City of Suffolk, Virginia

Department of Planning

Non-Point Source Pollution Load Guidance Calculation Procedures

Step 1: **Compile Site Specific Data** (Note: unless otherwise noted, round to nearest 3rd decimal place.) (Note: One (1) acre equals 43,560 square feet.)

CBPA Determination:
[ ] RPA [ ] RMA
[ ] IDA [ ] None

1. Area of Lot (excluding wetlands or water) = **A**

   Area of Lot (in square feet) ÷ 43,560 = **A**

   ____________ ÷ 43,560 = **A**

   A = ________________ acres

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2. Current Impervious Area = I_a ***(Skip this Equation if the Property Is Currently Undeveloped)***

   Impervious area includes all surfaces covered by roofs, concrete, or gravel (including sidewalks and driveways). This includes all structures regardless of whether they are set on a permanent foundation (including sheds, swimming pools, and gazebos). Do not include wooden open deck structures in the total.

   structures ________________ square feet
   parking ________________ square feet
   sidewalks ________________ square feet
   roadway ________________ square feet
   other ________________ square feet
   additions ________________ square feet
   accessory ________________ square feet

   Total: ________________ (square feet) ÷ 43,560 = I_a
   I_a = ________________ acres

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3. Proposed Impervious Area (after proposed construction) = I_b

   structures ________________ square feet
   parking ________________ square feet
   sidewalks ________________ square feet
   roadway ________________ square feet
   other ________________ square feet
   additions ________________ square feet
   accessory ________________ square feet

   Total: ________________ (square feet) ÷ 43,560 = I_b
   I_b = ________________ acres

Enter these equations from the previous page:

A = ________________ acres
$\mathbf{I_a}$ = ________________ acres
$\mathbf{I_b}$ = ________________ acres

3. Percent of site covered by impervious surfaces before development (Current) = $\mathbf{I_{site}\ a}$

(Skip this Equation if the Property Is Currently Undeveloped)

(Total $\mathbf{I_a}$ ÷ **A**) x 100 = $\mathbf{I_{site}\ a}$

(__________÷__________) x 100 = $\mathbf{I_{site}\ a}$

____________ = $\mathbf{I_{site}\ a}$

$\mathbf{I_{site}\ a}$ = __________% (Note: Round to nearest whole number)

4. Percent of site covered by impervious surfaces after development (Proposed) = $\mathbf{I_{site}\ b}$

(Total $\mathbf{I_b}$ /**A**) x 100 = $\mathbf{I_{site}\ b}$

(__________÷__________) x 100 = $\mathbf{I_{site}\ b}$

____________ = $\mathbf{I_{site}\ b}$

$\mathbf{I_{site}\ b}$ = __________% (Note: Round to nearest whole number)

Step 2: Determine the need to continue.

16% = $\mathbf{I_{watershed}}$ (Chesapeake Bay Watershed Default Impervious Area).

If $\mathbf{I_{site}\ b}$ is less than or equal to **16%,** STOP and submit analysis to this point.

If $\mathbf{I_{site}\ b}$ is greater than **16%,** CONTINUE ANALYSIS and go to Step 3.

Step 3: Use Part A for new development on an unimproved (vacant) parcel or use Part B for development proposed on a improved parcel (additions to an existing dwelling or accessory structure) to calculate $\mathbf{L_{pre}}$.

Part A **Calculate Pre-Development Pollution Load** = $\mathbf{L_{pre}}$

***** Use only for new development on an unimproved (vacant) parcel *****

40.5 x [0.05 + (0.009 x $\mathbf{I_{watershed}}$)] x 0.26 x **A** x 2.72 ÷ 12 = $\mathbf{L_{pre}}$

2.043 x________x 2.72 ÷ 12 =

$\mathbf{L_{pre}}$ = ________pounds per year of pollutants

Part B **Calculate Pre-Development Pollution Load** = $\mathbf{L_{pre}}$

***** Use only for development proposed on a improved parcel (additions to an existing dwelling or accessory structure) *****

40.5 x [0.05 + (0.009 x $\mathbf{I_{site}}$ **a**)] x 0.26 x **A** x 2.72 ÷ 12 = $\mathbf{L_{pre}}$

40.5 x [0.05 + (0.009 x_________)] x 0.26 x_________x 2.72 ÷ 12 =

40.5 x [0.05 +_________] x 0.26 x_________x 2.72 ÷ 12 =

40.5 x [_________] x 0.26 x_________x 2.72 ÷ 12 =

$\mathbf{L_{pre}}$ = ________pounds per year of pollutants

Step 4:Calculate Post-Development Pollutant Load ($\mathbf{L_{post}}$) = $\mathbf{L_{post}}$

40.5 x [0.05 + (0.009 x $\mathbf{I_{site}}$ **b**)] x 0.26 x **A** x 2.72 ÷ 12 =

40.5 x [0.05 + (0.009 x_________)] x 0.26 x_________x 2.72 ÷ 12 =

40.5 x [0.05 +_________] x 0.26 x_________x 2.72 ÷ 12 =

40.5 x [_________] x 0.26 x_________x 2.72 ÷ 12 =

$\mathbf{L_{post}}$ = ________pounds per year of pollutants.

Step 5:Calculate Pollutant Removal Requirement = RR

$\mathbf{L_{post}}$ **-** $\mathbf{L_{pre}}$ [from Steps 3 (Part A or Part B) and 4 above] =

(_________-___________) =

RR = _________pounds per year

To determine the overall **BMP efficiency required (%RR)** when selecting BMP options:

RR ÷ $\mathbf{L_{post}}$ x 100 (from steps 4 and 5 above) **=**

(________÷_________) x 100 =

____________ x 100 =_____________= **%RR**

%RR = __________% (Note: Round to nearest whole number)

Step 6: Worksheet C: Compliance

Select BMP option from the list provided and list them below. Then calculate the pollutant load removed from each option. **DO NOT LIST BMPs IN SERIES HERE**.

*** Note: If the proposed site impervious area **(I_{site} b) is 20% or under vegetated BMPs** may be used. If the proposed site impervious area **(I_{site} b) over 20% engineered BMPs** should be used.***

Selected Option	Removal Efficiency (% ÷ 100) (expressed in decimal form)	x	Fraction of CBPA Drainage Area Served (*) (expressed in decimal form)	x	Lpost (lbs/yr)	=	Pollutant Load Removed (lbs/yr)
____________	______	x	______	x	______	=	______
____________	______	x	______	x	______	=	______
____________	______	x	______	x	______	=	______

**** The Fraction of CBPA Drainage Area Served is found by dividing the area draining to the proposed BMP by the total lot area. Both numbers used in the equation must be in the same format (either square feet or acres).***

If the Load Removed (lbs/yr) is greater than or equal to **RR** (Pollutant removal requirement from step 5), then the selected BMP option is adequate to serve the proposed new development.

Step 7: Worksheet D: BMP Design

Calculate the proper size of BMP to determine storage volume based on type and required efficiency (typically BMPs are designed to accommodate the first half (1/2) inch of rainfall for the proposed impervious area. If using engineered BMPs be sure to account for void area created by the use of aggregate material (gravel, etc.).

Provide plot plan identifying the location of existing and proposed structures and the proposed BMPs. Additionally, provide all calculations and a cross section identifying the dimensions and materials of the proposed BMPs.

<u>BMPs and Phosphorous Removal Efficiencies</u>

Water Quality BMP	Target Phosphorous Removal Efficiency
Vegetated Practices	
Vegetated Filter Strip - Min Std. 3.14	10%
Grass Swale (with check dams) - Min Std. 3.13	15%
Water Quality Swale - Min Std. 3.13	35%
Detention Practices and Wetlands	
Extended Detention (30-hr draw down of 2 x WQV) - Min Std. 3.07	35%
Enhanced Extended Detention (30-hr draw down of 1 x WQV, and 1x WQV shallow marsh) - Min Std. 3.07	50%
Constructed Wetlands (2x WQV) - Min Std. 3.09	30%
Retention Practices	
Retention Basin I (3 x WQV) - Min Std. 3.06	40%
Retention Basin II (4 x WQV) - Min Std. 3.06	50%
Retention Basin III (4 x WQV, aquatic bench) - Min Std. 3.06	65%
Infiltration Practices	
Infiltration Facility (storage volume= ½" runoff from impervious areas) – Min Std. 3.10	50%
Infiltration Facility (storage volume = 1" runoff from impervious areas) – Min Std. 3.10	65%
Bioretention / Biofiltration Practices - Min Std. 3.11, 3.11a, 3.11 b	
Bioretention Basin (capture/treatment volume = ½" runoff from impervious areas)	50%
Bioretention Basin (capture/treatment volume =1" runoff from impervious areas)	65%
Bioretention Filter (capture/treatment volume = ½" runoff from impervious areas)	50%
Bioretention Filter (capture/treatment volume =1" runoff from impervious areas)	65%
Green Alleys (capture/treatment volume = ½" runoff from impervious areas)	50%
Green Alleys (capture/treatment volume = 1" runoff from impervious areas)	65%
Sand Filters	
Intermittent Sand Filter (treating ½" runoff from impervious areas) - Min Std. 3.12	65%
Manufactured BMPs - Min Std. 3.15	
Hydrodynamic Structures (*Stormceptor, Vortechs, Downstream Defender, BaySaver*	15-20%
Filtering Structures (*StormFilter, StormTreat System)*	50%

<u>Notes:</u>

WQV= Water quality volume (first ½" of runoff from the impervious surfaces)

The 30-hour draw down time of water quality volume pertains to the brim drawn down time, beginning at the time of peak storage of the water quality volume. Brim draw down time means the time required for the entire calculated volume to drain out of the basin. See Virginia Stormwater Management Handbook Section 5-6.2 for methods to verify the draw down time and design performance.

Design Standards and Specifications for the BMPs referenced in the table above can be found in the Virginia Stormwater Management Handbook.

Assume nutrients means phosphorous.

Step 1: Determine the pollutant load (L) generated by the drainage area of the buffer.

L = 0.000047 (lbs/in-ft) x annual rainfall (in) x lot width (ft)

This equation is derived by the following method:

Assume a maximum of 200 feet of overload sheet flow can be handled by the buffer. [The 200-foot maximum is established by the new state Erosion and Sediment Control regulations (VR 625-02-00), and is suggested as policy by both VDOT and ASCS-SCS.] Multiply the average lot width (see attached graphic) in feet by the 200-foot overland sheet flow factor and divide by 43,560 (sqft/ac) to determine the “drainage area” in acres. Let the average land cover condition by 16 percent impervious and use the Simple Method to calculate the load generated by the drainage area. Since the drainage area always includes dividing 200 by 43,560 and other constants from the Simple Method, the only variables are the lot width and annual rainfall. Therefore, this procedure can be reduced to the above equation, where L is in pounds.

Step 2: Determine the maximum load (R_{max}) capable of being removed by the full buffer.

$$R_{max} = L \times 0.4$$

Multiply the load generated (from Step 1) by 0.40 (the removal rate dictated by the Regulations for a full 100-foot buffer).

Step 3: Determine the actual load removed (R_{act}) by the remaining, undisturbed buffer.

$$R_{act} = L \times EFF$$

Multiply the load generated (from Step 1) by the appropriate removal efficiency shown on the next page.

Buffer Equivalency Number 3

Total Buffer Width (BW)		Removal Efficiency (EFF)
100	(no encroachment)	.40
90	(10’ encroachment)	.37
80	(20’ encroachment)	.35
70	(30’ encroachment)	.32
60	(40’ encroachment)	.30
50	(max. encroachment)	.25

Step 4: Determine the load removal requirement (RR) of an “equivalent” BMP.

$$RR = R_{max} – R_{act}$$

The load removal requirement is the difference between the maximum load removal (from Step 2) and the load removal provided by the remaining buffer (from Step 3).

Step 5: Determine available BMP options.

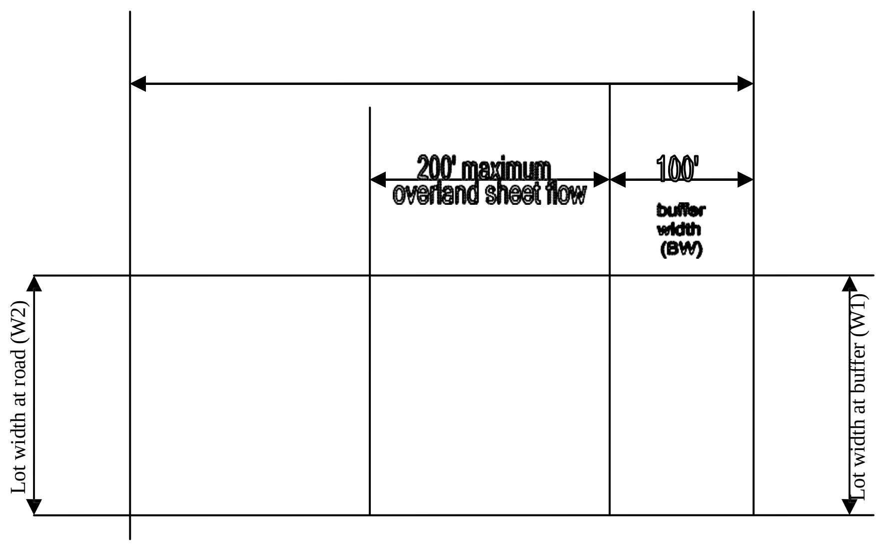
Refer to Table 2 in Appendix C of the Local Assistance Manual for pollutant removal efficiencies of BMPs. Sometimes an additional (relocated) buffer width may be appropriate.

Step 6: Provide adequate BMP selection and design.

Site conditions may determine ultimate selection. Refer to Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs by Thomas Schuler. (Washington, D.C.: Metropolitan Washington Council of Governments, 1987)

Buffer Equivalency Procedure Graphic

Total lot length



Note – if lot widths at road (W2) and buffer (W1) greatly differ,
Average lot width may be used: [(W1) + (W2) / 2 = (Wavg)]