Flooding	Water Quality Part V, Article 3 Runoff Reduction, Pollutant Removal
≥ 1 acre		
≥ 10,000 ft. <sup>2</sup>		
≥ 2,500 ft. <sup>2</sup> in CBPA		

\*May be more stringent (district or locality)

For all ESC or ESM plans approved after July 1, 2014, compliance with MS-19 includes addressing runoff **during construction** using the requirements stated in the previous section.

Post-construction (or post-development) stormwater management for sites where plans were approved after July 1, 2014, must show compliance with the requirements listed in this section. If an LDA does not meet the threshold for requiring stormwater program compliance (≥ 1 acre or potentially lower in localities with more stringent thresholds, including in the CBPA), then post-construction stormwater management compliance must be satisfied and reviewed for approval by the erosion program authority. Remember, for VESCPs, DEQ does not review plans for post-development discharges unless the disturbance threshold reaches that which requires stormwater program compliance, as noted earlier.

The plan must show compliance with all of the minimum standards including MS-19 as discussed in this module. The plan must show compliance with the post-development stormwater management requirements. The post-development requirements for plans approved after July 1, 2014 are provided in the following sections.

It should be noted that an LDA greater than or equal to 1 acre, or greater or equal to 2,500 square feet in the Chesapeake Bay Preservation Areas, must have both an approved erosion and

sediment control plan (VESCP) and an approved stormwater management plan (DEQ), or an approved Erosion and Stormwater Management (ESM) plan (VESMP).

## **WATER QUANTITY GENERAL PROVISIONS**

### **(9VAC25-875-600.F)**

The general provisions that accompany the water quantity technical criteria under Part V, Article 3 (**9VAC25-875-600.F**) state that pre-development and post-development runoff characteristics and site hydrology must be verified by:

- Site inspections,
- Topographic surveys,
- Available soil mapping or studies, and
- Calculations consistent with good engineering practices.

This section of the regulation further states that guidance provided in the Virginia Stormwater Management Handbook (VSWHB) and on the Virginia Stormwater BMP Clearinghouse Website (for post-construction BMPs) shall be considered appropriate practices. The VSWHB may be incorporated by reference in many VESCP or VESMP authority ordinances. It includes design and review specifications for constructed channels used to convey post-development stormwater runoff, and other post-development related items including permanent stabilization and outlet protection. It also provides general guidance for reviewing post-development compliance of stormwater conveyance systems in terms of meeting velocity and flow capacity requirements.

## **DESIGN STORMS AND HYDROLOGIC METHODS**

### **(9VAC25-875-620)**

Part V, Article 3 of the VESM Regulation provides general technical criteria for acceptable design storms and hydrologic methods used to demonstrate compliance with the specific technical criteria of Part V, Article 3:

- Design storms are the 1-, 2-, and 10-year 24-hour storms using site-specific rainfall precipitation frequency data recommended by the U.S. National Oceanic and

Atmospheric Administration (NOAA) Atlas 14 (partial duration time series). **(9VAC25-875-620.A)**

- Unless otherwise specified, all hydrologic analyses must be based on existing watershed characteristics and how the ultimate development condition of the subject project will be addressed. **(9VAC25-875-620.B)**
- Small and large construction projects are defined to include all areas within a common plan of development or sale that will ultimately undergo development. **(9VAC25-875-20)**
- Required hydrologic/hydraulic analyses must be conducted using U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) synthetic 24-hour rainfall distribution and models, including, but 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. **(9VAC25-875-620.C)**
- For drainage areas  $\leq 200$  acres, the VESMP authority or DEQ as the VSMP authority may allow for the use of the Rational Method for evaluating peak discharges and the Modified Rational Method for evaluating volumetric flows. **(9VAC25-875-620.D and E)**

## Part V, Article 3 Stormwater Quantity

### Channel Protection *Section B*

- Criteria depends on natural, manmade, or restored conveyance system
- 1 year storm used for Energy Balance
- 2 year storm is used to analyze for *erosivity*

AND

### Flood Protection *Section C*

- Criteria depends on existing flooding conditions
- 10 year storm analyzed for *capacity*

### Sheet Flow *Section D*

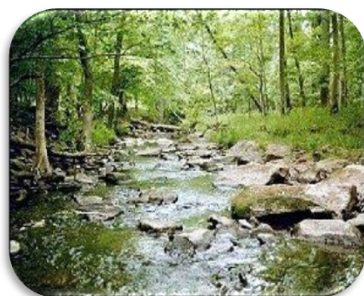
- Disconnected impervious area or physical spreading of water from a level spreader
- Increased volumes of sheetflow have to be analyzed
- If satisfied, no further water quantity controls are required

## CHANNEL PROTECTION CRITERIA

(9VAC25-875-600.B)

Concentrated runoff must be discharged into a stormwater conveyance system and must meet the water quantity requirements of **9VAC25-875-600**.

The Channel Protection Criteria is broken into three types of receiving stormwater conveyance systems as follows:



Natural



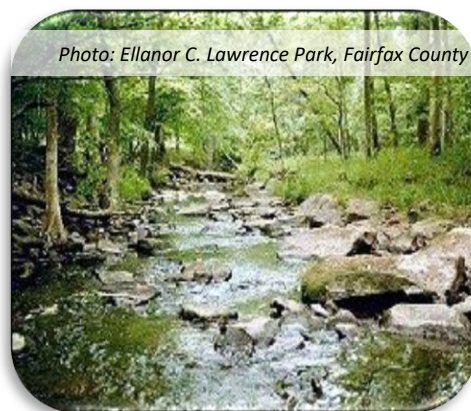
Man-made



Restored

*"Natural stormwater conveyance system" means the main channel of a natural stream and the flood-prone area adjacent to the main channel.*

When stormwater from a development is discharged to a natural stormwater conveyance system, the maximum allowable peak flow rate from the **one-year 24-hour storm** following the land-disturbing activity must be calculated either using the Energy Balance method or another methodology that is demonstrated by the VESMP authority to achieve ***equivalent results and is approved by DEQ.***



- Restore using natural channel design **OR**
- Energy Balance (1-year 24-hr peak flow rate) **OR**
- Safe Harbor Provision ([§ 62.1-44.15:28.13.a](#), [§ 62.1-44.15:52.a](#)) & [VSWHB Chapter 5](#)\*

\*Safe Harbor Provision is discussed further in the DEQ Plan Reviewer for Stormwater Management certification course and the Virginia Stormwater Management Handbook (VSWHB).

***“Manmade Stormwater Conveyance System”** is defined as a pipe, ditch, vegetated swale, or other stormwater conveyance system constructed by man except for restored stormwater conveyance systems.*



The Channel Protection criteria for a manmade conveyance system (**9VAC25-875-600.B.1**):

- The manmade stormwater conveyance system must convey the post-development peak flow rate from the two-year 24-hour storm event without causing erosion of the system. Detention of stormwater or downstream improvements may be incorporated into the approved land-disturbing activity to meet this criterion, at the discretion of the VESMP authority; or
- The peak discharge requirements for concentrated stormwater flow to natural stormwater conveyance systems (Energy Balance) must be met.

- Non-erosive capacity for 2-year peak flow **to the Limits of Analysis**  
**OR**
- Energy Balance (1-year 24-hr peak flow rate)



***“Restored stormwater conveyance system”** is defined as a conveyance system that has been designed and constructed using natural channel design concepts. Restored stormwater conveyance systems include the main channel and the flood-prone area adjacent to the main channel.*



The Channel Protection criteria for a restored conveyance system (**9VAC25-875-600.B.2**):

When stormwater from a development is discharged to a restored stormwater conveyance system that has been restored using natural design concepts, following the land-disturbing activity, either:

- The development must be consistent, in combination with other stormwater runoff, with the design parameters of the restored stormwater conveyance system that is functioning in accordance with the design objectives; or
- The peak discharge requirements for concentrated stormwater flow to natural stormwater conveyance systems (Energy Balance) must be met.

- Development (density, scale, etc.) and peak flow consistent with design parameters of the restored system **to the Limits of Analysis**

**OR**

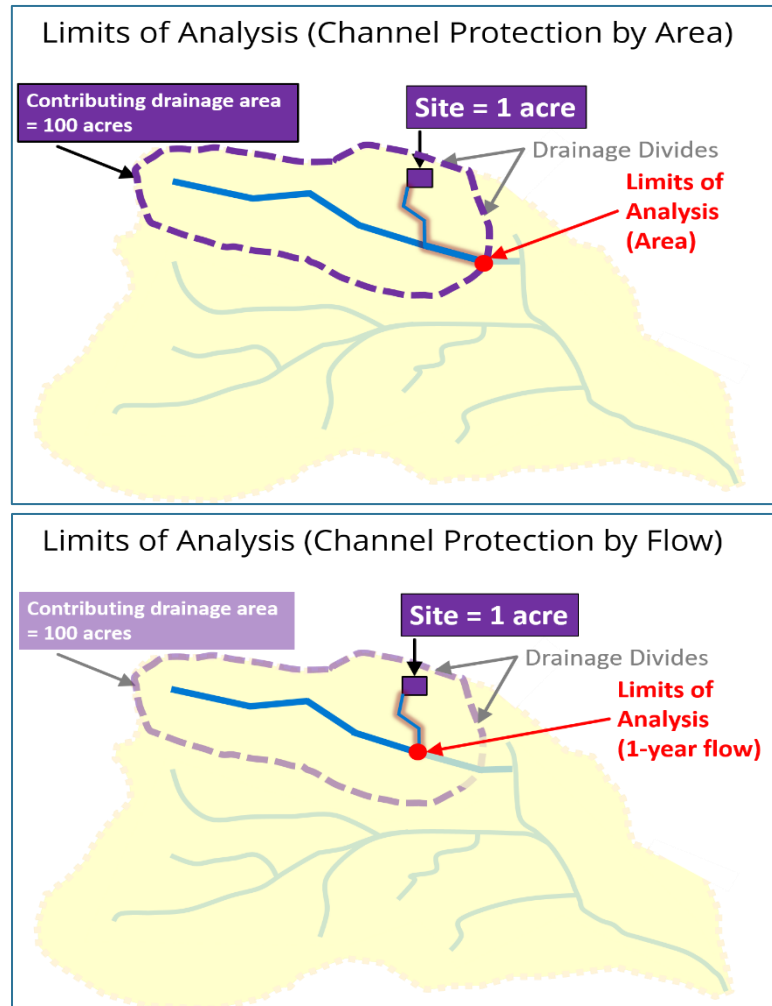
- Energy Balance (1-year 24-hr peak flow rate)

## Limits of Analysis for Channel Protection (9VAC25-875-600.B.4, 9VAC25-875-620)

The limits of analysis establish how far downstream the designer must verify compliance with the applicable criteria. The requirement to analyze the downstream system applies only in cases where the energy balance criteria are not being utilized.

Channel protection analysis is carried to a point where:

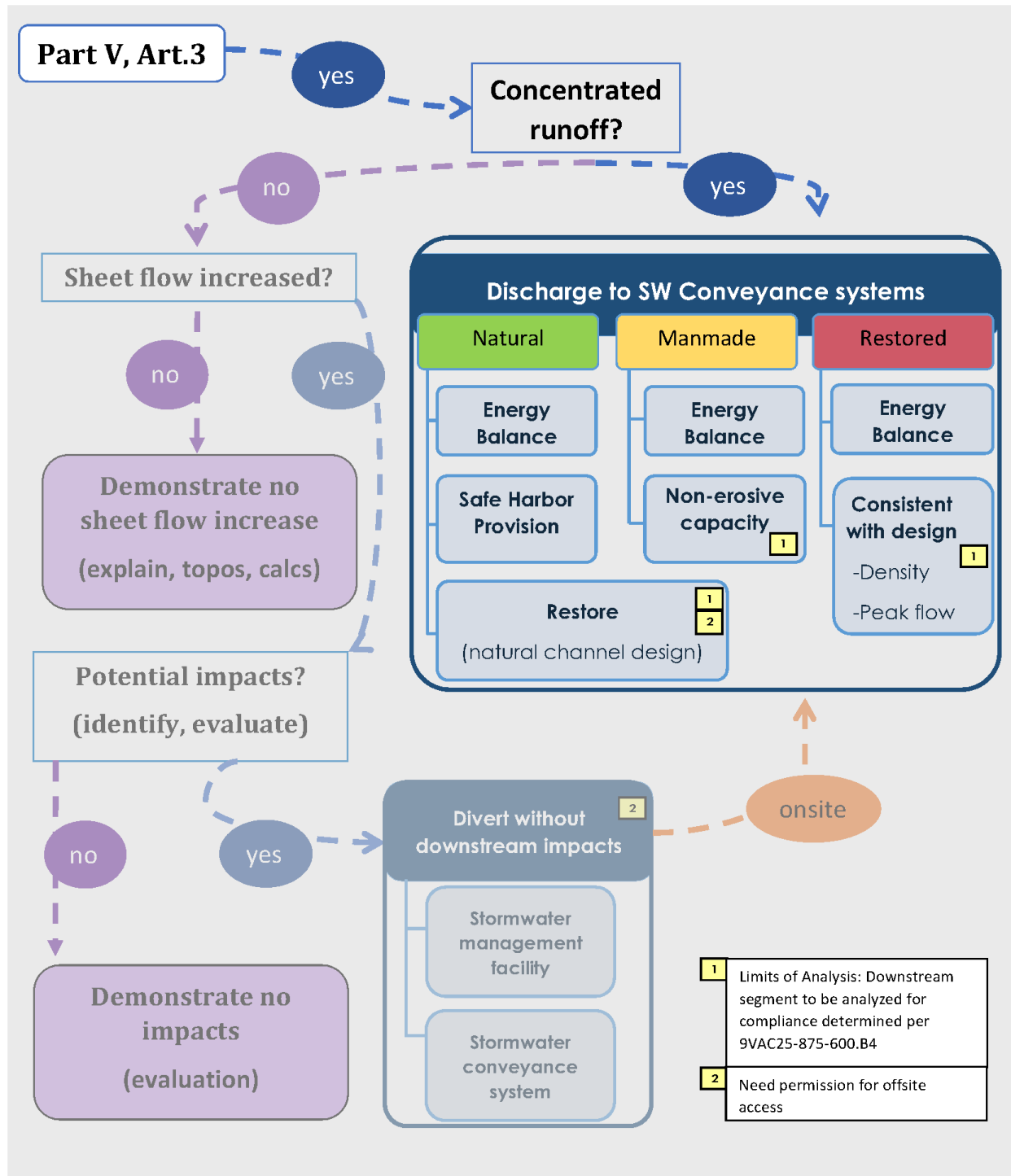
- a. The site's contributing drainage area is less than or equal to 1.0% of the total watershed area draining to a point of analysis in the downstream stormwater conveyance system; **OR**
- b. Based on peak flow rate, the site's peak flow rate from the 1-year 24-hour storm event is less than or equal to 1.0% of the existing peak flow rate from the 1-year 24-hour storm event prior to the implementation of any stormwater quantity control measures.



The designer must analyze the stormwater conveyance system using *acceptable hydrologic and hydraulic methodologies* to the defined limit of analysis.

# Stormwater Quantity Requirements

## Channel Protection (9VAC25-875-600.B)

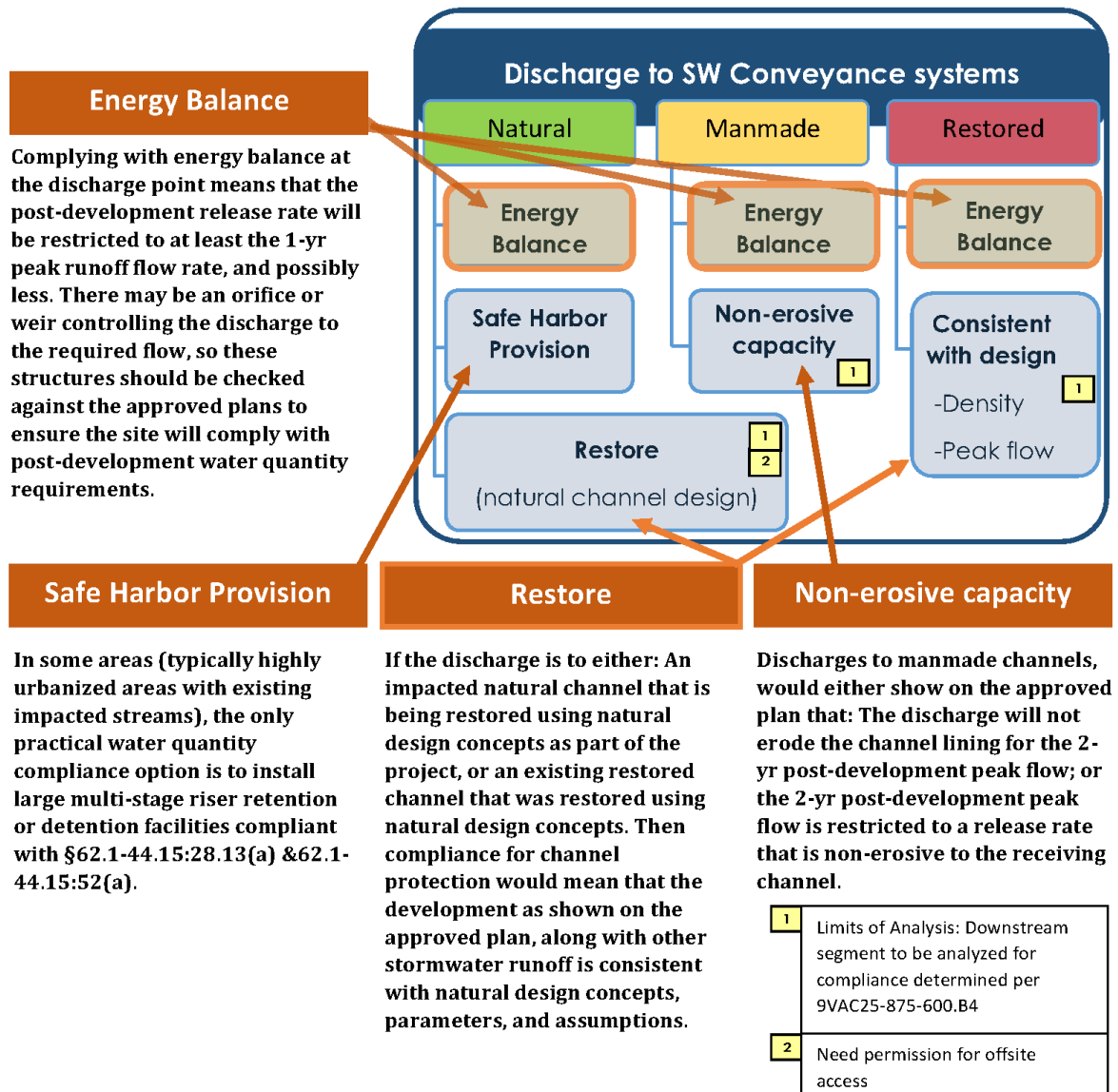




## Part V, Art.3

**When concentrated runoff is discharged from a site, it must be discharged to a stormwater conveyance system:**

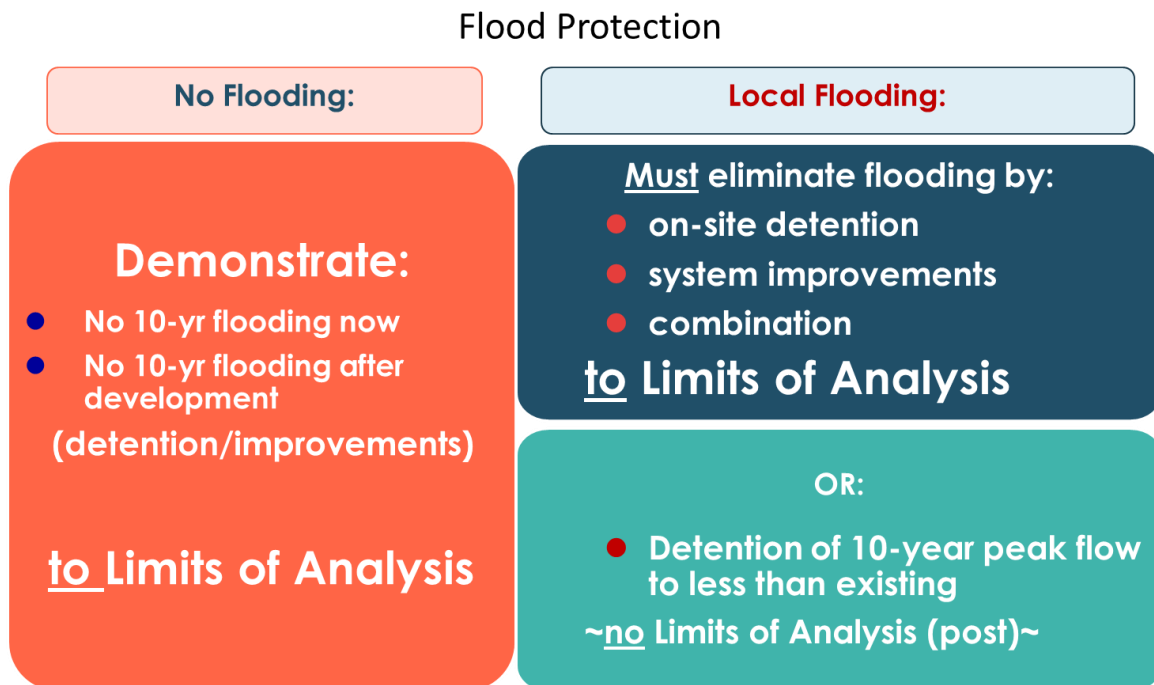
Every point of discharge will comply with one of these 7 options, depending on the type of channel receiving the discharge



## FLOOD PROTECTION

(9VAC25-875-600.C)

Flood Protection criterion is based on an assessment of the current condition of the downstream *stormwater conveyance system*: Does it currently experience localized flooding during the **10-year 24-hour storm event**? Compliance options may include channel/system improvements and/or detention of stormwater runoff.



1. Discharges to areas that are ***not experiencing localized flooding*** must ensure that the post-development peak flow rate from the 10-year 24-hour storm event is confined within the stormwater conveyance system. Detention of stormwater or downstream improvements may be incorporated into the approved land-disturbing activity to meet this criterion, at the discretion of the VESMP authority.
2. Discharges to areas that are ***experiencing localized flooding*** must:
  - a. Confine the post-development peak flow rate from the 10-year 24-hour storm event within the stormwater conveyance system to avoid the localized flooding. Detention of stormwater or downstream improvements may be incorporated into the approved land-disturbing activity to meet this criterion, at the discretion of the VESMP authority; **OR**

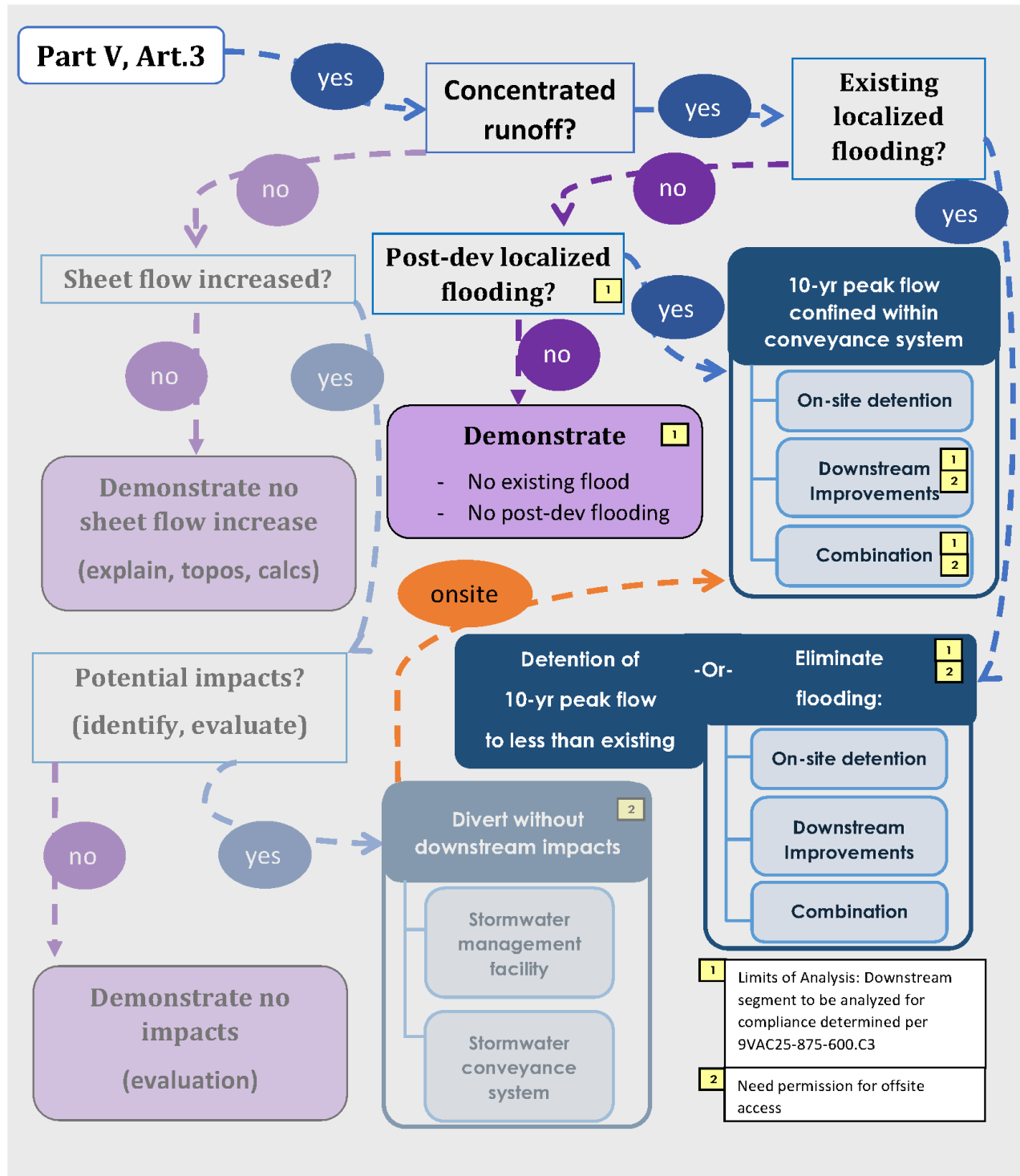
- b. Release a post-development peak flow rate for the 10-year 24-hour storm event that is less than the pre-development peak flow rate from the 10-year 24-hour storm event. Downstream stormwater conveyance systems do not require any additional analysis to show compliance with flood protection criteria if this option is utilized.

Localized flooding is defined in the regulation as smaller scale flooding that may occur outside of a stormwater conveyance system. This may include high water, ponding, or standing water from stormwater runoff, which is likely to cause property damage or unsafe conditions. Since this definition may lead to subjective determinations of the presence (or lack of) localized flooding, the program authority may identify areas to be subject to item 2.

In all cases, program authorities are given discretion for the allowance or exclusion of on-site detention or downstream channel improvements as compliance options for the requirement to keep the 10-year 24-hour peak flow rate confined within the downstream stormwater conveyance system.

# Stormwater Quantity Requirements

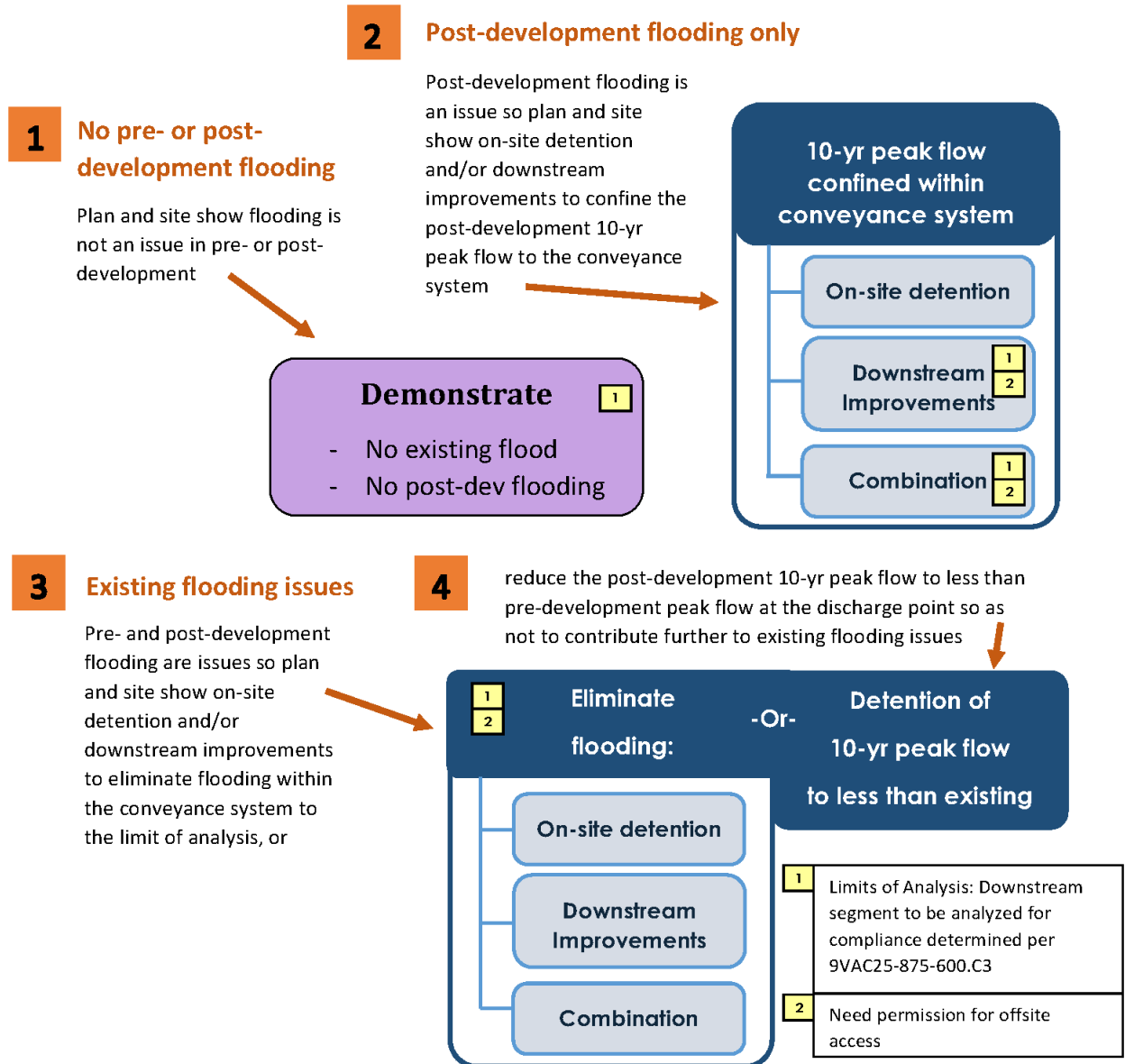
## Flood Protection (9VAC25-875-600.C)



## Part V, Art.3

**When concentrated runoff is discharged from a site, it must be discharged to a stormwater conveyance system:**

Every point of discharge will comply with one of these 4 options, depending on whether or not existing flooding occurs and/or if post-development flooding will



## Limits of Analysis for Flood Protection (9VAC25-875-600.C.3)

Downstream conveyance system analysis is applicable in the flood protection criteria when the existing downstream stormwater conveyance system:

- Does not experience localized flooding and the system will contain the post-development peak discharge as required, where on-site detention and/or downstream improvements can be implemented in order to alleviate the localized flooding (at program authority discretion); **OR**
- Does experience localized flooding and the system will contain the post-development peak discharge as required to avoid localized flooding, where on-site detention and/or downstream improvements can be implemented in order to alleviate the localized flooding (at program authority discretion).

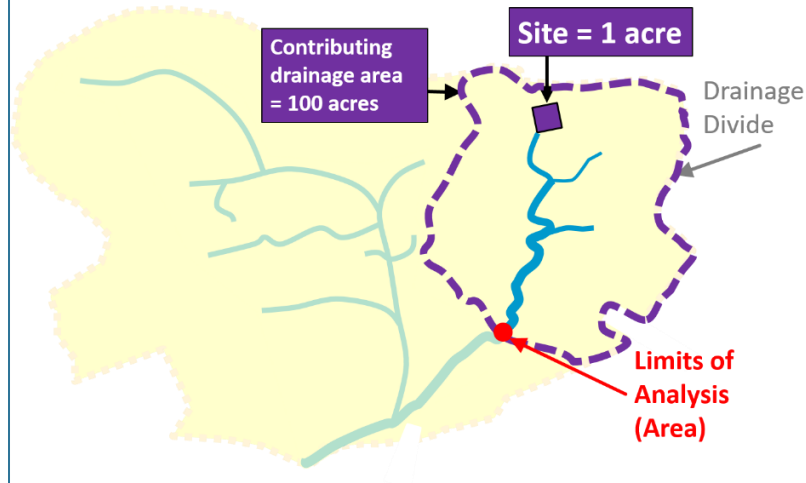
The designer must analyze the stormwater conveyance system using ***acceptable hydrologic and hydraulic methodologies*** to the defined limit of analysis.

The limit of analysis is a function of the site's contributing drainage area as follows:

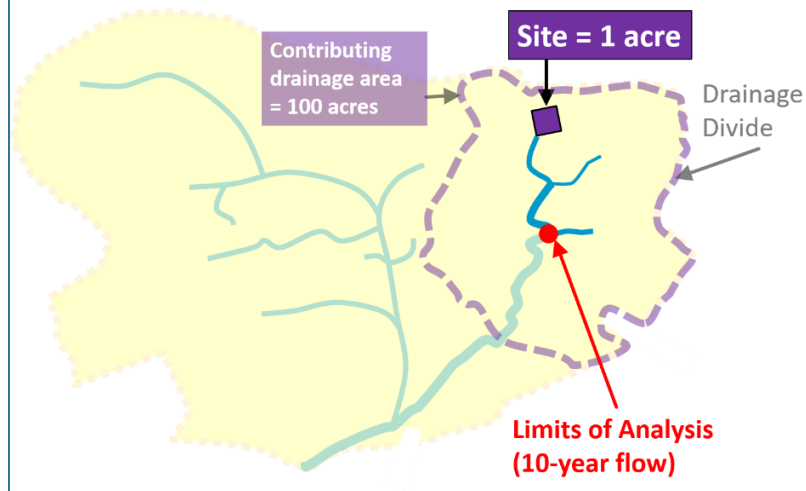
- a. The site's contributing drainage area is less than or equal to 1.0% of the total watershed area draining to a point of analysis in the downstream stormwater conveyance system; **OR**
- b. Based on peak flow rate, the site's peak flow rate from the 10-year 24-hour storm event is less than or equal to 1.0% of the existing peak flow rate from the 10-year 24-hour storm event prior to the implementation of any stormwater quantity control measures; **OR**
- c. The stormwater conveyance system enters a mapped floodplain or other flood-prone area, adopted by ordinance, of any locality.



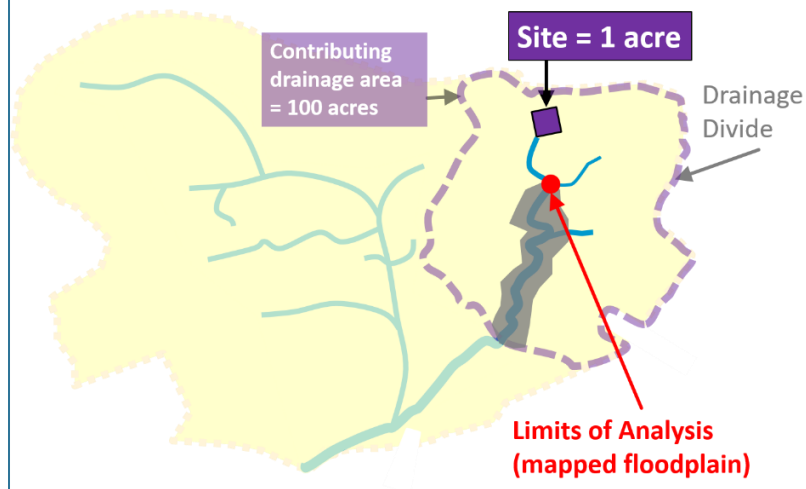
### Limits of Analysis (Flood Protection by Area)



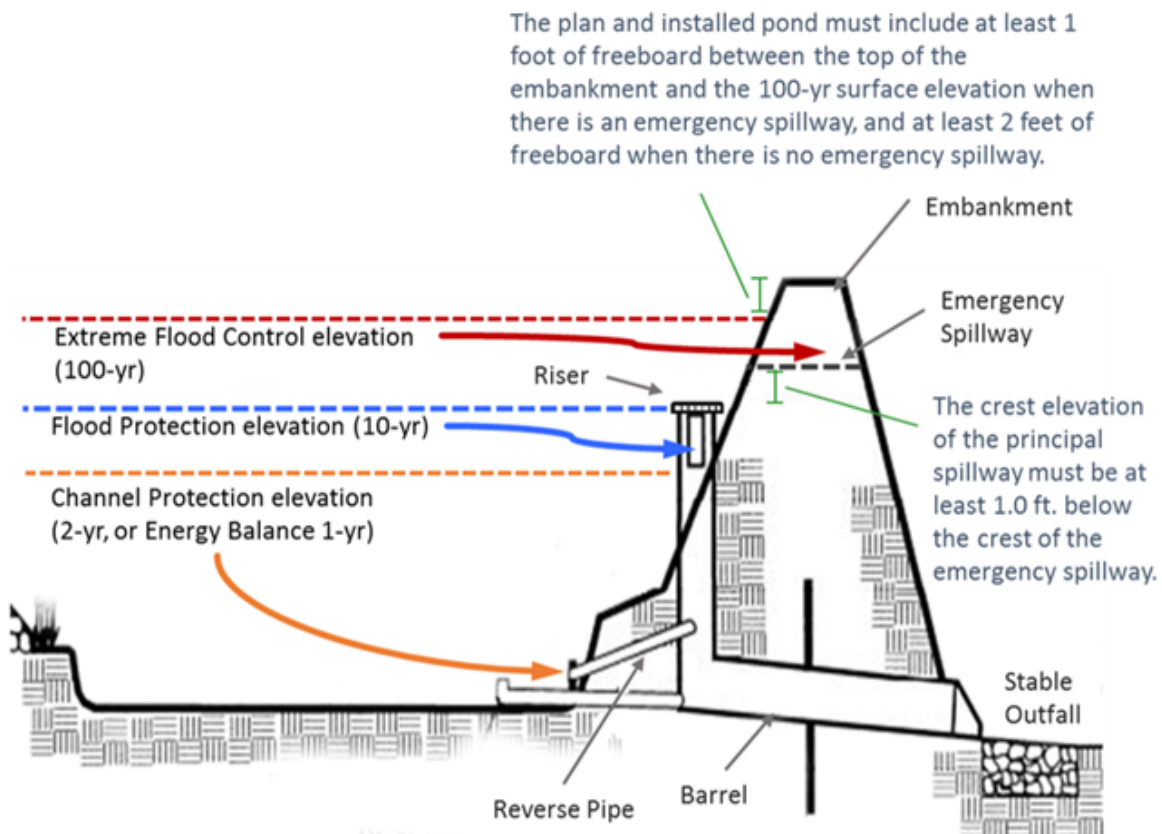
### Limits of Analysis (Flood Protection by Flow)



### Limits of Analysis (Flood Protection if floodplain)



## Stormwater Management Pond Schematic (Profile)



Stormwater ponds are often used to provide channel protection and/or volume protection. Ponds not regulated by the Impounding Structure Regulations (**4VAC50-20**) must be able to safely convey the 100-yr storm through the pond and emergency spillway per (**9VAC25-875-650**). Final construction specifications for all aspects of stormwater management structures should be included in the approved plans.

**Water quantity compliance on approved plan/installed pond achieved via size of riser pipe, size of riser orifice(s), size of outflow pipes, and barrel size.**

**The plan details should correspond with sizes and elevations shown with the water quantity evaluations for both channel and flood protection.**



## **SHEET FLOW**

**(9VAC25-875-600.D)**

Sheet flow discharged from the site must be managed.

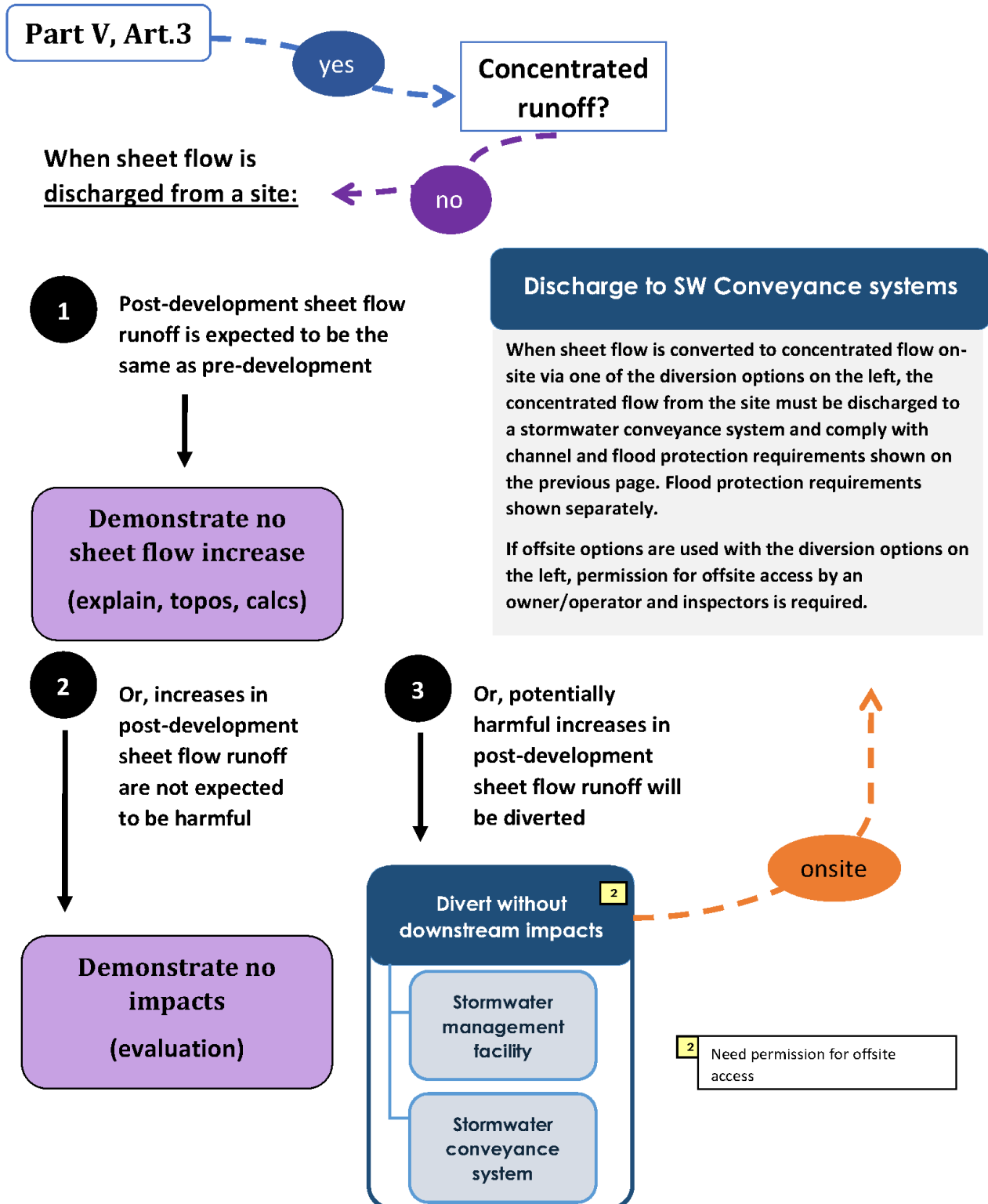
- Increased volumes of sheet flow must be identified and evaluated for potential impacts on down-gradient properties or resources.
- Increased volumes of sheet flow that will cause or contribute to erosion, sedimentation, or flooding of down-gradient properties or resources must be diverted to a stormwater management facility or a stormwater conveyance system so that impacts (erosion, sedimentation, or flooding) are avoided.



While the VESM Regulation do not give very specific direction about how to handle sheet flow and what is acceptable and unacceptable in terms of plan review, there is information that can be pulled together from the regulation, federal guidance, and other technical resources to help plan reviewers. See Module 11 for a summary of some of this information that may be useful for plan reviewers and designers when evaluating sheet flow.

# Stormwater Quantity Requirements

## Sheet Flow (9VAC25-875-600.D)



## 5d. MS-19 Post-Development Stormwater Management

Minimum Standard 19 applies in its entirety during construction for plans submitted for approval. A guide through MS-19 for post-development requirements is provided:

Post-development requirements: supplanted by 9VAC-875-600 (grey italicized areas)	9VAC25-875-560.19.a	<i>Concentrated runoff leaving development site shall be discharged directly to adequate natural or manmade channel, pipe, or storm sewer system. Where runoff discharged into pipe/pipe system, downstream stability analyses at outfall of pipe or pipe system must be performed.</i>
	9VAC25-875-560.19.b	<i>Requirements for verification for channel protection/flood protection adequacy of natural/manmade channels or 1% rule.</i>
	9VAC25-875-560.19.c	<i>When existing natural or manmade channels/pipes not adequate: Requirements for channel/pipe(s) improvements or site design with non-erosive/non-flooding discharges. VESCP/VESMP approval required. Improvements to offsite areas need access permission.</i>
	9VAC25-875-560.19.d	The applicant must provide evidence of permission to make improvements
	9VAC25-875-560.19.e	All hydrologic analyses must be based on existing watershed characteristics and ultimate development condition.
	9VAC25-875-560.19.f	Maintenance plan for stormwater detention options required: <ul style="list-style-type: none"> <li>• Must be approved by VESCP/VESMP authority</li> <li>• Include maintenance requirements of facility and person responsible</li> </ul>
	9VAC25-875-560.19.g	<i>Outfall from a detention facility shall be discharged to a receiving channel, and <u>energy dissipaters shall be placed at the outfall of all detention facilities as necessary to provide a stabilized transition from the facility to the receiving channel.</u></i>
	9VAC25-875-560.19.h	All on-site channels must be verified to be adequate.
	9VAC25-875.560.19.i	<i>Increased volumes of sheet flows ...</i>
	9VAC25-875-560.19.j	Developments consisting of individual lots or parcels must be considered as a whole: <ul style="list-style-type: none"> <li>• Residential, commercial, or industrial</li> <li>• Hydrologic parameters in engineering calculations must reflect ultimate development condition</li> </ul>
	9VAC25-875-560.19.k	Measures used to protect properties and waterways must be employed to minimize impacts on physical, chemical, and biological integrity of rivers, streams, and other waters of the state.
	9VAC25-875-560.19.l	<i>Any plan approved prior to July 1, 2014,...</i>
	9VAC25-875-560.19.m	Plans approved on and after 7/1/2014 must comply with flow rate capacity and velocity requirements of the ESC Law and MS-19 via compliance with water quantity requirements in VESMA and attendant regulations (9VAC25-875-600)...
	9VAC25-875-560.19.n	Compliance with water quantity minimum standards in 9VAC25-875-600 satisfies the requirements of MS-19.

## Summary

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As a plan reviewer, it is important to be able to:

- Recall and describe post-development stormwater management requirements for plans approved after July 1, 2014 in accordance with Minimum Standard 19.
- Distinguish the MS-19 requirements for plans approved prior to and after July 1, 2014.