



# **Preliminary Engineering Report for Chesapeake Bay TMDL Action Plan Phase II - Compliance Reassessment**

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## Executive Summary

Central Virginia Community College (CVCC) is permitted to discharge stormwater from the college's municipal separate storm sewer system (MS4) by maintaining coverage under the General Virginia Pollutant Discharge Elimination System (VPDES) Permit for Discharges of Stormwater from Small MS4s (MS4 General Permit). In part, the MS4 General Permit requires the college meet special conditions for the Chesapeake Bay Total Maximum Daily Load (TMDL). Included as a special condition is the development of the CVCC Chesapeake Bay TMDL Action Plan (Action Plan), previously updated by Wetlands Solutions and dated June 30, 2022. The Action Plan includes the description of past progress and proposes street sweeping to achieve pollutant reductions required to be achieved during the previous and current MS4 General Permit cycles. Based on outdated quantification methods, CVCC successfully achieved the pollutant reductions required during the last permit cycle that spanned from 2013 – 2018, representing a minimum of 5% of the total reductions required to annually be achieved by 2028.

The current MS4 General Permit requires reduction of an additional 35% of the total required pollutant reductions (40% cumulative) be achieved prior to the conclusion of the current permit cycle that expires on October 31, 2023. CVCC's Phase II Action Plan proposes to achieve the 2023 reductions with continued implementation of a street sweeping program using a new quantification method provided in DEQ's Guidance memo No. 20-2003. However, a third-party review of the Action Plan found the quantification method improperly applied, resulting in an overestimation of the pollutant reductions that could be achieved. Required reductions were also miscalculated. The improper application of the quantification of pollutant reduction from street sweeping requires a reassessment of the identification of the means and methods for achieving the required pollutant reductions by the end of the current permit cycle.

Quantification of pollutant reductions achieved the past three reporting years from street sweeping finds the current level of sweeping does not achieve the required annual reductions necessary for this permit cycle based on two quantification methods described in this preliminary Engineering Report (PER). Other VCCS colleges have utilized the Refined Sampling Method, based on a published study and continued sampling of swept material. However, it is not yet known if the Department of Environmental Quality (DEQ) will continue to accept this quantification method. Alternatively, DEQ issued guidance for quantifying pollutant reductions from street sweeping in DEQ Guidance Memo No. 20-2003 (DEQ Guidance), dated November 11, 2020.

Although guidance and not regulation, DEQ may *require* the guidance be used for quantifying pollutant reductions. The DEQ Guidance method is based on data from street solids information and uses a model to determine street sweeping credit. However, the determinations are not based on calibrated sampling information in surface waters and the results are suspect, dramatically reducing the pollutant reduction credits quantified by previous DEQ Guidance and those quantified using the Refined Sampling Method. If the DEQ Guidance quantification method is required, street sweeping alone is not a viable practice towards achieving the required reductions for the current permit cycle.

The purpose of this PER was to reassess the ability of the CVCC Phase II Action Plan to result in pollutant reduction compliance. All potential alternative practices were considered towards achieving the compliance targets, with limited options identified as applicable or feasible. Due to uncertainty regarding compliance based on pollutant reduction quantification from street sweeping and the feasibility constraints for implementing structural stormwater practices, the following concurrent steps are recommended to ensure compliance:

1. As soon as possible, CVCC is recommended to purchase nutrient credits for the full reductions required by 2023 (equivalent to 2.62 lbs of TP with an estimated cost of \$47,160); and
2. (**Optional**) CVCC is recommended to continue street sweeping to a level desired by the College with pollutant reduction quantifications based on the Refined Sampling Method. Sweeping should occur when there has been at least 2-days since rainfall and include annual sampling and chemical testing, similarly conducted by other VCCS colleges. It is recommended the Refined Sampling Method be used for annual reporting. This approach allows for *potential* credit from sweeping at a level quantified by the Refined Sampling Method in the case of continued acceptance by DEQ through the annual reporting process. In this case, credits from sweeping can be applied to reductions required under the subsequent permit cycle, beginning in October 2023.

If CVCC decides not to continue street sweeping as described in Step 2, Step 1 would be sufficient to ensure compliance for the 2023 pollutant reduction targets, with purchase ideally occurring prior to the end of this calendar year to ensure they can be applied prior to the pollutant reduction deadline. It is further recommended that CVCC consider purchase of credits to achieve 100% of the pollutant reductions that will ultimately be required by 2028. To obtain the entirety of the pollutant

reductions required by 2028, 6.55 lbs. of TP could be purchased at a cost of approximately \$117,900.

## 1.0 Introduction

CVCC has developed, implements and enforces a municipal separate storm sewer system (MS4) program designed to reduce the discharge of pollutants from the college's municipal separate storm sewer systems (MS4s) to the maximum extent practicable (MEP) in accordance with the General Virginia Pollutant Discharge Elimination System (VPDES) Permit for Discharges of Stormwater from Small MS4s (MS4 General Permit). The purpose of the program is to protect water quality and to satisfy the appropriate water quality requirements of the State Water Control Law and its attendant regulations. CVCC utilizes the legal authority provided by the laws and regulations of the Commonwealth of Virginia to control discharges to and from the college MS4s through the MS4 General Permit, college policies and specific contract language, as applicable.

Compliance with the MS4 General Permit is dependent on the implementation of best management practices (BMPs) to address minimum control measures described in the permit and Special Condition requirements associated with applicable total maximum daily loads (TMDLs). The CVCC MS4 program plan describes the BMPs to address each permit requirement, including reference to the previously developed CVCC Phase II Chesapeake Bay TMDL Action Plan (Action Plan), latest version dated June 30, 2022. The Action Plan serves as the second phase of an anticipated three-phase plan to ultimately achieve 100% of assigned pollutant reductions by 2028. The current permit requires 40% of the reductions be achieved by October 2023. The Action Plan, as required by the MS4 General Permit, includes:

1. Loading and cumulative reduction calculations, as specified by the permit;
2. Total pollutant reductions achieved during the last permit cycle that concluded in 2018, along with the BMPs implemented and reductions achieved by each;
3. A description of the BMPs to be implemented to achieve the reductions required prior to the expiration of the current permit; and
4. A description of legal authorities necessary to implement the BMP to be employed to achieve the pollutant reductions required by the permit.

For context, this PER also includes Items 1, 2 and 3 listed above, with modifications to Item 3 as part of a reassessment of the Action Plan to ensure compliance with pollutant reduction targets for this permit cycle.

## 2.0 MS4 Pollutant Discharge Characterization

Pollutant load and cumulative reduction calculations are provided in this Section for CVCC’s regulated MS4 discharge. The loading and required reduction calculations are determined using tables provided within the MS4 General Permit and are dependent on the regulated impervious and pervious area draining to the college’s MS4, as reflected in **Table 2.1** and as described in the CVCC Chesapeake Bay TMDL Action Plan. CVCC’s regulated campus lies within the James River Basin of the Chesapeake Bay watershed.

**Table 2.1** Summary of regulated impervious and pervious area for the CVCC regulated campus.

CVCC Campus	MS4 Regulated Area (acres) <sup>1</sup>	
	Impervious	Pervious
Main Campus	20.70	20.10

<sup>1</sup> Reference CVCC Chesapeake Bay TMDL Action Plan for mapping.

### 2.1 Pollutant Loadings

Pollutant loading are computed for each campus using the calculation sheets provided in the MS4 General Permit for the James River Basin. The calculation sheets provide the loading rates, as pounds (lbs) per acre (ac) per year (yr), as reflected in **Table 2.2** for the regulated area of the CVCC campus.

**Table 2.2** CVCC campus loadings based on the James River Basin calculation sheet provided in the MS4 General Permit.

Pollutant	Subsource	Loading Rate (lbs/ac/yr)	Area (acres) <sup>1</sup>	Load (lbs/yr)	Total Load (lbs/yr)
TN	Impervious	9.39	20.70	194.37	334.87
	Pervious	6.99	20.10	140.50	
TP	Impervious	1.76	20.70	36.43	46.48
	Pervious	0.50	20.10	10.05	
TSS	Impervious	676.94	20.70	14,012.66	16,045
	Pervious	101.08	20.10	2,031.71	

<sup>1</sup> Area served by the Hampton campus MS4 within the 2010 Census Urbanized Area.

### 2.2 Required Pollutant Reductions

The required cumulative pollutant reductions are computed for the regulated campus using the calculation sheets provided in the MS4 General Permit for the James River Basin. The



calculation sheets provide the total percentage of the loadings required for the L2 Scoping Run of the Chesapeake Bay Model, as reflected in **Table 2.3**, for computing required reductions from the campus. Additional pollutant reductions as a result of: (1) new sources initiating construction between July 1, 2009, through June 30, 2019 with total phosphorus loadings exceeding 0.45 lbs/acre/yr, or (2) grandfathered projects initiating construction after July 1, 2014, with total phosphorus loadings exceeding 0.45 lbs/acre/yr are not necessary since neither occurred at either regulated campus.

**Table 2.3** CVCC campus required load reductions required by October 2023 based on the James River Basin calculation sheet provided in the MS4 General Permit.

Pollutant	Subsource	Load (lbs/yr) <sup>1</sup>	Total Load Reduction (%) <sup>2</sup>	Required Reduction by 2023 (lbs/yr) <sup>3</sup>	Total Load Reduction by 2023 (lbs/yr) <sup>3</sup>
TN	Impervious	194.37	9	7.00	10.37
	Pervious	140.50	6	3.37	
TP	Impervious	36.43	16	2.33	2.62
	Pervious	10.05	7.25	0.29	
TSS	Impervious	14,013	20	1,121.01	1,192.12
	Pervious	2,032	8.75	71.11	

<sup>1</sup> From Table 2.2.

<sup>2</sup> Percentage of total load reduction per the L2 Scoping Run of the Chesapeake Bay Model.

<sup>3</sup> Represents 40% of the total load reduction, as required for the current permit cycle.

### 3.0 Pollutant Reduction – Phase I Milestones

CVCC’s Chesapeake Bay TMDL Action Plan identified the means and methods to achieve 5% of the total required reductions by July 1, 2018, with implementation, verification of effectiveness and documentation of street sweeping efforts. The following subsection presents the total reductions achieved by July 1, 2018 and describe the implementation to achieve reductions.

#### 3.1 Compliance Summary

CVCC identified street sweeping during the previous permit cycle to achieve at least 5% of the total required reductions, as was required during the previous MS4 General Permit cycle that expired in 2018. CVCC’s Action Plan specified the total annual weight of material that would be required to be annually collected to achieve the 5% target based on the Mass Loading Approach (MLA), as described in the Virginia Department of Environmental Quality (DEQ) Chesapeake Bay Action Plan Guidance Memo (VDEQ 2015). The MLA method is based on sampling of street particulate matter by Law et al. (2008), has been found to overestimate reductions, and is no longer a DEQ-acceptable quantification method. Using the MLA computation methods, CVCC’s 2019 through 2021 MS4 annual report demonstrated that street sweeping far exceeded the 5% target of the total reduction requirement, as reflected in **Table 3.1**.

**Table 3.1** CVCC Phase I Chesapeake Bay TMDL Action Plan compliance summary.

Required Swept Material for the Phase I Action Plan (5% of total reductions) <sup>1</sup> (tons/yr)	Annually Reported Sweeping (tons)		
	2019	2020	2021
0.372	9.511	11.540	1.040

<sup>1</sup> Required to achieve reductions for all pollutants using the Mass Loading Approach (VDEQ 2015) that is no longer accepted by DEQ (see note below).

**Note:** A new DEQ Guidance Memo (No. 20-2003), dated November 11, 2020, has been issued and no longer allows the use of the MLA for quantifying pollutant reductions. The guidance memo presents a new quantification method based on sweeper type, area swept and sweeping frequency. The new DEQ Guidance quantification method significantly reduces the pollutant reductions attributed to street sweeping. However, as discussed in later sections of this PER, several VCCS colleges participates in a study that bases quantification of street sweeping

reductions from separation of the swept TSS-associated particles and subsequent chemical analyses of swept samples (Refined Sampling Method). With the removal of the MLA for quantification, both a new DEQ Guidance quantification method and Refined Sampling Method are evaluated in Section 4 to assess compliance options moving forward related to street sweeping.

## 4.0 Phase II Pollutant Reduction Practices

CVCC has implemented a street sweeping program since 2019 intended to obtain the required reductions to achieve the cumulative 40% of the total reductions by the 2023 expiration date of the current MS4 General Permit. Using the total material swept each year since 2019, quantifications using the Refined Sampling Method, stemming from a continuing study in which several VCCS colleges participate that utilizes an ongoing dataset with results of chemical analysis on the fraction of swept materials associated with total suspended solids (TSS) is provided in **Table 4.1**. Current dataset values for the Refined Sampling Method for quantification of pollutant reductions from total mass of swept material are provided in **Table 4.2**. Note from Table 4.1 that targets for TP and TN have not been achieved the past three years with the current levels of sweeping based on the Refined Sampling Method.

**Table 4.1** Summary of possible reductions achieved by street sweeping the past two reporting periods if using the current values from the Refined Sampling Method, assuming sweeping occurred > 2 days since rainfall. **Red** indicates targets not achieved.

Pollutant	Annual Load Reduction Req'd by 2023 <sup>1</sup> (lbs/yr)	Annual Load Reduction Achieved (tons/yr)		
		2019 (9.51 tons swept)	2020 (11.54 tons swept)	2021 (1.04 tons swept)
TN	10.37	8.31	10.08	0.91
TP	2.62	2.02	2.45	0.22
TSS	1,192.12	12,440.39	15,094.32	1,360.32

<sup>1</sup> From Table 2.3.

**Table 4.2** Estimate of pollutant reduction to surface waters per ton of swept materials, revised values based on refined sampling and current dataset added to each year with continued sampling performed by several VCCS colleges. Values provided are median values within dataset.

Days Since Rain	TP (lbs/ton) <sup>1</sup>	TN (lbs/ton) <sup>1</sup>	TSS (≤ 841 μm) (lbs/ton) <sup>2</sup>
≤ 2	0.044	1.188	794 (39.7%)
> 2	0.324	1.336	1,308 (65.4%)

<sup>1</sup> Values applied to material swept < 841 μm (computed with last column).

<sup>2</sup> Adjusted using a moisture content of 2.2% to compute dry weight, the median value measured in samples presented by Hixon and Dymond (2019).

In review of **Table 4.1**, it is noted that the 2020-2021 sweeping efforts were minimal, resulting in reductions well below the targets. Although results from 2019 and 2020 reporting periods indicate potential for sweeping to achieve the required reductions, an increase in sweeping efforts would be necessary. However, there is additional uncertainty regarding the ability for sweeping to achieve the pollutant reduction targets since the values in **Table 4.2** are based on the Refined Sampling Method that finds higher pollutant reductions than the method presented in the new DEQ guidance. Although guidance, and not regulation, DEQ *may* require the guidance be used for quantifying pollutant reductions. Further assessment of the two quantification methods is provided in the following Section.

#### **4.1 Street Sweeping for Achieving 2023 Reduction Targets**

This Section provides an assessment of the potential for street sweeping to achieve the required 2023 pollutant reductions based on both the Refined Sampling Method and the new DEQ Guidance method, the latter based on area swept, frequency of sweeping and sweeper type. Note the assessment of both methods is based on sweeping being performed with a regenerative-air or vacuum type sweeper.

##### **4.1.1 Street Sweeping - Refined Sampling Method Quantification**

To estimate the annual sweeping effort necessary to achieve the reduction targets, the refined values for quantifying pollutant reductions from **Table 4.2** are applied as:

$$\text{Required Mass Swept (tons)} = \frac{\text{TN or TP Mass Removed (lb)}}{(\% \text{ as TSS} \times \text{Concentration of TP or TN in lb/ton})} \quad (1)$$

Use of Equation 1 solves for required tonnage necessary as the values provided in **Table 4.3**. Based on quantification of reductions with the Refined Sampling Method, each sweeping instance would need to occur when more than 2 days has passed since rainfall since TP reductions in swept material within 2 days since rainfall are very small. If all sweeping instances occurred when more than 2 days since rain, 12.4 tons would need to be annually swept to achieve all of the required pollutant reductions using the Refined Sampling Method for quantifying the reductions. It is noted these amounts may fluctuate over time as the values in the dataset are further refined with continued swept material sampling and analysis. A review of

**Table 4.1** finds the 2019-2020 level of sweeping, which collected 11.54 tons, would annually need to be increased by approximately 8% to achieve all of the required pollutant reductions with sweeping always occurring after two days since rainfall. In addition, as a measure of effectiveness, it is recommended that CVCC begin participation in the sampling and analysis study as a measure of effectiveness.

**Table 4.3** Estimate of required tonnage of swept material to achieve the 2023 required reductions using the Refined Sampling Method for reduction quantification. Note: this pollutant reduction quantification method may not be accepted by DEQ.

Days Since Rain when Sweeping	TN	TP	TSS
	Material Swept (tons)	Material Swept (tons)	Material Swept (tons)
≤ 2	22.0	150 <sup>1</sup>	1.6
> 2	11.9	12.4 <sup>2</sup>	1.0
Target Achieved →	10.37 lbs/yr	2.62 lbs/yr	1,192.12 lbs/yr

<sup>1</sup> Not feasible, so sweeping must occur after 2 days since rainfall. This is due to TP being washed off the surface after rain since it clings to small particles.

<sup>2</sup> Swept mass required to achieve reductions for all pollutants based on the Refined Sampling Method.

#### 4.1.2 Street Sweeping - New DEQ Guidance Quantification

The DEQ Guidance provides pollutant reduction credit based on the frequency a specified area is swept. The credit values are provided as a percentage of removal from the annual pollutant load generated from the swept area using the loading rates in **Table 2.2** for impervious cover. The values in the Guidance are based on data from street solids information and a model to determine street sweeping credit. However, these values are not based on calibrated sampling information in surface waters and the results are suspect in the opinion of the author of this report. In contrast, the Refined Sampling Method is based on years of continuing sampling data that provides an actual measure of the portion of swept material and associated pollutants that would be transported from the swept surface ultimately to surface waters. The DEQ Guidance values dramatically reduce the pollutant reduction credits provided by previous DEQ Guidance and are also significantly lower than reductions quantified with the Refined Sampling Method.

According to the CVCC Chesapeake Bay TMDL Action Plan, there is a total available area for sweeping of approximately 13.66 acres (aka curb lane miles), including parking lots and campus-interior streets. Potential reductions based on various sweeping frequency over the 13.66 acres are provided in **Table 4.4**. Results in the Table show that pollutant reductions from sweeping based on the DEQ Guidance quantification methods do not provide the opportunity to achieve the required reductions with sweeping alone. However, sweeping may serve as a supplemental practice in the case the DEQ Guidance is required to be used in combination with other practices.

**Table 4.4** Potential reductions from street sweeping at CVCC using the DEQ Guidance pollutant reduction quantification method (GM20-2003). Equivalent curb lane miles available = 13.66 acres.

Pollutant	Loading Rate (lbs/ac/yr)	Load (lbs/yr)	Total Load Reduction Credit (lbs/yr) *			
			Every 2 Months	Every Month	Every 2 Weeks	Every Week
TN	9.39	128.27	0.90 (9%)	1.28 (12%)	2.57 (25%)	3.85 (37%)
TP	1.76	24.04	0.48 (18%)	0.72 (28%)	1.20 (46%)	1.92 (73%)
TSS	676.94	9,247	369.88 (31%)	554.82 (47%)	1,017.72 (85%)	1,479.52 (124%)

\* Within parenthesis are the percentage of total reductions achieved of those required by 2023.

#### 4.2 Alternative Options for Achieving 2023 Reduction Targets

In the case the Refined Sampling Method is accepted by DEQ, sweeping efforts with increased efforts, as described in Section 4.1.1, would be adequate for achieving the 2023 reduction targets (> 12.4 tons annually collected with sweeping occurring more than 2 days since rainfall). In the case the Refined Sampling Method is not accepted by DEQ and the DEQ Guidance must be used, additional BMPs to achieve reductions will be necessary. For the latter scenario, of the available means and methods available for achieving reductions, the following were identified to have the potential ability to supplement sweeping for CVCC: (1) structural SWM facilities and (2) the purchase of nutrient credits. Opportunity does not readily present itself for other means and methods available, such as retrofits to existing BMPs, land use change, forest buffers, stream restoration and/or outfall stabilization due to either lack of opportunity on campus or opportunity does not provide for the level of credits needed, or both.

#### 4.2.1 Structural BMP(s)

Assessment of the installation of structural BMPs towards achieving the required 2023 pollutant reduction targets is based on the computation of area that would need to be treated to achieve the targets, both alone, and in combination with street sweeping. The assessment also depends on available locations on the college campus to install BMP(s) that can treat the computed drainage areas and also the type of BMP that could feasibly be installed. A summary of consideration of BMP types is provided in **Table 4.5**. The summary identifies permeable pavement, underground proprietary filtering devices or bioretention facilities as the feasible BMP types to have the potential to achieve reductions towards achieving the 2023 targets. Depending on the sweeping scenario and BMP type, the total impervious area requiring structural BMP treatment is provided in **Tables 4.6.a, 4.6.b and 4.6.c**. A review of the tables finds bioretention most efficient, requiring the least amount of impervious area be treated to achieve the 2023 pollutant reduction targets, despite the sweeping scenario. For example, referring to **Table 4.6.b**, 2.21 acres of impervious area would require treatment to achieving the target reductions for each pollutant if there was no sweeping. If sweeping monthly, 1.55 acres would require treatment from bioretention. For the purpose of this reassessment, a preliminary review of the campus layout, topography and storm sewer system indicates 2 – 6 bioretention facilities would likely be necessary to achieve the reductions, depending on the sweeping scenario. The facilities would be distributed throughout campus at feasible locations receiving the greatest amount of imperviousness possible. Realignment of storm sewer, potential roof drain reconfiguration, possible utility relocation and site modifications would be necessary to direct flows to the facilities.

**Table 4.5** Summary of feasibility considerations for various types of structural BMP options.

Practice Type	Feasibility Considerations	Feasible?
Vegetated Roofs	Not feasible for existing buildings and could not provide significant reductions towards target reductions.	No
Rooftop Disconnection	Insufficient area of rooftop and very limited due to constructability (surface discharge of interior drains).	No
Permeable Pavement	Would require approximately 2.4 to 3.3 acres of transition of existing parking area to pervious pavement. Additional constructability constraints uncertainty regarding grades and	Possible, not



Practice Type	Feasibility Considerations	Feasible?
Permeable Pavement cont.	underdrains. Not feasible to be completed within required timeframe.	presently feasible
Grass channel	Insufficient opportunity and low reduction efficiency could not achieve target reductions.	No
Dry swale	Insufficient opportunity to capture significant impervious cover.	No
Bioretention	Preliminary assessment indicates opportunities. Would likely require 2 – 6 distributed bioretention facilities with realignment of storm sewer and pavement/curbing modifications. Not feasible to be completed within required timeframe.	Possible, not presently feasible
Infiltration	Considered not feasible due to poor soils for infiltration. Similar to bioretention, would require distributed facilities and drainage modifications.	No
Extended Detention Pond	Low reduction efficiency could not provide significant reductions towards target reductions for areas available.	No
Sheet Flow to Open Space	Insufficient opportunities and could not provide significant reductions towards target reductions. Lack of available space.	No
Wet swale	Insufficient opportunities and low reduction efficiency could not provide significant reductions towards target reductions.	No
Filtering Practices	Could achieve reductions. Would require underground proprietary systems at multiple locations and realignment of storm sewer with site modifications.	Possible, not presently feasible
Constructed wetlands/wet pond	Drainage areas and site conditions do not support these types of facilities.	No

<sup>1</sup> Other means and methods allowable in the DEQ Guidance to obtain reductions found not to be applicable to the campus or to provide only very small reductions.

**Table 4.6a** Required impervious area needed for treatment by permeable pavement with various sweeping scenarios. Values based on Chesapeake Bay Program established removal efficiencies for filters: TN = 50%, TP = 45% and TSS = 70%. (Limiting area in **green**)

Structural BMP Scenario <sup>1</sup>	Required Acreage Needed for Treatment by Filtering Device		
	TN	TP	TSS
No Sweeping	2.21	<b>3.32</b>	2.52
Every 2 Months	2.02	<b>2.71</b>	1.74
Once Monthly	1.94	<b>2.40</b>	1.36

<sup>1</sup> Sweeping more frequent than monthly assumed not practical.

**Table 4.6b** Required impervious area needed for treatment by bioretention with various sweeping scenarios. Values based on Chesapeake Bay Program established removal efficiencies for filters: TN = 75%, TP = 70% and TSS = 80%. (Limiting area in **green**)

Structural BMP Scenario <sup>1</sup>	Required Acreage Needed for Treatment by Filtering Device		
	TN	TP	TSS
No Sweeping	1.48	2.13	<b>2.21</b>
Every 2 Months	1.35	<b>1.74</b>	1.52
Once Monthly	1.30	<b>1.55</b>	1.18

<sup>1</sup> Sweeping more frequent than monthly assumed not practical.

**Table 4.6c** Required impervious area needed for treatment by proprietary filtering practice BMPs with various sweeping scenarios. Values based on Chesapeake Bay Program established removal efficiencies for filters: TN = 40%, TP = 60% and TSS = 80%. (Limiting area in **green**)

Structural BMP Scenario <sup>1</sup>	Required Acreage Needed for Treatment by Filtering Device		
	TN	TP	TSS
No Sweeping	<b>2.76</b>	2.48	2.21
Every 2 Months	<b>2.53</b>	2.03	1.52
Once Monthly	<b>2.42</b>	1.80	1.18

<sup>1</sup> Sweeping more frequent than monthly assumed not practical.

#### 4.2.2 Purchase of Perpetual Nutrient and TSS Credits

In accordance with § 62.1-44.19:21 of the Code of Virginia, “an MS4 permittee may acquire, use, and transfer nutrient credits for purposes of compliance with any waste load allocations established as effluent limitations in an MS4 permit ....” This applies to phosphorous, nitrogen, and sediment. with purchase of sediment reduction credits signed into law by the Governor on March 1, 2016. Purchase of credits must be consistent with the following:

- ✓ The perpetual credits are generated and applied for purposes of compliance for the same calendar year;
- ✓ Credits are acquired no later than a date following the calendar year in which the credits are applied as specified by the Department consistent with CVCC MS4 permit annual report deadline under such permit;
- ✓ The credits are generated in the same locality or tributary; and
- ✓ The credits either are point source nitrogen or point source phosphorus credits generated by point sources covered by the general permit issued pursuant to § 62.1-44.19:14, or are certified pursuant to § 62.1-44.19:20.

With the development of this PER, it was confirmed that credits for the required 2023 reductions are currently available within the watershed; but these credits cannot be reserved or guaranteed at a future date. Specifically, available credit would be purchased per pound of TP with 1.0 pound purchased of TP also providing 7.208 pounds of TN and 492.85 pounds of TSS reductions, respectively. As a result, purchase of the required 2023 TP reductions would provide 182% and 108% of the required TN and TSS reductions, respectfully.

## 5.0 Phase II Compliance Practices

Findings in this PER identify limited means and methods for addressing the 2023 pollutant reduction targets with the *potential* of the new DEQ Guidance being required for quantifying street sweeping pollutant reductions. However, in the case of continued acceptance of the Refined Sampling Method, street sweeping does have the potential to address the required 2023 reductions with a dedicated annual sweeping program (refer to Table 4.3). In summary, the following scenarios have been identified as having potential to provide compliance with the required 2023 reductions:

- **Scenario 1 (Conditional on DEQ Acceptance):** In the case of continued DEQ receipt of the Refined Sampling Method (**uncertain**), CVCC can achieve the 2023 pollutant reductions with annual sweeping of approximately 12.5 tons of material collected with annual sampling and analyses as a measure of effectiveness; or
- **Scenario 2:** In the case that DEQ requires pollutant reduction quantification for street sweeping using the DEQ Guidance, bioretention facility BMPs would be necessary to treat 1.55 – 2.21 acres, depending on the level of sweeping that would occur as part of this scenario (refer to Table 4.4); or
- **Scenario 3:** Purchase of TP, TN and TSS credits for the full reductions, or for partial reductions to supplement a selected sweeping frequency (refer to Table 4.4).

### 5.1 Scenario 1 Considerations

This scenario requires DEQ acceptance of the Refined Sampling Method, and thus does not guarantee compliance with the required 2023 pollutant reductions. The DEQ Guidance states it “... does not mandate any particular method nor does it prohibit any alternative method.” The Guidance also states, “If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.” Therefore, the continued acceptance of the Refined Sampling Method utilized by other VCCS colleges over the current permit cycle are dependent on DEQ review and acceptance for future compliance, which is not likely to be immediately forthcoming. However, the Refined Sampling Method is suggested to have technical compliance based on the following:

- ✓ Quantification is only based on the portion of collected material that would be expected to be transported in runoff to downstream receiving waters.

- ✓ TN and TP concentrations are estimated based on chemical analysis at a certified laboratory for the sieved portion of material associated with the particles expected to be transported in runoff to downstream receiving waters.
- ✓ Participating colleges take multiple samples each year of swept material as a measure of effectiveness, with results included in a database to continue tightening the statistical significance of the data. Quantification values are revised, as necessary, for annual reporting.

This scenario has the smallest impact on the college regarding cost and resources, but the quantification method is not guaranteed to be accepted by DEQ and requires annual implementation to a compliant level, which has not been consistently implemented over the past few years (refer to Table 4.1). However, there is potential the Refined Sampling Method will continue to be accepted by DEQ and is therefore recommended to be implemented and reported in combination with Scenario 3 (see Section 5.3). *Note: this scenario is not recommended without purchase of nutrient credits as a fail-safe for compliance.*

## **5.2 Scenario 2 Considerations**

Scenario 2, based on the case the DEQ Guidance quantification is required, has a significant impact whereas multiple bioretention facility BMPs would be necessary to achieve the required reductions, even with implementation of a street sweeping program (see **Table 5.1**). Further, due to the time necessary for budgeting, planning, design and construction, the option of including bioretention facility BMPs at this scale is not feasible to achieve the pollutant reductions required by the October 2023 deadline. See also the cost considerations in Section 6.0. This scenario, in part, may want to be reconsidered in the next permit cycle, depending on the level of reductions achieved at that time.

**Table 5.1** Estimate of required bioretention facility BMPs dependent on combined sweeping program scenarios.

Sweeping Frequency	Remaining Reduction			Estimated Area Needing Treatment (acres)	Associated # of Bioretention Facility BMPs <sup>2</sup>
	TN <sup>1</sup>	TP <sup>1</sup>	TSS		
No Sweeping	10.37	2.62	1193	2.21	<b>4 to 6</b>
Every 2 Months	9.47	2.14	823	1.74	<b>3 to 5</b>
Monthly	9.09	1.90	638	1.55	<b>3 to 5</b>
Every 2 Weeks	7.80	1.42	175	1.16	<b>2 to 4</b>
Weekly	6.52	0.70	-287	0.93	<b>2 to 3</b>

<sup>1</sup> TP is limiting pollutant, with the exception of weekly sweeping, for which TN becomes limiting.

<sup>2</sup> Estimate based on preliminary campus assessment. See also Section 6.0 for cost considerations.

### 5.3 Scenario 3 Considerations (Recommended Scenario)

Due to uncertainty regarding compliance with Scenario 1 and the feasibility constraints of Scenario 2, Scenario 3 is recommended for implementation to achieve the 2023 pollutant reduction targets. The implementation of Scenario 3 is proposed with the following concurrent steps:

1. As soon as possible, CVCC is recommended to purchase nutrient credits for the full reductions required by 2023 (equivalent to 2.62 lbs of TP); and
2. **(Optional)** CVCC is recommended to continue street sweeping to a level desirable by the college with annual reporting quantification based on the Refined Sampling Method, including implementing annual chemical testing, similar to other VCCS colleges, of swept samples (4/year). This approach allows for *potential* credit from sweeping at a level quantified by the Refined Sampling Method in the case of continued acceptance by DEQ through the annual reporting process. In this case, the additional credit can be applied to the subsequent permit cycle beginning after October 2023.

If CVCC decides not to continue street sweeping, Step 1 would be sufficient to ensure compliance and the necessary credits should be purchased as soon as possible, ideally prior to the end of the calendar year to ensure they can be applied prior to the pollutant reduction deadline.

## 6.0 Cost Considerations

As demonstrated in this PER, opportunities to achieve the required pollutant reductions by 2023 for the Chesapeake Bay TMDL are limited to scenarios involving purchase of nutrient credits, with or without supplemental street sweeping. In the case that sweeping is paired with nutrient credit purchase, and anticipating that the DEQ Guidance for pollutant reduction quantification has to be used, the required amount of credit that would need to be purchased is associated with the remaining TP reductions in Table 5.1. For example, if street sweeping is not employed as a practice, 2.62 lbs. of TP would need to be purchased; but if sweeping occurred monthly, 1.90 lbs. would need to be purchased. A summary of associated costs for the Scenarios described in Section 5 are provided in **Table 6.1**. Purchase of nutrient credits is by far the most cost-effective option for CVCC. Scenario 2 is not feasible within timeframe, but provided for comparison and for possible consideration in during the next permit cycle.

**Table 6.1** Preliminary cost estimates based on identified scenarios for achieving compliance of the required 2023 Chesapeake Bay TMDL pollutant reductions.

Scenario	Implementation Description	Implementation Cost (\$)	Notes
1	Sweep 12.4 tons/year quantify using Refined Sampling Method. <b>Not guaranteed for acceptance by DEQ at this time. Requires implementation of Scenario 3, as fail-safe.</b>	See notes	Recommended college use past sweeping cost for estimate. Recommend cost for 2020 sweeping with a multiplier of 1.3.
2	Bioretention with no sweeping or sweeping every 1 to 2 months, 3 to 6 BMPs required.	\$160,000 to \$300,000 + Cost associated with Scenario 1 for sweeping	Cost range for filters - estimated cost for survey, design, construction and construction administration + sweeping costs (per applicable frequency). <b>Not feasible within timeframe.</b>
	Bioretention with sweeping every 2 weeks, 2 to 4 BMPs required.	\$120,000 to \$190,000 + plus sweeper cost \$280,000 <sup>1</sup>	
	Bioretention with weekly sweeping, 2 to 3 BMPs required.	\$1320,000 to \$150,000 + plus sweeper cost \$280,000 <sup>1</sup>	
3	Purchase of full nutrient credits to achieve the 2023 reduction targets.	\$47,160 + Cost associated with Scenario 1 for sweeping (sweeping optional) <sup>2</sup>	Cost based on purchase of 2.62 lbs. TP at \$18,000/lb. (current estimate).

<sup>1</sup> Assumes sweeping frequency necessitates purchase of sweeper.

<sup>2</sup> Sweeping optional, but allows for opportunity to receive credit using the Refined Sampling Method that could be applied to required future reductions. Credit cost subject to change.