VIMS | William & Mary
Virginia Institute of Marine Science

Chesapeake Bay TMDL Action Plan

September 2023

vhb

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Acknowledgements

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List of Abbreviations

Title	Abbreviation
Best Management Practice	BMP
Chesapeake Bay Local Assistance Department	CBLAD
Chesapeake Bay Preservation Act	CBPA
Capital Improvement Project	CIP
Virginia Department of Conservation and Recreation	DCR
Virginia Department of Environmental Quality	DEQ
Department of General Services	DGS
Edge of Stream	EOS
Environmental Protection Agency	EPA
Intensely Developed Area	IDA
Leadership in Energy and Environmental Design	LEED
Low Impact Design	LID
Minimum Control Measure	MCM
Minimum Standard	MS
Municipal Separate Storm Sewer Systems	MS4
National Pollution Discharge Elimination System	NPDES
Pollutant of Concern	POC
Resource Protection Area	RPA
Stormwater Improvement Project	SIP
Stormwater Management	SWM
Stormwater Management Masterplan	SWMP
Stormwater Pollution Prevention Plan	SWPPP
Total Maximum Daily Load	TMDL
Total Nitrogen	TN
Total Phosphorus	TP
Total Suspended Solids	TSS
Vanasse Hangen Brustlin	VHB
Virginia Institute of Marine Science	VIMS
Virginia Erosion and Sediment Control Program	VESCP
Virginia Pollution Discharge Elimination System	VPDES
Virginia Stormwater Management Handbook	VSMH
Virginia Stormwater Management Program	VSMP
Watershed Implementation Plan	WIP

1. Introduction

Purpose

This Chesapeake Bay Total Maximum Daily Load (TMDL) Action Plan was written to describe the means and methods by which Virginia Institute of Marine Science (VIMS) intends to meet the Special Condition for the Chesapeake Bay TMDL. This Special Condition is located in the General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems which was effective as of July 1, 2013, and states that Small Municipal Separate Storm Sewer Systems (MS4) must create a TMDL Action Plan and submit the plan to the Virginia Department of Environmental Quality (DEQ).

VIMS' MS4 permit (VAR040052) requires action plans to be implemented for the impaired bodies of water to which it discharges stormwater runoff. The ultimate discharge point for VIMS is the Chesapeake Bay. The entire campus drains to the York River. A TMDL is assigned to determine a waste load allocation to VIMS that establishes the maximum amount of pollutant that can enter an impaired water without violating water quality standards.

The TMDL for the Chesapeake Bay was established by the EPA in 2010 and targets specific Pollutants of Concern (POCs). POCs included in the TMDL are total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS). Virginia developed a Chesapeake Bay TMDL Watershed Implementation Plan (WIP) that implements an outline for meeting the Chesapeake Bay TMDL. The WIP requires a phased approach over three five-year permit cycles for meeting required POC reductions in order to meet the final TMDL target goal. The reductions include a 5% first permit cycle reduction, which will need to be accomplished by the end of the first permit cycle (June 30, 2018), a 35% second permit cycle reduction, which will need to be accomplished by the end of the second permit cycle (June 30, 2023), and a 60% third permit cycle reduction which will need to be accomplished by the end of the third permit cycle (June 30, 2028). The total reduction thus is 100% of the TMDL requirement.

Reductions are applied to 2009 Edge of Stream (EOS) loading rates for each POC as defined by the Chesapeake Bay Program Watershed Model Phase 5.3.2 for the York River Basin. A target reduction percent in the 2009 EOS loading rates must be met in order meet the TMDL target goal at the end of the third permit cycle. The reduction target percent is defined for each POC by the Chesapeake Bay WIP. Target reduction percentages are further broken into two categories for impervious and pervious cover. Impervious areas must show a reduction of 9.0% for TN loads, 16% for TP loads, and 20% for TSS loads. Pervious areas must show a reduction of 6.0% for TN loads, 7.25% for TP loads, and 8.75% for TSS loads.

This plan will establish how VIMS intends to meet the 5%, 35%, and 60% reduction requirements by the end of the first, second, and third permit cycles to stay in compliance with their MS4 Permit and the Chesapeake Bay TMDL Special Condition Guidance developed by DEQ. This plan follows the order specified in Guidance Memo No. 15-2005 set forth by DEQ and dated May 18, 2015.
The following elements are included within this Action Plan:

1. Current Program and Existing Legal Authority
2. New or Modified Legal Authority
3. Means and Methods to Address Discharges from New Sources
4. Estimated Existing Source Loads and Calculated Total Pollutant of Concern Required Reductions
5. Means and Methods to Meet the Required Reductions and Schedule
6. Means and Methods to Offset Increased Loads From New Sources Initiating Construction Between July 1, 2009 and June 30, 2014
7. Means and Methods to Offset Increased Loads from Grandfathered Projects that Begin Construction After July 1, 2014
8. List of Future Projects and Associated Acreage that Qualify as Grandfathered
9. An Estimate of the Expected Cost to Implement the Necessary Reductions
10. Public Comments on Draft Action Plan

MS4 Permit Compliance

Table 1 of this plan provides the requirements of VIMS' MS4 permit and the specific section of this plan where the requirement is met by VIMS' MS4 Program Plan. Additionally, *Table 1* also describes actions VIMS has taken to meet the requirements specified by the MS4 permit.

Table 1: MS4 Permit Compliance

VIMS TDML Action Plan Section	Element from DEQ TMDL Special Condition Guidance	MS4 General Permit Section	MS4 Permit Requirement
2	Part VI.1 - Current Program and Existing Legal Authority	I.C.2.a(1)	A review of the current MS4 program implemented as a requirement of this state permit including a review of the existing legal authorities and the operator's ability to ensure compliance with this special condition
2	Part VI.2 - New or Modified Legal Authority	I.C.2.a(2)	The identification of any new or modified legal authorities such as ordinances, state and other permits, orders, specific contract language, and interjurisdictional agreements implemented or needing to be implemented to meet the requirements of this special condition

3	Part VI.3 - Means and Methods to Address Discharges from New Sources	I.C.2.a(3)	The means and methods that will be utilized to address discharges into the MS4 from new sources
4	Part VI.4 - Estimated Existing Source Loads and Calculated Total Pollutants of Concern (POC) Required Reductions	I.C.2.a(4) and I.C.2.a(5)	An estimate of the annual POC loads discharged from the existing sources as of June 30, 2009, based on the 2009 progress run. The operator shall utilize the applicable versions of Tables 2 a-d in this section based on the river basin to which the MS4 discharges by multiplying the total existing acres served by the MS4 on June 30, 2009, and the 2009 Edge of Stream (EOS) loading rate. A determination of the total pollutant load reductions necessary to reduce the annual POC loads from existing sources utilizing the applicable versions of Tables 3 a-d in this section based on the river basin to which the MS4 discharges. This shall be calculated by multiplying the total existing acres served by the MS4 by the required reduction in loading rate. For the purposes of this determination, the operator shall utilize those existing acres identified by the 2000 U.S. Census Bureau urbanized area and served by the MS4
5	Part VI.5 - Means and Methods to Meet the Required Reductions and Schedule	I.C.2.a(6)	The means and methods, such as management practices and retrofit programs that will be utilized to meet the required reductions included in subdivision 2 a (5) of this subsection, and a schedule to achieve those reductions. The schedule should include annual benchmarks to demonstrate the ongoing progress in meeting those reductions

6	Part VI.6 - Means and Methods to Offset Increased Loads from New Sources Initiating Construction between July 1, 2009 and June 30, 2014	I.C.2.a(7)	The means and methods to offset the increased loads from new sources initiating construction between July 1, 2009, and June 30, 2014, that disturb one acre or greater as a result of the utilization of an average land cover condition greater than 16% impervious cover for the design of post-development stormwater management facilities. The operator shall utilize Table 4 to develop the equivalent pollutant load for TN and TSS.
7	Part VI.7 - Means and Methods to Offset Increased Loads from Grandfathered Projects that Begin Construction after July 1, 2014	I.C.2.a(8)	The means and methods to offset the increased loads from projects as grandfathered in accordance with 9VAC25-870-48, that disturb one acre or greater that begin construction after July 1, 2014, where the project utilizes an average land cover condition greater than 16% impervious cover in the design of post-development stormwater management facilities. The operator shall utilize Table 4 to develop the equivalent pollutant load for TN and TSS.
8	Part VI.8 - List of Future Projects and Associated Acreage that Qualify as Grandathered	I.C.2.a(10)	A list of future projects and associated acreage that qualify as grandfathered in accordance with 9VAC25-870-48;
9	Part VI.9 - Estimated Expected Cost to Implement Necessary Reductions	I.C.2.a(11)	An estimate of the expected costs to implement the requirements of this special condition during the state permit cycle.
10	Part VI.10.a&b - Public Comments on Draft Action Plan	I.C.2.a(12)	An opportunity for receipt and consideration of public comment regarding the draft Chesapeake Bay TMDL Action Plan.

Summary

In accordance with the MS4 Permit, VIMS must calculate required permit cycle reductions and offsets for the following:

- Existing sources as of June 30, 2009
- Sources beginning construction between July 1, 2009 and June 30, 2014,
- Grandfathered sources beginning construction after July 1, 2014

Existing best management practices (BMPs) that were constructed simultaneously with pollutant sources will provide offset for the required first permit cycle reductions. BMPs that are outlined in the 2016 VIMS Stormwater Master Plan will provide pollutant offset for the required second and third permit cycle reductions. Total POC Load Reductions required by the permit cycles and associated offsets can be found in *Table 2A* through *Table 2B* of this plan. Calculations to determine load reductions can be found in *Table 3A* through *Table 3B* of this plan. Offset calculations can be found in *Appendix B*.

Table 2A: Summary of Required and Achieved Reductions – Second Permit Cycle

Pollutant of Concern	2009 POC Load (lbs/yr)	MS4 Target POC Load (lbs/yr)	Second Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Total POC Load Reduction Required by Second Permit Cycle (lbs/yr)	Second Permit Cycle POC Load Reduction Achieved (lbs/yr)
Total Nitrogen	311.31	288.91	0.391	**7.84**	**19.05**
Total Phosphorus	38.14	33.13	0.098	**1.75**	**1.85**
Total Suspended Solids	9530.81	7823.46	34.181	**597.57**	**1545.87**

Table 2B: Summary of Required and Achieved Reductions – Third Permit Cycle

Pollutant of Concern	2009 POC Load (lbs/yr)	MS4 Target POC Load (lbs/yr)	Third Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Third POC Load Reduction Required by First Permit Cycle (lbs/yr)	Third Permit Cycle POC Load Reduction Achieved (lbs/yr)
Total Nitrogen	311.31	288.91	0.670	**13.44**	**58.70**
Total Phosphorus	38.14	33.13	0.167	**3.01**	**4.91**
Total Suspended Solids	9530.81	7823.46	58.596	**1024.41**	**4481.13**

2. Current Program and Legal Authority

Current Program and Existing Legal Authority

As an operator of an MS4, the Virginia Institute of Marine Science must develop, implement, and enforce an MS4 Program Plan as stated in Phase II MS4 regulations. VIMS has created an MS4 Program Plan that is continually updated and monitored to ensure VIMS meets MS4 regulations. This MS4 Program Plan ensures the VIMS is acting in the most effective manner to reduce pollutant discharge, protect water quality, and ensure compliance with water quality standards. Additionally, the MS4 Program Plan ensures that VIMS is adhering to the Clean Water Act, the MS4 permit regulations, and other associated regulations.

The VIMS MS4 Program Plan is managed by the Office of Safety and Environmental Programs in addition to Facilities Management and includes updating the MS4 Program Plan and the MS4 General Permit Annual Report. Six Minimum Control Measures (MCMs) are outlined in the Phase II MS4 General Permit:

- Public Education and Outreach on Stormwater Impacts
- Public Involvement and Participation
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Control
- Post Construction Stormwater Management
- Pollution Prevention and Good Housekeeping for Municipal Operations

Best Management Practices have been integrated into these six MCMs to assist in protecting the water quality within the regulated acreage that ultimately discharges into the Chesapeake Bay. The VIMS' MS4 Program Plan lists each of the six MCMs and activities that VIMS is pursuing to meet them.

Stormwater policies that have been implemented by VIMS within the MS4 Program Plan to administer the Program and comply with the MCMs. These policies can be found on the VIMS' Stormwater Management Webpage.

- Stormwater Management Master Plan, November 2016
- Illicit Discharge Detection and Elimination Program, September 2016
- Stormwater Pollution Prevention Plans, September 2016

New or Modified Legal Authority

New or modified legal authorities are not required for compliance with the Special Condition for the Chesapeake Bay TMDL. VIMS possesses the authorities necessary to meet pollution reduction goals.

VIMS and neighboring MS4 jurisdictions are responsible for the drainage area within their boundaries. In the event that an agreement is made with a neighboring MS4 operator that provides more easily managed compliance, this TMDL Action Plan will be updated.

3. Means and Methods to Address Discharges from New Sources

VIMS must introduce and implement means and methods to offset pollutant loads from new sources. To offset pollutant loads, provisions of the Virginia Stormwater Management Program (VSMP), as of the 2014 revisions, require that for a redevelopment project site of less than 1 acre, TP loadings from that site be reduced by 10%. For a redevelopment project site of greater than 1 acre, VSMP Regulations require TP loadings from that site be reduced by 20% as compared to the existing developed conditions. VSMP Regulations identify TP loading as the "keystone" indicator of runoff water quality. As TP is present in stormwater runoff in both particulate and soluble form, its concentration in stormwater runoff is considered indicative of the presence of other pollutants (TN, TSS) that exist in either form. VSMP regulations requires all new developments to remove 0.41 pounds of TP per acre per year. The Virginia Stormwater Management Handbook (VSMH) evaluates BMP pollutant removal performance in terms of percentage of TP removed. TP removal loads are used to determine TN and TSS removal loads through use of pollutant loading ratios found in *Table 4* of the MS4 General Permit regulations and *Appendix B* of this plan.

Since VIMS is a graduate school of the College of William and Mary, the ESC and SWM plan approval and application process is governed by the College of William and Mary Annual Standards and Specifications. Construction documents are developed by a design team hired by VIMS which includes surveyors, engineers, and landscape architects. Plans are designed to comply with the Virginia Standards and to comply with the MS4 General Permit regulations.

Following plan approval, general contractors are responsible for obtaining the necessary land disturbance permits and attending preconstruction meetings with VIMS officials. The purpose of the preconstruction meeting is to review all erosion and sediment controls once they are installed on site and to confirm they comply with the approved plans. The contractor is also responsible for maintaining the latest approved set of plans and the SWPPP on-site for each project during the extent of construction. A certified inspector is responsible for making sure each inspection is completed for the site.

A preconstruction meeting is also held prior to installation of any permanent water quality BMPs. Following construction, permanent stormwater facilities are inspected for conformance with plans, specifications, and standards. Annual inspection of stormwater facilities will be conducted with maintenance being performed as required by the contractor, or VIMS Facilities Management staff.

In addition to measures discussed within this TMDL Action Plan, VIMS has a previously completed Stormwater Master Plan previously provided to the Virginia DEQ. This Master Plan outlines several Stormwater Improvement and Capital Improvement projects that can be implemented on campus to meet future Permit Cycle pollutant reduction goals. Campus-wide Stormwater Pollution Prevention Plans

are to be submitted as part of the VIMS' MS4 Program Plan to assist in facilitating the measures for maintaining current and future best management practices.

4. Estimated Existing Source Loads and Calculated Total Pollutant of Concern (POC) Required Reductions

MS4 Area Delineation

In order to estimate the existing source loads within VIMS' regulated area, an MS4 boundary for the campus was outlined. The MS4 area delineation as well as areas of pervious and impervious regulated land are determined based on data from the 2016 Stormwater Master Plan (SWMP). Area delineation is calculated in the SWMP using GIS data and survey for the VIMS campus that was generated from an aerial flown in 2016. GIS data was supplemented by various record drawings of completed projects on the VIMS campus. A map of VIMS' MS4 boundary can be found in *Appendix A*.

In accordance with DEQ's Chesapeake Bay TMDL Special Guidance, VIMS may exclude from its MS4 service area land regulated under any general VPDES permit that addresses industrial stormwater or forested land one half contiguous acre or more that meets specific criteria. VIMS has not identified any property with a VPDES industrial stormwater permit or forested area within its MS4 boundary. If a property within the VIMS campus obtains an industrial stormwater permit, further analysis would be necessary to determine if this property meets specific criteria to be excluded from the MS4 service area delineation.

Existing Source Loads

Existing source loads for TP, TN, and TSS were calculated using 2009 Edge of Stream (EOS) loading rates specified in the MS4 General Permit. Since the VIMS campus is in the York River watershed, 2009 EOS rates were taken from *Table 2D* of the MS4 General Permit. Loading rates were applied to impervious and pervious cover and summed to determine total existing source loads. See *Table 3A* through *3B* of this plan for existing source load calculations.

Total POC Reduction Requirements

Total pollutant of concern (POC) reduction requirements were calculated using 2009 EOS loading rates that were reduced to meet the final TMDL target goals as required by the Chesapeake Bay Watershed Implementation Plan (WIP). Loading rates for the York River watershed can be found in *Table 2D* of the MS4 Permit. The loading rate reduction percentage is defined by the Chesapeake Bay WIP for each specific POC and land cover type. MS4 Impervious areas must show a reduction of 9.0% for TN loads, 16% for TP loads, and 20% for TSS loads. MS4 Pervious areas must show a reduction of 6.0% for TN loads, 7.25% for TP loads, and 8.75% for TSS loads. Reduced loading rates were then used to determine reduced final POC loads required at the end of the third permit cycle.

After determining the total net reduction required to meet TMDL target goals, the percent reduction for each POC for each permit cycle was calculated. Reduction required for pervious and impervious cover were summed to determine a total reduction required for each POC for each permit cycle. *Table 3A* through *3B* of this plan summarizes POC reduction requirements.

Total POC Source Loads and Second Permit Cycle Required Load Reductions

2023 VIMS Chesapeake Bay TMDL Action Plan

VHB Project No.: 34588.03
Date: 9/28/2023
Computed By: KMB
Checked By: JDH

Two Columbus Center
4500 Main Street, Suite 400
Virginia Beach, VA 23462
(757) 490-0132

Campus MS4 Area: 41.45 acres
Impervious MS4 Area: 17.00 acres
Watershed: York River

Table 3: Summary of Existing Source Loads and POC Reduction Required

			1	2	3	4	5	6	7
Pollutant of Concern	**Impervious Area Served by MS4 (acre)**	**Pervious Area Served by MS4 (acre)**	**2009 EOS Loading Rate (lbs/acre/yr)**	**2009 POC Load (lbs/yr)**	**MS4 Required Loading Rate Reduction (%)**	**Final MS4 Target Loading Rate (lbs/acre/yr)**	**MS4 Target POC Load (lbs/yr)**	**Second Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)**	**Total POC Load Reduction Required by Second Permit Cycle (lbs/yr)**
Nitrogen	17.00		7.31	124.27	9.00	6.65	113.09	0.230	3.91
		24.45	7.65	187.04	6.00	7.19	175.82	0.161	3.93
			Total:	311.31			288.91	0.391	**7.84**
								Second Permit Cycle Total Reduction Achieved*:	11.94
								Excess First Permit Cycle Reduction Achieved:	7.11
								Total Reduction Achieved*:	**19.05**
Phosphorus	17.00		1.51	25.67	16.00	1.27	21.56	0.085	1.44
		24.45	0.51	12.47	7.25	0.47	11.57	0.013	0.32
			Total:	38.14			33.13	0.098	**1.75**
								Second Permit Cycle Total Reduction Achieved*:	1.13
								Excess First Permit Cycle Reduction Achieved:	0.72
								Total Reduction Achieved*:	**1.85**
Total Suspended Solids	17.00		456.68	7763.56	20.00	365.34	6210.85	31.968	543.45
		24.45	72.28	1767.25	8.75	65.96	1612.61	2.214	54.12
			Total:	9530.81			7823.46	34.181	**597.57**
								Second Permit Cycle Total Reduction Achieved*:	876.7
								Excess First Permit Cycle Reduction Achieved:	669.17
								Total Reduction Achieved*:	**1545.87**

1. 2009 EOS Loading Rates from Chesapeake Bay Program Watershed Model Phase 5.3.2 for the York River Basin.
2. 2009 POC Load is determined by applying the 2009 EOS Loading Rate for impervious and pervious areas to areas within the VIMS Campus MS4 Area. [POC Load] = [MS4 Area] * [2009 EOS Loading Rate].
3. MS4 Required Loading Rate Reduction is defined by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan.
4. Final MS4 Target Loading Rate is the 2009 EOS Loading Rate after the required loading rate reduction has been applied. [Final MS4 Target Loading Rate] = [2009 EOS Loading Rate] - [MS4 Required Loading Rate Reduction]/100 * [2009 EOS Loading Rate].
5. MS4 Target POC Load is determined by applying the Final MS4 Target Loading Rate for impervious and pervious areas to areas within the VIMS campus MS4 area. [MS4 Target POC Load] = [MS4 Area] * [Final MS4 Loading Rate].
6. A 35% Reduction in the POC Loading Rate is required by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan for the Second Permit Cycle. [Second Permit Cycle Reduction in Loading Rate] = [2009 EOS Loading Rate] - [Final MS4 Target Loading Rate] * 35%.
7. Total POC Load Reduction Required by Second Permit Cycle is 35% of the total load reduction required by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan for the Second Permit Cycle. [Total POC Load Reduction Required by Second

* Refer to Appendix B for Achieved Permit Cycle Reductions.

Total POC Source Loads and Third Permit Cycle Required Load Reductions

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Table 3: Summary of Existing Source Loads and POC Reduction Required

			1	2	3	4	5	6	7
Pollutant of Concern	**Impervious Area Served by MS4 (acre)**	**Pervious Area Served by MS4 (acre)**	**2009 EOS Loading Rate (lbs/acre/yr)**	**2009 POC Load (lbs/yr)**	**MS4 Required Loading Rate Reduction (%)**	**Final MS4 Target Loading Rate (lbs/acre/yr)**	**MS4 Target POC Load (lbs/yr)**	**Third Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)**	**Total POC Load Reduction Required by Third Permit Cycle (lbs/yr)**
Nitrogen	17.00		7.31	124.27	9.00	6.65	113.09	0.395	6.71
		24.45	7.65	187.04	6.00	7.19	175.82	0.275	6.73
			Total:	311.31			288.91	0.670	**13.44**
								Third Permit Cycle Total Reduction Achieved*:	47.49
								Excess Second Permit Cycle Reduction Achieved:	11.21
								Total Reduction Achieved*:	**58.70**
Phosphorus	17.00		1.51	25.67	16.00	1.27	21.56	0.145	2.46
		24.45	0.51	12.47	7.25	0.47	11.57	0.022	0.54
			Total:	38.14			33.13	0.167	**3.01**
								Third Permit Cycle Total Reduction Achieved*:	4.81
								Excess Second Permit Cycle Reduction Achieved:	0.10
								Total Reduction Achieved*:	**4.91**
Total Suspended Solids	17.00		456.68	7763.56	20.00	365.34	6210.85	54.802	931.63
		24.45	72.28	1767.25	8.75	65.96	1612.61	3.795	92.78
			Total:	9530.81			7823.46	58.596	**1024.41**
								Third Permit Cycle Total Reduction Achieved*:	3532.83
								Excess Second Permit Cycle Reduction Achieved:	948.30
								Total Reduction Achieved*:	**4481.13**

1. 2009 EOS Loading Rates from Chesapeake Bay Program Watershed Model Phase 5.3.2 for the York River Basin.
2. 2009 POC Load is determined by applying the 2009 EOS Loading Rate for impervious and pervious areas to areas within the VIMS Campus MS4 Area. [POC Load] = [MS4 Area] * [2009 EOS Loading Rate].
3. MS4 Required Loading Rate Reduction is defined by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan.
4. Final MS4 Target Loading Rate is the 2009 EOS Loading Rate after the required loading rate reduction has been applied. [Final MS4 Target Loading Rate] = [2009 EOS Loading Rate] - [MS4 Required Loading Rate Reduction]/100 * [2009 EOS Loading Rate].
5. MS4 Target POC Load is determined by applying the Final MS4 Target Loading Rate for impervious and pervious areas to areas within the VIMS campus MS4 area. [MS4 Target POC Load] = [MS4 Area] * [Final MS4 Loading Rate].
6. A 60% Reduction in the POC Loading Rate is required by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan for the Third Permit Cycle. [THird Permit Cycle Reduction in Loading Rate] = [2009 EOS Loading Rate] - [Final MS4 Target Loading Rate] * 60%.
7. Total POC Load Reduction Required by Third Permit Cycle is 60% of the total load reduction required by the Phase II Chesapeake Bay TMDL Watershed Implementation Plan for the Third Permit Cycle. [Total POC Load Reduction Required by Third Permit Cycle] = [2009 EOS POC Load - [Final MS4 Target POC Load] * 60%.

* Refer to Appendix B for Achieved Permit Cycle Reductions.

5. Means and Methods to Meet the Required Reductions and Schedules

Best Management Practices

Best Management Practices (BMP) are used extensively by VIMS to offset sources of pollutant loads. It is a common VIMS practice to construct BMPs as part of Capital Improvement Projects (CIPs) and Stormwater Improvement Projects (SIPs) located on campus. These BMPs are intended to provide water quality treatment and to offset increases in pollutant loads that are associated with developments. Additionally, these BMPs provide surplus treatment that can be used to offset future increases in pollutant loads. The sum offset provided by existing condition BMPs provided enough credit to meet the 5% first permit cycle reduction requirements. BMPs that are planned to be constructed with future CIPs and SIPs will provide additional credit to meet the second and third permit cycle reduction requirements. Since TP is considered a "keystone" pollutant, reduction calculations were performed to target solely TP. Pollutant loading ratios found in *Table 4* of the MS4 General Permit regulations were used to calculate required TN and TSS reductions. See *Appendix B* of this plan for a summary of existing BMPs and associated pollutant offsets.

2016 Virginia Institute of Marine Science Master Plan

The 2016 VIMS Stormwater Master Plan (SWMP) has been previously submitted to DEQ in July 2017. The goal of the SWMP is to provide a "menu" of Capital Improvement Projects (CIPs), and Stormwater Improvement Projects (SIPs) that could be implemented to meet TMDL reduction goals using a variety of BMPs. CIPs are projects that have State funding allocated for their construction and typically include buildings, additions, or improvements to the VIMS campus. SIPs are stand-alone projects that improve the VIMS campus water quality performance and are not tied to any CIP budget. The Master Plan outlines the reduction potential for six CIPs and four SIPs on the VIMS campus. These projects provide enough pollutant offset to meet VIMS TMDL goals and will be used towards meeting permit cycle goals.

First Permit Cycle:

The first permit cycle reduction goals have been met with one existing BMP and two proposed BMPs associated with CIPs. Existing BMPs include an infiltration basin that was utilized with the Facilities Management Building project, called the Moat. Proposed BMPs include two bioretention basins that were constructed with the Davis Hall project.

Second Permit Cycle:

The second permit cycle goals have been met with a total of three proposed BMPs, one existing BMP, and a purchase of nutrient credits with the Acuff Center for Aquaculture and Boat Basin CIP project. BMPs include permeable pavement and a hydrodynamic separator. In addition, the manufactured treatment device at Andrews

Hall will receive an increase in drainage area from the CIP project. These BMPs are located in the eastern portion of the VIMS campus.

Third Permit Cycle:

The third permit cycle goals can be met with a combination of seventeen proposed BMPs that are planned to be constructed with four CIPs and three SIPs and the purchase of offsite nutrient credits. BMPs associated with CIPs include permeable pavement and bioretention basins that will be constructed with the proposed Nunally Hall Addition, Watermen's Hall Addition and Amphitheater, and the Field Support Admin Building. An infiltration basin will be installed with the Chesapeake Bay Hall project that is currently under construction. BMPs associated with SIPs include permeable pavement that will be constructed near the Seawater Laboratory and the Boat Basin, and bioretention basins to be constructed near the Wilson House. These BMPs are located in both the western and eastern portions of the VIMS campus.

Calculations for pollutant removal can be found in *Appendix B*.

Offsite Nutrient Credit Purchases

In addition to using nutrient credits to aid CIPs in meeting their development goals the "General VPDES Permit for Discharges or Stormwater from Small Municipal Separate Storm Sewer Systems" effective November 1, 2018 allows the use of nutrient credits to meet TMDL requirements. Refer to the VIMS MS4 permit (VAR040052) including nutrient credit requirements. If Stormwater Improvement Projects are not constructed to meet the requirements of the 2023 and 2028 permit cycles, VIMS will need to purchase nutrient credits. The approximate rate of nutrient trading for the James River watershed is $20,000 per pound phosphorus. This is a one-time fee.

6. Means and Methods to Offset Increase Loads from New Sources Initiating Construction between July 1, 2009 and June 30, 2014

No projects with BMPs have been constructed on the VIMS campus between July 1, 2009 and June 30, 2014. No increases in pollutant loads or load offsets were introduced during this time.

7. Means and Methods to Offset Increased Loads from Grandfathered Projects Beginning Construction after July 1, 2014

Grandfathered Projects Beginning Construction after July 1, 2014

VIMS does not have any projects that qualify for grandfathering under 9VAC25-870-48.

Future Projects Beginning Construction after July 1, 2014

VIMS is expecting to begin construction projects after July 1, 2014 as part of the Campus Master Plan.

8. List of Future Projects Qualifying as Grandfathered

VIMS has not identified any projects that qualify to be grandfathered under 9VAC25-870-48

9. Estimated Cost of Compliance

The estimated cost of compliance includes estimated stormwater construction costs in addition to operation and maintenance costs that are required to keep existing BMPs functioning. These costs are summarized in *Table 4* and *5* of this plan. Cost breakdowns can be found in *Appendix C*.

Table 4: Costs of Compliance (Operations and Maintenance)

				Existing 2023	
BMP Type	**Typical Cycle (years)**	**Cycle Cost ($)**		**Qty**	**Total Cost ($/year)**
Water Quality Inlet	1	1000	per structure	0	$ -
Permeable Pavers	1	3000	per acre	0.26	$ 780
Hydrodynamic Structure	1	1000	per structure	3	$ 3,000
Bioretention Basin	1	2000	per basin	4	$ 8,000
Infiltration Basin	1	2000	per basin	1	$ 2,000
Wet Pond	1	1500	per pond	1	$ 1,500
Total BMP's				10	
Yearly Cost					$ 15,280

*Existing constructed facilities as per the date of this report.

Table 5: Costs of Compliance (New Projects)

Permit Cycle	Name/Description	Reduction Means/Methods	Estimated Total Cost ($)	Phosphorus Removed (lbs)	Estimated Cost per Pound of Phosphorus Removed ($/lb)
2028	Watermen's Hall Addition and Amphitheater	Permeable Pavement Bioretention Basins	$524,683	1.04	$504,503
2028	Nunnally Hall Addition	Permeable Pavement Bioretention Basin	$419,299	0.81	$517,653
2028	Field Support Admin Building	Permeable Pavement Bioretention Basin	$263,642	0.72	$366,169
2028	Seawater Laboratory	Permeable Pavement	$337,341	0.73	$462,111
2028	Boat Basin	Permeable Pavement	$1,943,592	2.84	$684,363
2028	Wilson House	Bioretention Basins	$302,807	0.86	$352,101
		Permit Cycle Total:	$3,791,364	7.00	$541,623

*Costs are per the VIMS November 2016 Stormwater Masterplan and does not include the Chesapeake Cay Hall CIP due to the project being currently under construction

10. Public Comment

Part of the VIMS' MS4 program includes Public Education and Outreach to students, faculty and staff. As part of this program, this TMDL Action Plan will be available on VIMS' Stormwater Management webpage. A two-week public comment period will take place which will provide an opportunity the VIMS community to provide feedback. Public comments and feedback will be considered and incorporated into this Action Plan before final completion.

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Chesapeake Bay TMDL Action Plan

Appendices

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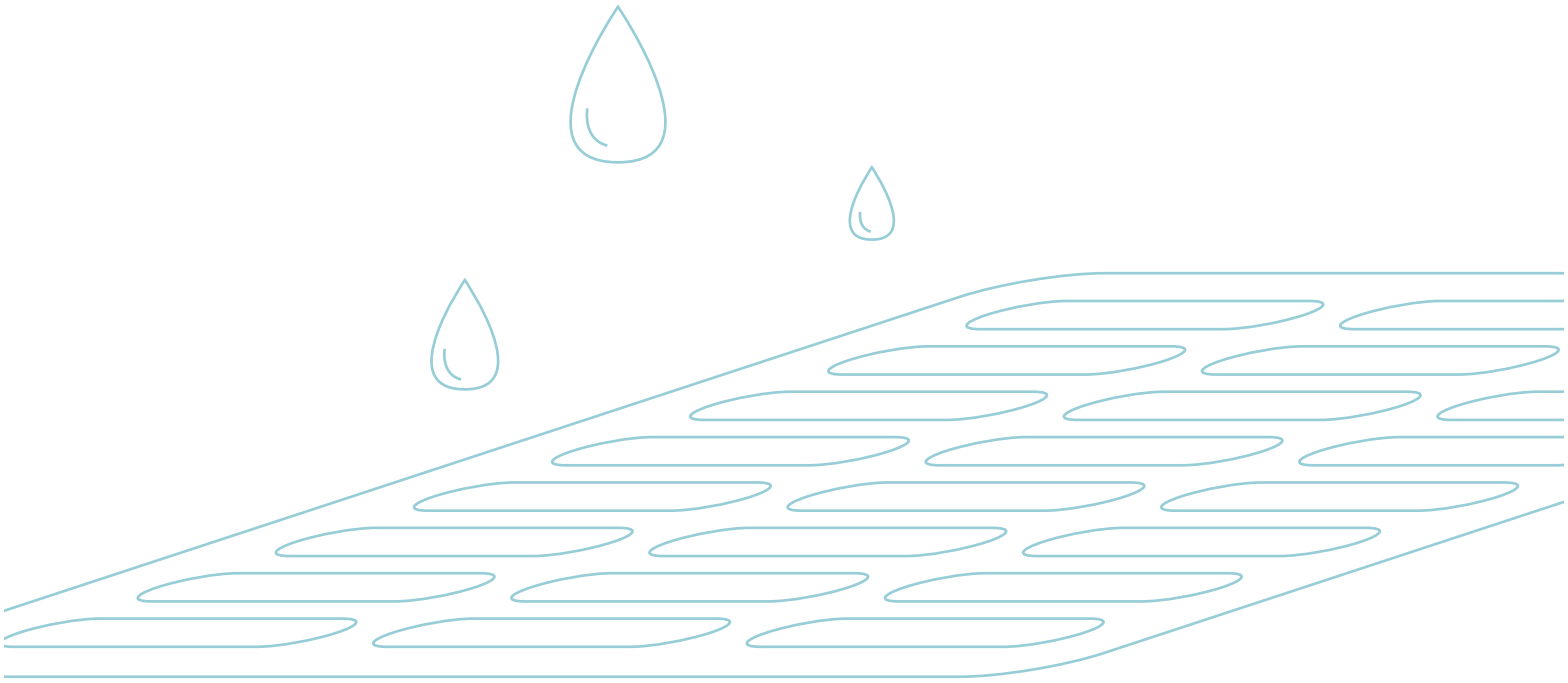
Appendix A:

Figures



For Reference from 2017 Stormwater Master Plan

Campus Study Area = ± 41.45 AC

Stormwater Management Master Plan (2017)

Figure 1 Applicable Area

0 75 150 Feet

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For Reference from 2017 Stormwater Master Plan

Laffayette Heights Dr

BMP-4

EC-7

EC-6

EC-9

Spencer Rd

17

George Washington Memorial Hwy

Greate Rd

1208

1203

EC-10

EC-1

EC-8

WC-3

Franklin Rd

WC-2

WC-1

Vernon St

EC-5

EC-4

EC-2

EC-3

York River

York River

Coleman Bridge

LEGEND

- 2018 Capital Improvement Project
- 2023 Capital Improvement Project
- 2028 Capital Improvement Project
- Capital Improvement BMP
- Stormwater Improvement Project BMP
- Existing BMP

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CIP Projects

2018 BMP

BMP 4 - Facilities Management Building
Existing "Moat" Infiltration Basin

EC-1 - Consolidated Scientific Research Facility - Bioretention Planters CONSTRUCTED

2023 BMP

~~EC-2 - Oyster Hatchery Building Bioretention Basin~~

EC-3 - Oyster Hatchery Building Permeable Pavers CONSTRUCTED

2028 EC-4 - Watermen's Hall Addition and Amphitheater - Bioretention Basin

2028 EC-5 - Watermen's Hall Addition and Amphitheater - Permeable Pavers

2028 BMP

EC-6 - Nunallly Hall Addition Bioretention Basin

EC-7 - Nunally Hall Addition Permeable Pavers

WC-1 - Field Support Admin Building Bioretention Basin

WC-2 - Field Support Admin Builidng Permeable Pavers

SIP Projects

EC-8 - Wilson House Bioretention Basin Retrofit

EC-9 - Seawater Research Laboratory Permeable Pavement

EC-10 - Chesapeake Bay Hall Water Quality Inlets NEW CIP UNDER CONSTRUCTION

WC-3 - Boat Basin Permeable Pavers

Stormwater Management Master Plan (2017)

Figure 5 Proposed Conditions

0 75 150 Feet

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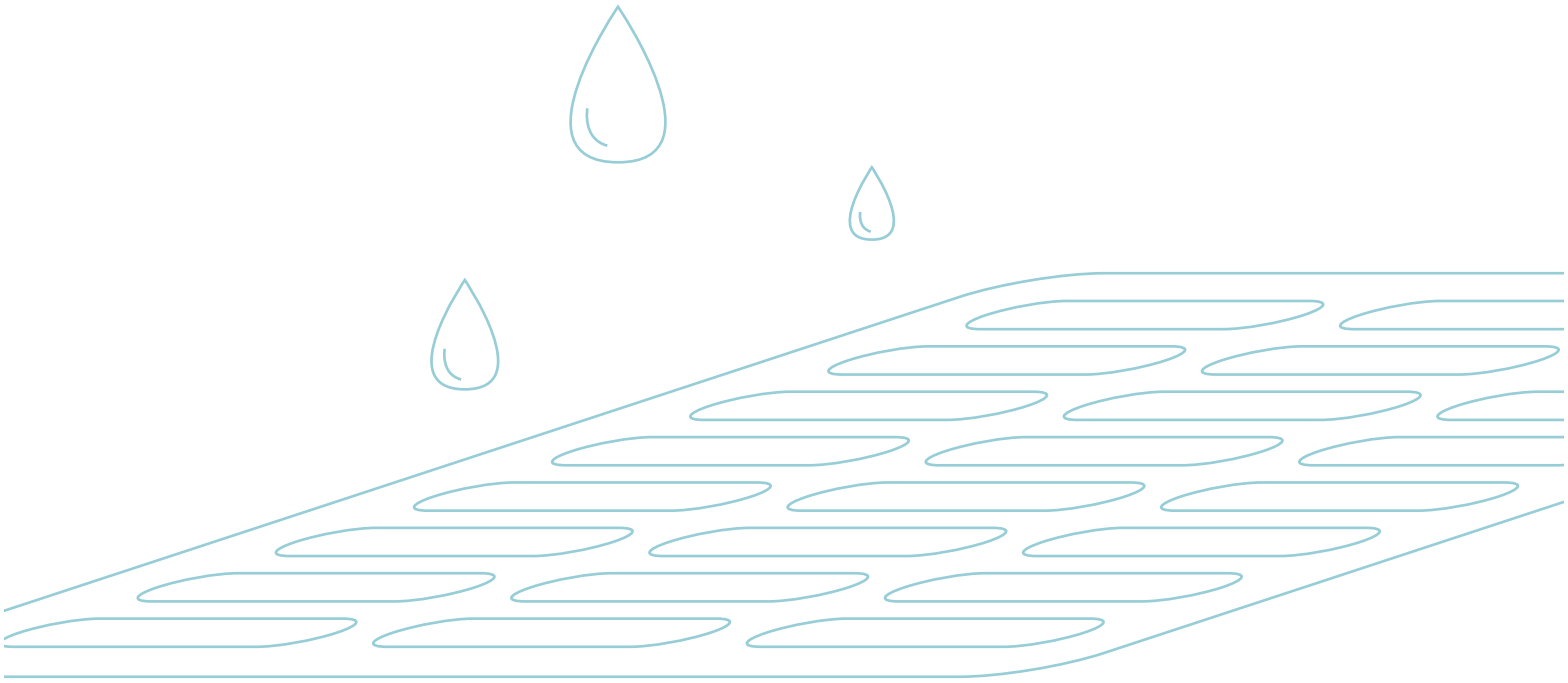
Appendix B:

Permit Cycle Reduction Calculations



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POC Removal Conversions

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POC Achieved Removal Conversions

2023 VIMS Chesapeake Bay TMDL Action Plan
VHB Project No.: 34588.03
Date: 9/28/2023
Computed By: KMB
Checked By: JDH

Two Columbus Center
4500 Main Street, Suite 400
Virginia Beach, VA 23462
(757) 490-0132

					Post Development POC Load (lb/yr)								Excess POC Removal Achieved (lb/yr)		
				1	2	3	4	5		6	7		8	9	10
Permit Cycle	**Project Type**	**Project Name**	**Reduction Means/Methods**	**TP Removal Required**	**TP Load to BMP**	**Scaled TN Load to BMP**	**Scaled TSS Load to BMP**	**TP Removal Achieved (lb/yr)**	**Excess TP Removal Achieved (lb/yr)**	**Proportion of TP Removed**	**TN Removal Efficiency**	**TSS Removal Efficiency**	**TP**	**TN**	**TSS**
2018	CIP	Facilities Management Building	Infiltration Basin (the Moat) (Existing)	2.31	4.98	47.31	2647.37	3.23	0.92	0.28	0.57	0.95	**0.92**	**7.68**	**716.35**
2018	CIP	Davis Hall	Bioretention Basins	0.44	0.88	8.36	467.81	0.49	0.05	0.10	0.64	0.80	**0.05**	**0.55**	**38.19**
												SUM:	**0.97**	**8.23**	**754.54**
2023	CIP	Acuff Center for Aquaculture + Boat Basin	Permeable Pavement	0.85	1.36	12.92	722.98	0.80	-0.05	-0.06	0.59	0.85	**-0.05**	**-0.48**	**-38.41**
			MTD - Hydrodynamic	0.08	0.40	3.80	212.64	0.08	0.00	0.00	0.10	0.10	**0.00**	**0.00**	**0.00**
			MTD (Existing)	0.04	0.09	0.86	47.84	0.02	-0.02	-1.00	0.10	0.10	**-0.02**	**-0.09**	**-4.78**
			Nutrient Credits	0.00				1.20	1.20	1.00			**1.20**	**12.50**	**919.90**
												SUM:	**1.13**	**11.94**	**876.70**
2023	CIP	Chesapeake Bay Hall	Infiltration Basin	1.33	2.29	21.76	1217.36	2.12	0.79	0.37	0.85	0.95	**0.79**	**6.89**	**430.96**
2028	CIP	Watermen's Hall Addition and Amphitheater	Permeable Pavement	0.14	0.41	3.90	217.96	0.24	0.10	0.42	0.59	0.85	**0.10**	**0.96**	**77.19**
			Bioretention Basins	0.37	1.10	10.45	584.76	0.61	0.24	0.39	0.64	0.80	**0.24**	**2.63**	**184.06**
2028	CIP	Nunnally Hall Addition	Permeable Pavement	0.25	0.76	7.22	404.02	0.44	0.19	0.43	0.59	0.85	**0.19**	**1.84**	**148.29**
			Bioretention Basin	0.20	0.67	6.37	356.17	0.37	0.17	0.46	0.64	0.80	**0.17**	**1.87**	**130.92**
2028	CIP	Field Support Admin Building	Permeable Pavement	0.11	0.28	2.66	148.85	0.17	0.06	0.35	0.59	0.85	**0.06**	**0.55**	**44.65**
			Bioretention Basin	0.38	1.03	9.79	547.55	0.56	0.18	0.32	0.64	0.80	**0.18**	**2.01**	**140.80**
2028	SIP	Seawater Laboratory	Permeable Pavement	0.07	1.23	11.69	653.87	0.72	0.65	0.90	0.59	0.85	**0.65**	**6.22**	**501.75**
2028	SIP	Boat Basin	Permeable Pavement	1.27	4.83	45.89	2567.63	2.84	1.57	0.55	0.59	0.85	**1.57**	**14.97**	**1206.51**
2028	SIP	Wilson House	Bioretention Basins	0.00	1.57	14.92	834.61	0.86	0.86	1.00	0.64	0.80	**0.86**	**9.55**	**667.69**
												SUM:	**4.81**	**47.49**	**3532.83**

1. Total phosphorus removal as required by VSMP Regulations.
2. Total TP Load received by BMP. Taken from the Drainage Area sheet of the Runoff Reduction Spreadsheet.
3. Scaled Total Nitrogen Removal. Calculated using York River Basin Loading Ratios from Table 4 of Virginia Administration Code Section 9VAC25-890-40.
4. Scaled Total Suspended Solids Removal. Calculated using York River Basin Loading Ratios from Table 4 of Virginia Administration Code Section 9VAC25-890-40
5. Total Phosphorus Removed for VSMP Regulations using VRRM Spreadsheet. Refer to Runoff Reduction Method Spreadsheets for calculations.
6. Proportion of TP Removed calculated as specified in DEQ Guidance Memo 15-2005. [Proportion of TP Removed] = [Excess TP Removal Achieved] / [TP Removal Achieved]
7. POC Removal Efficiencies from DEQ Guidance Memo 15-2005, Tables V.A.1 and Tables V.C.1.
8. Excess TP Removal Achieved using Virginia Runoff Reduction Method. Refer to Runoff Reduction Method Spreadsheet. [TP] = [TP Removal Achieved] - [TP Removal Required]
9. TN Removal Achieved Using Methods outlined in DEQ Guidance Memo 15-2005 for Meeting Special Condition 7 Requirements. [TN] = [Proportion of TP Removed] * [Scaled TN Load] * [TN Removal Efficiency]
10. TSS Removal Achieved Using Methods outlined in DEQ Guidance Memo 15-2005 for Meeting Special Condition 7 Requirements. [TSS] = [Proportion of TP Removed] * [Scaled TSS Load] * [TSS Removal Efficiency]

From Virginia Runoff Reduction Spreadsheet (VRRM)
Based on Established Efficiencies and Loading Rates
Nitrogen Removal based on Icarus Forest bank ratio to P of 10.42
Assumed TSS credit provided for purchasing Phosphorus Credits for permit cycles after 2018

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Phosphorus Removal Calculations

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Third Permit Cycle - 2028

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Watermen's Hall Addition and Amphitheater

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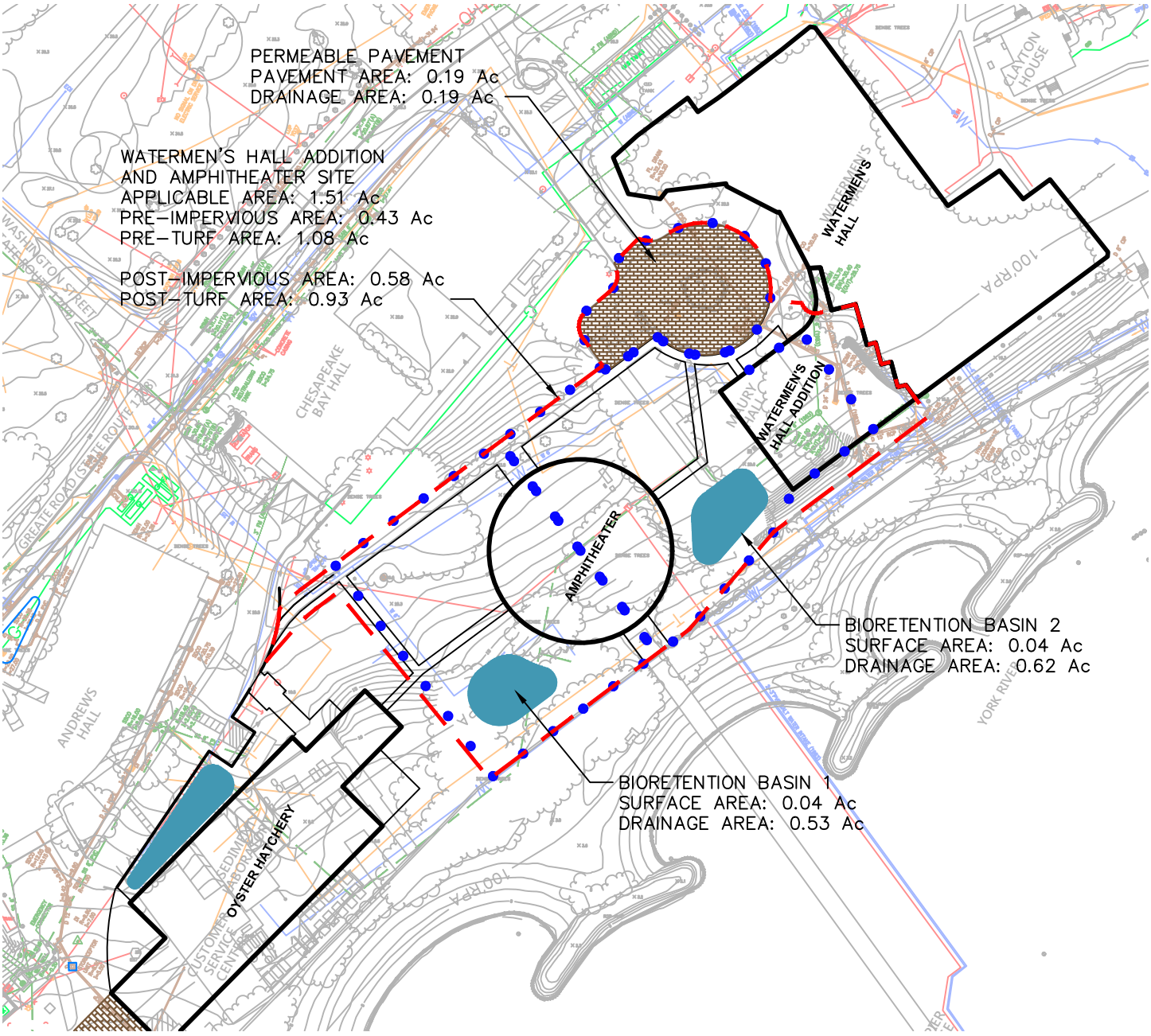


Legend

BIORETENTION BASIN
PERMEABLE PAVERS
WATER QUALITY INLET
DRAINAGE AREAS
EXISTING BMP
APPLICABLE AREAS

0 50 100 Feet

Watermen's Hall Addition and Ampitheter

Permit Cycle: 2018 - 2023
Virginia Institute of Marine Science
Stormwater Management
Master Plan 2016

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 3.0**

☑ 2011 BMP Standards and Specification ☑ 2013 Draft BMP Standards and Specifications

Project Name:	VIMS SWMP 2016 - Watermen's Hall Addition
Date:	10/18/2016
Linear Development Project?	No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 1.51

Check:

BMP Design Specifications List: 2013 Draft Stds & Specs

Maximum reduction required: 20%

Linear project? No

The site's net increase in impervious cover (acres) is: 0.15

Land cover areas entered correctly? ✓

Post-Development TP Load Reduction for Site (lb/yr): 0.51

Total disturbed area entered? ✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	1.08				1.08
Impervious Cover (acres)	0.43				0.43
					1.51

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.93				0.93
Impervious Cover (acres)	0.58				0.58
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	1.51

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre		
Pre-ReDevelopment	**Listed**	**Adjusted[1]**
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	1.08	0.93
Weighted Rv(turf)	0.15	0.15
% Managed Turf	72%	68%
Impervious Cover (acres)	0.43	0.43
Rv(impervious)	0.95	0.95
% Impervious	28%	32%
Total Site Area (acres)	**1.51**	**1.36**
Site Rv	**0.38**	**0.40**

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)	
Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.93
Weighted Rv (turf)	0.15
% Managed Turf	62%
Impervious Cover (acres)	0.58
Rv(impervious)	0.95
% Impervious	38%
Final Site Area (acres)	**1.51**
Final Post Dev Site Rv	**0.46**

Land Cover Summary-Post	
Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.93
Weighted Rv (turf)	0.15
% Managed Turf	68%
ReDev. Impervious Cover (acres)	0.43
Rv(impervious)	0.95
% Impervious	32%
Total ReDev. Site Area (acres)	**1.36**
ReDev Site Rv	**0.40**

Land Cover Summary-Post	
Post-Development New Impervious	
New Impervious Cover (acres)	0.15
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0475	0.0457
Pre-ReDevelopment Treatment Volume (cubic feet)	2,071	1,989
Pre-ReDevelopment TP Load (lb/yr)	**1.30**	**1.25**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	0.86	0.92
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.56*

Final Post-Development Treatment Volume (acre-ft)	0.0575	
Final Post-Development Treatment Volume (cubic feet)	2,507	
Final Post-Development TP Load (lb/yr)	**1.57**	
Final Post-Development TP Load per acre (lb/acre/yr)	1.04	

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume (acre-ft)	0.0457
Post-ReDevelopment Treatment Volume (cubic feet)	1,989
Post-ReDevelopment Load (TP) (lb/yr)*	**1.25**
Post-ReDevelopment TP Load per acre (lb/acre/yr)	0.92
Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**
TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.25**

Post-Development Treatment Volume (acre-ft)	0.0119
Post-Development Treatment Volume (cubic feet)	517
Post-Development TP Load (lb/yr)	**0.33**
TP Load Reduction Required for New Impervious Area (lb/yr)	**0.26**

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**0.51**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	9.31	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	11.27

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)					0.00	0.00
Managed Turf (acres)	0.76				0.76	0.15
Impervious Cover (acres)	0.58				0.58	0.95
				Total	1.34	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	1.52
Post Development Treatment Volume in D.A. A (ft^3)	2,414

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)														**1. Vegetated Roof (RR)**				
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)														**2. Rooftop Disconnection (RR)**				
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)														**3. Permeable Pavement (RR)**				
3.a. Permeable Pavement #1 (Spec #7)	45		0.19	0	295	360	655	25	0.00	0.41	0.24	0.17		25	0.00	2.94	1.73	1.21
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00		25		0.00	0.00	0.00
4. Grass Channel (RR)														**4. Grass Channel (RR)**				
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)														**5. Dry Swale (RR)**				
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
6. Bioretention (RR)														**6. Bioretention (RR)**				
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.76	0.39	0	703	1,055	1,759	25	0.00	1.10	0.61	0.50		40	0.00	7.90	5.05	2.84
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration (RR)														**7. Infiltration (RR)**				
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)														**8. Extended Detention Pond (RR)**				
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.58	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.76	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	998	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.52	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.85	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.67	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	998	
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	6.78	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.58	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.76	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.51	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.52	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.85	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	0.85	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	0.67	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	6.78
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	6.78

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	0.58	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	0.58	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	0.76	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	0.76	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	2,507

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	998	0	0	0	0	998
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	1.52	0.00	0.00	0.00	0.00	1.52
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.85	0.00	0.00	0.00	0.00	0.85
TP LOAD REMAINING (lb/yr)	0.67	0.00	0.00	0.00	0.00	0.67
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	6.78	0.00	0.00	0.00	0.00	6.78

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	1.57	
TP LOAD REDUCTION REQUIRED (lb/yr)	0.51	
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.85	
TP LOAD REMAINING (lb/yr):	0.73	
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	0.00	**

** TARGET TP REDUCTION EXCEEDED BY 0.34 LB/YEAR **

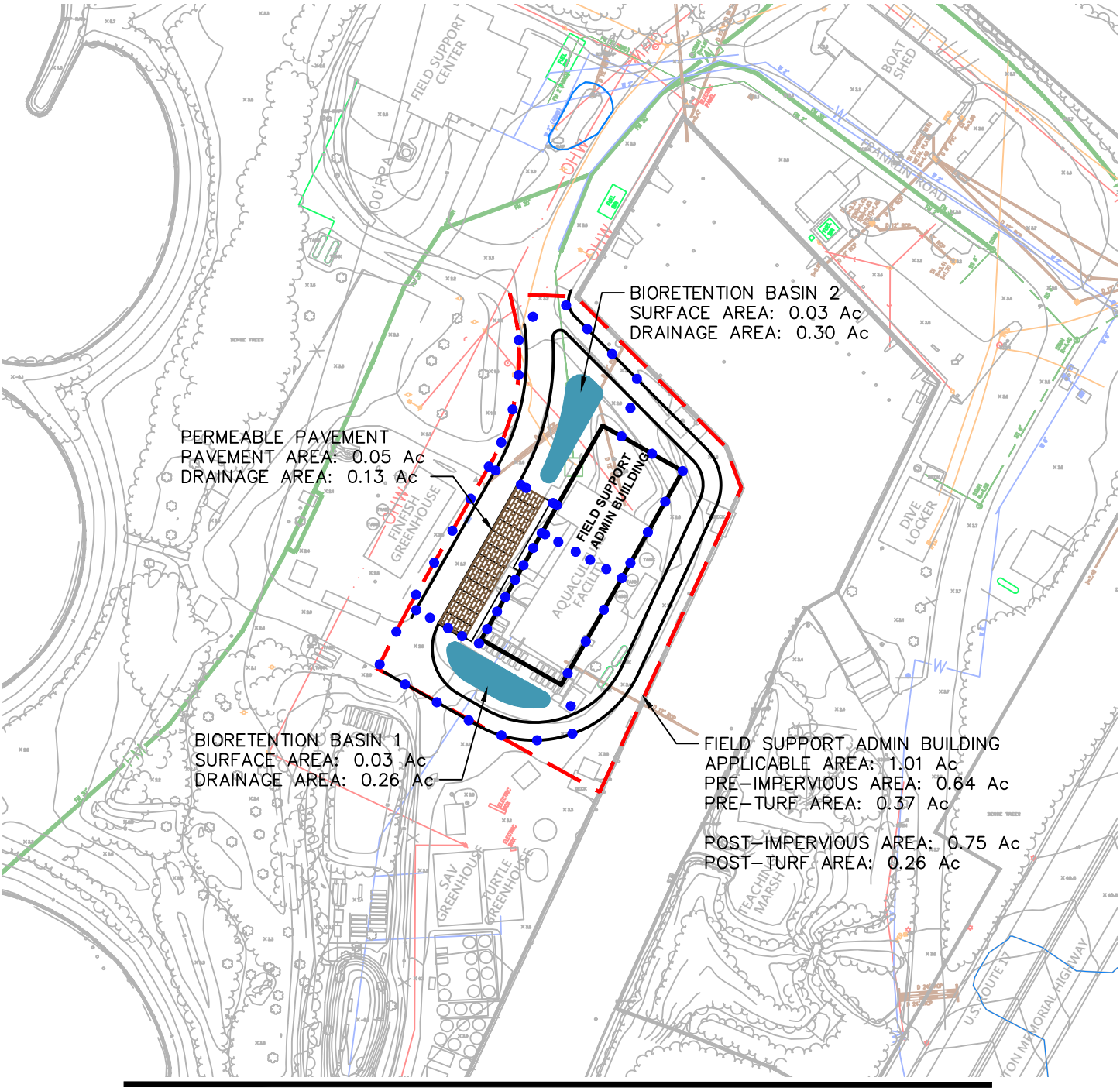
Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	11.27
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	6.78
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	4.48

VIMS | William & Mary
Virginia Institute of Marine Science

Field Support Admin Building

vhb



0 50 100 Feet

Field Support Admin Building

Permit Cycle: 2023 - 2028
Virginia Institute of Marine Science
Stormwater Management
Master Plan 2016

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 3.0**

☑ 2011 BMP Standards and Specification ☑ 2013 Draft BMP Standards and Specifications

Project Name:	VIMS SWMP 2016 - Field Support Admin Building
Date:	10/18/2016
Linear Development Project?	No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 1.01

Check:

BMP Design Specifications List: 2013 Draft Stds & Specs

Maximum reduction required: 20%

Linear project? No

The site's net increase in impervious cover (acres) is: 0.11

Land cover areas entered correctly? ✓

Post-Development TP Load Reduction for Site (lb/yr): 0.49

Total disturbed area entered? ✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.37				0.37
Impervious Cover (acres)	0.64				0.64
					1.01

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.26				0.26
Impervious Cover (acres)	0.75				0.75
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	1.01

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	0.37	0.26
Weighted Rv(turf)	0.15	0.15
% Managed Turf	37%	29%
Impervious Cover (acres)	0.64	0.64
Rv(impervious)	0.95	0.95
% Impervious	63%	71%
Total Site Area (acres)	**1.01**	**0.90**
Site Rv	**0.66**	**0.72**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0553	0.0539
Pre-ReDevelopment Treatment Volume (cubic feet)	2,409	2,349
Pre-ReDevelopment TP Load (lb/yr)	**1.51**	**1.48**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	1.50	1.64
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.37*

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.26
Weighted Rv (turf)	0.15
% Managed Turf	26%
Impervious Cover (acres)	0.75
Rv(impervious)	0.95
% Impervious	74%
Final Site Area (acres)	**1.01**
Final Post Dev Site Rv	**0.74**

Final Post-Development Treatment Volume (acre-ft)	0.0626
Final Post-Development Treatment Volume (cubic feet)	2,728
Final Post-Development TP Load (lb/yr)	**1.71**
Final Post-Development TP Load per acre (lb/acre/yr)	1.70

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.26
Weighted Rv (turf)	0.15
% Managed Turf	29%
ReDev. Impervious Cover (acres)	0.64
Rv(impervious)	0.95
% Impervious	71%
Total ReDev. Site Area (acres)	**0.90**
ReDev Site Rv	**0.72**

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume (acre-ft)	0.0539
Post-ReDevelopment Treatment Volume (cubic feet)	2,349
Post-ReDevelopment Load (TP) (lb/yr)*	**1.48**
Post-ReDevelopment TP Load per acre (lb/acre/yr)	1.64
Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**
TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.30**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.11
Rv(impervious)	0.95

Post-Development Treatment Volume (acre-ft)	0.0087
Post-Development Treatment Volume (cubic feet)	379
Post-Development TP Load (lb/yr)	**0.24**
TP Load Reduction Required for New Impervious Area (lb/yr)	**0.19**

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**0.49**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	10.83	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	12.26

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)					0.00	0.00
Managed Turf (acres)	0.10				0.10	0.15
Impervious Cover (acres)	0.59				0.59	0.95
				Total	0.69	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	1.31
Post Development Treatment Volume in D.A. A (ft^3)	2,089

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)														**1. Vegetated Roof (RR)**				
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)														**2. Rooftop Disconnection (RR)**				
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)														**3. Permeable Pavement (RR)**				
3.a. Permeable Pavement #1 (Spec #7)	45		0.13	0	202	247	448	25	0.00	0.28	0.17	0.12		25	0.00	2.01	1.18	0.83
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00		25		0.00	0.00	0.00
4. Grass Channel (RR)														**4. Grass Channel (RR)**				
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)														**5. Dry Swale (RR)**				
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
6. Bioretention (RR)														**6. Bioretention (RR)**				
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.10	0.46	0	656	984	1,641	25	0.00	1.03	0.57	0.46		40	0.00	7.37	4.71	2.65
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration (RR)														**7. Infiltration (RR)**				
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)														**8. Extended Detention Pond (RR)**				
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.59	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.10	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	858	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.31	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.73	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.58	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	858	
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	5.90	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.59	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.10	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.49	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.31	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.73	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	0.73	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	0.58	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	5.90
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	5.90

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	0.59	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	0.59	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	0.10	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	0.10	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	2,728

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	858	0	0	0	0	858
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	1.31	0.00	0.00	0.00	0.00	1.31
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.73	0.00	0.00	0.00	0.00	0.73
TP LOAD REMAINING (lb/yr)	0.58	0.00	0.00	0.00	0.00	0.58
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	5.90	0.00	0.00	0.00	0.00	5.90

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	1.71	
TP LOAD REDUCTION REQUIRED (lb/yr)	0.49	
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.73	
TP LOAD REMAINING (lb/yr):	0.98	
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	**0.00**	**

** TARGET TP REDUCTION EXCEEDED BY 0.24 LB/YEAR **

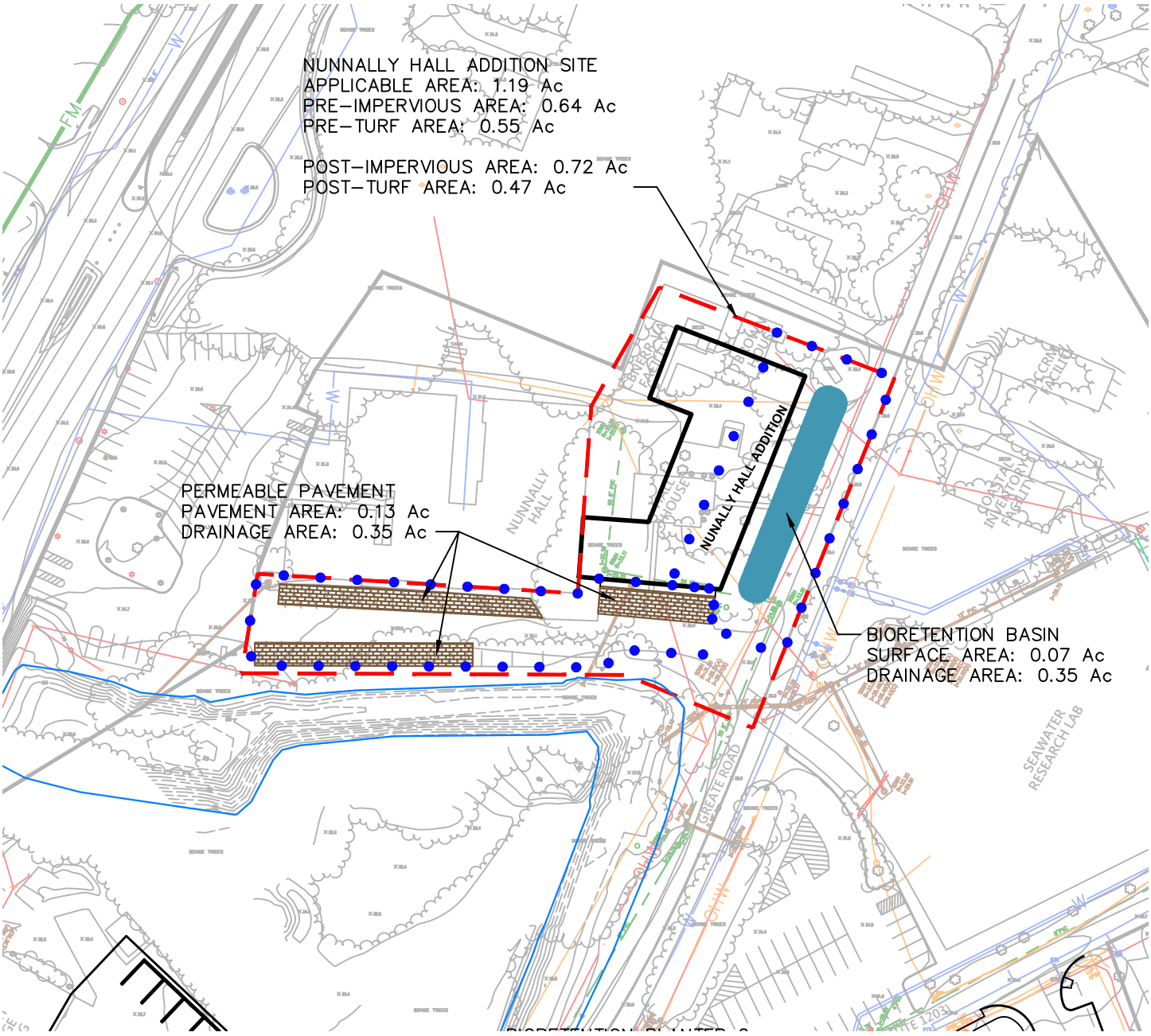
Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	12.26
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	5.90
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	6.36

VIMS | William & Mary
Virginia Institute of Marine Science

Nunnally Hall Addition

vhb



Legend

BIORETENTION BASIN
PERMEABLE PAVERS
WATER QUALITY INLET
DRAINAGE AREAS
EXISTING BMP
APPLICABLE AREAS

0 50 100 Feet

Nunnally Hall Addition

Permit Cycle: 2023 - 2028
Virginia Institute of Marine Science
Stormwater Management
Master Plan 2016

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 3.0**

☑ 2011 BMP Standards and Specification ☑ 2013 Draft BMP Standards and Specifications

Project Name:	VIMS SWMP 2016 - Nunally Hall Addition
Date:	10/28/2016
Linear Development Project?	No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 1.19

Check:

BMP Design Specifications List: 2013 Draft Stds & Specs

Maximum reduction required: 20%

Linear project? No

The site's net increase in impervious cover (acres) is: 0.08

Land cover areas entered correctly? ✓

Post-Development TP Load Reduction for Site (lb/yr): 0.45

Total disturbed area entered? ✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.55				0.55
Impervious Cover (acres)	0.64				0.64
					1.19

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.47				0.47
Impervious Cover (acres)	0.72				0.72
Area Check	OK.	OK.	OK.	OK.	1.19

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	0.55	0.47
Weighted Rv(turf)	0.15	0.15
% Managed Turf	46%	42%
Impervious Cover (acres)	0.64	0.64
Rv(impervious)	0.95	0.95
% Impervious	54%	58%
Total Site Area (acres)	**1.19**	**1.11**
Site Rv	**0.58**	**0.61**

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.47
Weighted Rv (turf)	0.15
% Managed Turf	39%
Impervious Cover (acres)	0.72
Rv(impervious)	0.95
% Impervious	61%
Final Site Area (acres)	**1.19**
Final Post Dev Site Rv	**0.63**

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.47
Weighted Rv (turf)	0.15
% Managed Turf	42%
ReDev. Impervious Cover (acres)	0.64
Rv(impervious)	0.95
% Impervious	58%
Total ReDev. Site Area (acres)	**1.11**
ReDev Site Rv	**0.61**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.08
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0575	0.0565
Pre-ReDevelopment Treatment Volume (cubic feet)	2,507	2,463
Pre-ReDevelopment TP Load (lb/yr)	**1.57**	**1.55**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	1.32	1.39
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.46*

Final Post-Development Treatment Volume (acre-ft)	0.0629
Final Post-Development Treatment Volume (cubic feet)	2,739
Final Post-Development TP Load (lb/yr)	**1.72**
Final Post-Development TP Load per acre (**lb/acre/yr**)	1.45

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume (acre-ft)	0.0565
Post-ReDevelopment Treatment Volume (cubic feet)	2,463
Post-ReDevelopment Load (TP) (lb/yr)*	**1.55**
Post-ReDevelopment TP Load per acre (**lb/acre/yr**)	1.39
Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**
TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.31**

Post-Development Treatment Volume (acre-ft)	0.0063
Post-Development Treatment Volume (cubic feet)	276
Post-Development TP Load (lb/yr)	**0.17**
TP Load Reduction Required for New Impervious Area (lb/yr)	**0.14**

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**0.45**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	11.27	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	12.31

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)					0.00	0.00
Managed Turf (acres)	0.05				0.05	0.15
Impervious Cover (acres)	0.70				0.70	0.95
				Total	0.75	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	1.53
Post Development Treatment Volume in D.A. A (ft^3)	2,441

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed
1. Vegetated Roof (RR)													
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00	
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00	
2. Rooftop Disconnection (RR)													
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00	
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00	
3. Permeable Pavement (RR)													
3.a. Permeable Pavement #1 (Spec #7)	45		0.35	0	543	664	1,207	25	0.00	0.76	0.45	0.31	
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00	
4. Grass Channel (RR)													
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00	
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00	
5. Dry Swale (RR)													
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00	
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00	
6. Bioretention (RR)													
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.05	0.30	0	425	637	1,062	25	0.00	0.67	0.37	0.30	
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00	
7. Infiltration (RR)													
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00	
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00	
8. Extended Detention Pond (RR)													
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00	
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00	

Practice	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)					
1.a. Vegetated Roof #1 (Spec #5)	0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)					
2.a. Simple Disconnection to A/B Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)					
3.a. Permeable Pavement #1 (Spec #7)	25	0.00	5.42	3.18	2.24
3.b. Permeable Pavement #2 (Spec #7)	25		0.00	0.00	0.00
4. Grass Channel (RR)					
4.a. Grass Channel A/B Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)					
5.a. Dry Swale #1 (Spec #10)	25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	35	0.00	0.00	0.00	0.00
6. Bioretention (RR)					
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	0.00	4.77	3.05	1.72
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	60	0.00	0.00	0.00	0.00
7. Infiltration (RR)					
7.a. Infiltration #1 (Spec #8)	15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)					
8.a. ED #1 (Spec #15)	10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.65	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.05	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	968	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.53	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.81	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.72	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	968	
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	6.23	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.65	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.05	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.45	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.53	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.81	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	0.81	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	0.72	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	6.23
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	6.23

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	0.70	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	0.65	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	0.05	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	0.05	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	2,739

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	968	0	0	0	0	968
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	1.53	0.00	0.00	0.00	0.00	1.53
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.81	0.00	0.00	0.00	0.00	0.81
TP LOAD REMAINING (lb/yr)	0.72	0.00	0.00	0.00	0.00	0.72
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	6.23	0.00	0.00	0.00	0.00	6.23

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	1.72	
TP LOAD REDUCTION REQUIRED (lb/yr)	0.45	
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.81	
TP LOAD REMAINING (lb/yr):	0.91	
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	**0.00**	**

** TARGET TP REDUCTION EXCEEDED BY 0.36 LB/YEAR **

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	12.31
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	6.23
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	6.08

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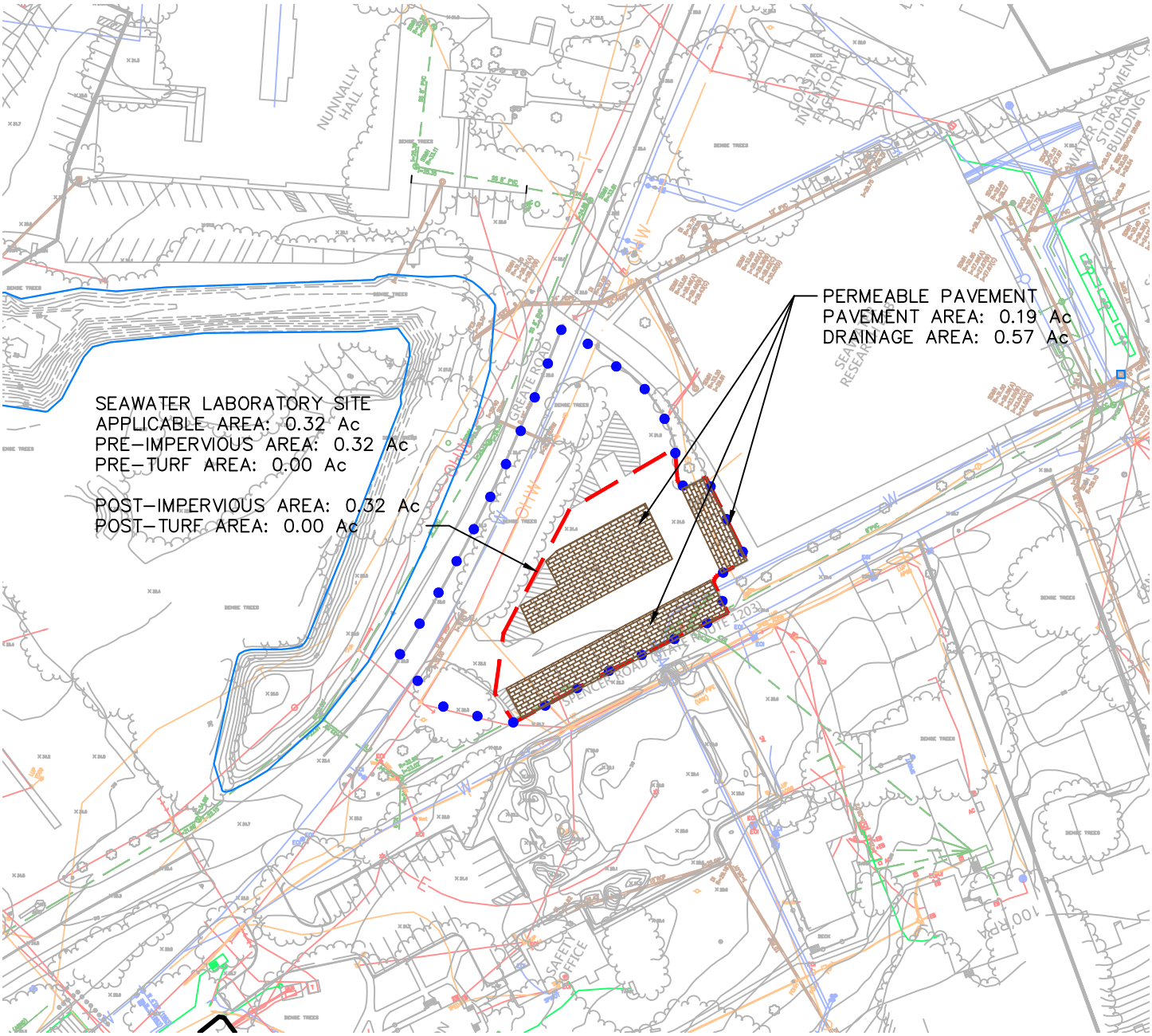
Seawater Laboratory

vhb



Legend

BIORETENTION BASIN
PERMEABLE PAVERS
WATER QUALITY INLET
DRAINAGE AREAS
EXISTING BMP
APPLICABLE AREAS

0 50 100 Feet

Seawater Lab Permeable Pavement

Stormwater Improvement Project
Virginia Institute of Marine Science
Stormwater Management
Master Plan 2016

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 3.0**

☐ 2011 BMP Standards and Specification ☑ 2013 Draft BMP Standards and Specifications

Project Name:	VIMS SWMP 2016 - SIP Seawater Lab Permeable Pavers
Date:	9/27/2016
Linear Development Project?	No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 0.32

Maximum reduction required: 10%
The site's net increase in impervious cover (acres) is: 0
Post-Development TP Load Reduction for Site (lb/yr): 0.07

Check:
BMP Design Specifications List: 2013 Draft Stds & Specs
Linear project? No
Land cover areas entered correctly? ✓
Total disturbed area entered? ✓

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00				0.00
Impervious Cover (acres)	0.32				0.32
					0.32

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.00				0.00
Impervious Cover (acres)	0.32				0.32
Area Check	OK.	OK.	OK.	OK.	0.32

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	0.00	0.00
Weighted Rv(turf)	0.00	0.00
% Managed Turf	0%	0%
Impervious Cover (acres)	0.32	0.32
Rv(impervious)	0.95	0.95
% Impervious	100%	100%
Total Site Area (acres)	**0.32**	**0.32**
Site Rv	**0.95**	**0.95**

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.00
Weighted Rv (turf)	0.00
% Managed Turf	0%
Impervious Cover (acres)	0.32
Rv(impervious)	0.95
% Impervious	100%
Final Site Area (acres)	**0.32**
Final Post Dev Site Rv	**0.95**

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.00
Weighted Rv (turf)	0.00
% Managed Turf	0%
ReDev. Impervious Cover (acres)	0.32
Rv(impervious)	0.95
% Impervious	100%
Total ReDev. Site Area (acres)	**0.32**
ReDev Site Rv	**0.95**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.00
Rv(impervious)	--

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0253	0.0253
Pre-ReDevelopment Treatment Volume (cubic feet)	1,104	1,104
Pre-ReDevelopment TP Load (lb/yr)	**0.69**	**0.69**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	2.17	2.17
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.13*

Final Post-Development Treatment Volume (acre-ft)	0.0253
Final Post-Development Treatment Volume (cubic feet)	1,104
Final Post-Development TP Load (lb/yr)	**0.69**
Final Post-Development TP Load per acre (lb/acre/yr)	2.17

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume (acre-ft)	0.0253
Post-ReDevelopment Treatment Volume (cubic feet)	1,104
Post-ReDevelopment Load (TP) (lb/yr)*	**0.69**
Post-ReDevelopment TP Load per acre (lb/acre/yr)	2.17
Max. Reduction Required (Below Pre-ReDevelopment Load)	**10%**
TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.07**

Post-Development Treatment Volume (acre-ft)	--
Post-Development Treatment Volume (cubic feet)	--
Post-Development TP Load (lb/yr)	--
TP Load Reduction Required for New Impervious Area (lb/yr)	**0**

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**0.07**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	4.96	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	4.96

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)					0.00	0.00
Managed Turf (acres)	0.00				0.00	0.00
Impervious Cover (acres)	0.57				0.57	0.95
				Total	0.57	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	1.24
Post Development Treatment Volume in D.A. A (ft^3)	1,966

Stormwater Best Management Practices (RR = Runoff Reduction)

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)														**1. Vegetated Roof (RR)**				
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)														**2. Rooftop Disconnection (RR)**				
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)														**3. Permeable Pavement (RR)**				
3.a. Permeable Pavement #1 (Spec #7)	45		0.57	0	885	1,081	1,966	25	0.00	1.23	0.72	0.51		25	0.00	8.83	5.18	3.64
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00		25		0.00	0.00	0.00
4. Grass Channel (RR)														**4. Grass Channel (RR)**				
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)														**5. Dry Swale (RR)**				
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
6. Bioretention (RR)														**6. Bioretention (RR)**				
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration (RR)														**7. Infiltration (RR)**				
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)														**8. Extended Detention Pond (RR)**				
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)					
0	0.00	0.00	0.00	0.00	
0	0.00	0.00	0.00	0.00	
0	0.00	0.00	0.00	0.00	

TOTAL IMPERVIOUS COVER TREATED (ac)	0.57	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	885	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.24	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.72	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.51	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	885
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	5.18

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)					
30	0.00	0.00	0.00	0.00	
20	0.00	0.00	0.00	0.00	
40	0.00	0.00	0.00	0.00	
30	0.00	0.00	0.00	0.00	

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.57	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.12	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.24	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.72	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	0.72	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	0.51	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	5.18
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	5.18

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	0.57	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	0.57	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	0.00	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	0.00	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	1,966

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	885	0	0	0	0	885
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	1.24	0.00	0.00	0.00	0.00	1.24
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.72	0.00	0.00	0.00	0.00	0.72
TP LOAD REMAINING (lb/yr)	0.51	0.00	0.00	0.00	0.00	0.51
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	5.18	0.00	0.00	0.00	0.00	5.18

Total Phosphorus

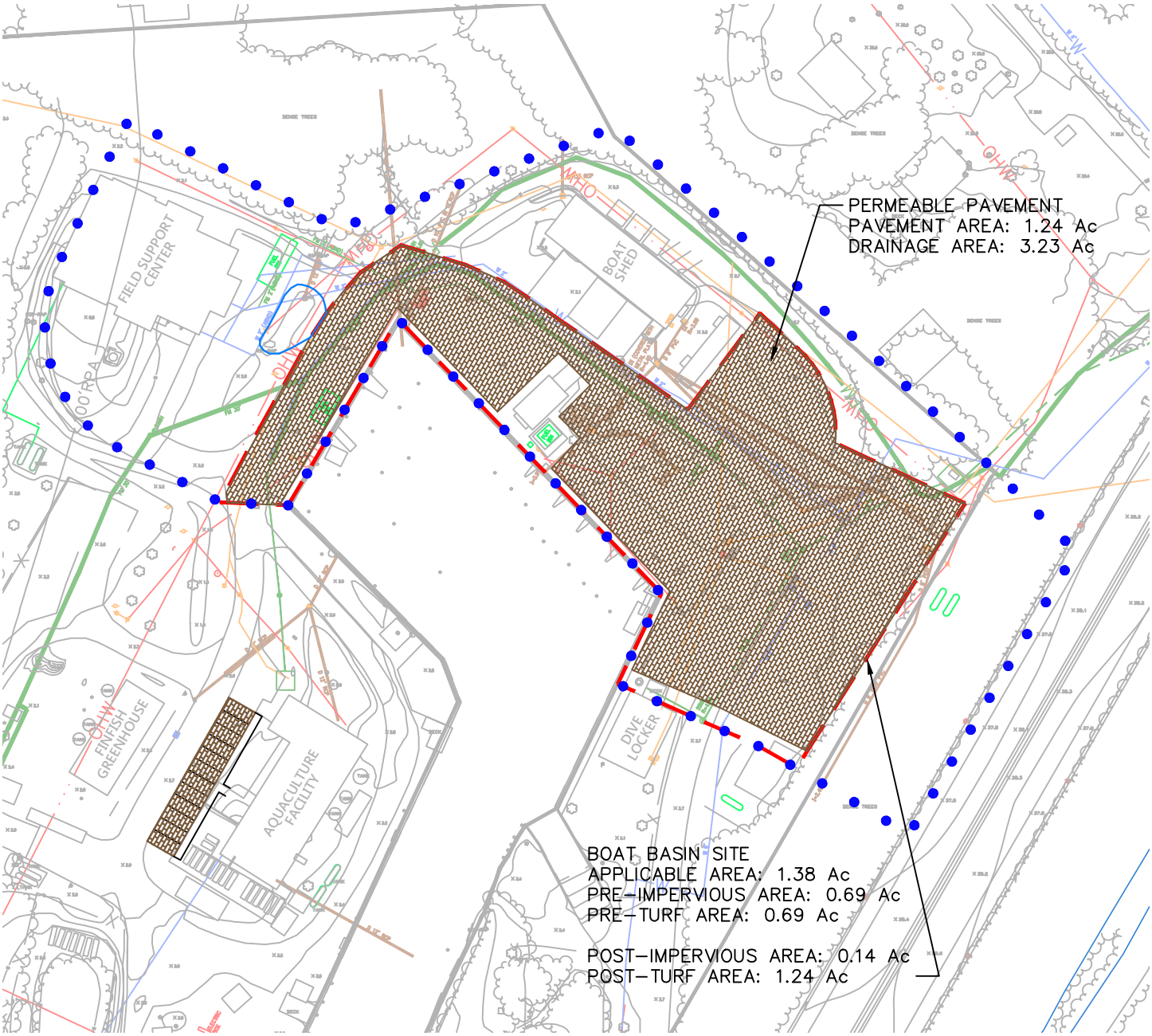
FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	~~1.24~~	0.69 (See Site Data Sheet)
TP LOAD REDUCTION REQUIRED (lb/yr)	~~0.12~~	0.07 (See Site Data Sheet)
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.72	
TP LOAD REMAINING (lb/yr):	~~0.51~~	-0.03
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	0.00	**

** TARGET TP REDUCTION EXCEEDED BY ~~0.6~~ 0.65 LB/YEAR **

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	8.84
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	5.18
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	3.65

Boat Basin



Legend

BIORETENTION BASIN
PERMEABLE PAVERS
WATER QUALITY INLET
DRAINAGE AREAS
EXISTING BMP
APPLICABLE AREAS

0 50 100 Feet

Boat Basin Permeable Pavement

Stormwater Improvement Project
Virginia Institute of Marine Science
Stormwater Management
Master Plan 2016

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 3.0**

☑ 2011 BMP Standards and Specification ☑ 2013 Draft BMP Standards and Specifications

Project Name:	VIMS SWMP 2016 - SIP Boat Basin Permeable Pavers
Date:	9/27/2016
Linear Development Project?	No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 1.38

Check:

BMP Design Specifications List: 2013 Draft Stds & Specs

Linear project? No

Land cover areas entered correctly? ✓

Total disturbed area entered? ✓

Maximum reduction required: 20%

The site's net increase in impervious cover (acres) is: 0.55

Post-Development TP Load Reduction for Site (lb/yr): 1.27

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.69				0.69
Impervious Cover (acres)	0.69				0.69
					1.38

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.14				0.14
Impervious Cover (acres)	1.24				1.24
Area Check	**OK.**	**OK.**	**OK.**	**OK.**	1.38

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	0.69	0.14
Weighted Rv(turf)	0.15	0.15
% Managed Turf	50%	17%
Impervious Cover (acres)	0.69	0.69
Rv(impervious)	0.95	0.95
% Impervious	50%	83%
Total Site Area (acres)	**1.38**	**0.83**
Site Rv	**0.55**	**0.82**

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0633	0.0564
Pre-ReDevelopment Treatment Volume (cubic feet)	2,755	2,456
Pre-ReDevelopment TP Load (lb/yr)	**1.73**	**1.54**
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	1.25	1.86
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.34*

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.14
Weighted Rv (turf)	0.15
% Managed Turf	10%
Impervious Cover (acres)	1.24
Rv(impervious)	0.95
% Impervious	90%
Final Site Area (acres)	**1.38**
Final Post Dev Site Rv	**0.87**

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.14
Weighted Rv (turf)	0.15
% Managed Turf	17%
ReDev. Impervious Cover (acres)	0.69
Rv(impervious)	0.95
% Impervious	83%
Total ReDev. Site Area (acres)	**0.83**
ReDev Site Rv	**0.82**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.55
Rv(impervious)	0.95

Treatment Volume and Nutrient Load

Final Post-Development Treatment Volume (acre-ft)	0.0999	**Post-ReDevelopment Treatment Volume (acre-ft)**	0.0564
Final Post-Development Treatment Volume (cubic feet)	4,352	**Post-ReDevelopment Treatment Volume (cubic feet)**	2,456
Final Post-Development TP Load (lb/yr)	**2.73**	**Post-ReDevelopment Load (TP) (lb/yr)***	**1.54**
Final Post-Development TP Load per acre (lb/acre/yr)	1.98	Post-ReDevelopment TP Load per acre (lb/acre/yr)	1.86
		Max. Reduction Required (Below Pre-ReDevelopment Load)	**20%**
		TP Load Reduction Required for Redeveloped Area (lb/yr)	**0.31**

Post-Development Treatment Volume (acre-ft)	0.0435
Post-Development Treatment Volume (cubic feet)	1,897
Post-Development TP Load (lb/yr)	**1.19**
TP Load Reduction Required for New Impervious Area (lb/yr)	**0.97**

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr)	**1.27**

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	12.38	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	19.56

Drainage Area A

CLEAR BMP AREAS

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)					0.00	0.00
Managed Turf (acres)	1.13				1.13	0.15
Impervious Cover (acres)	2.23				2.23	0.95
				Total	3.36*	

Total Phosphorus Available for Removal in D.A. A (lb/yr)	5.22
Post Development Treatment Volume in D.A. A (ft^3)	8,305

Stormwater Best Management Practices (RR = Runoff Reduction) Drainage Area A includes up-gradient area from outside site limits

--Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)														**1. Vegetated Roof (RR)**				
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)														**2. Rooftop Disconnection (RR)**				
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)														**3. Permeable Pavement (RR)**				
3.a. Permeable Pavement #1 (Spec #7)	45		2.23	0	3,461	4,230	7,690	25	0.00	4.83	2.84	1.99		25	0.00	34.53	20.28	14.24
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00		25		0.00	0.00	0.00
4. Grass Channel (RR)														**4. Grass Channel (RR)**				
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)														**5. Dry Swale (RR)**				
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
6. Bioretention (RR)														**6. Bioretention (RR)**				
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration (RR)														**7. Infiltration (RR)**				
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)														**8. Extended Detention Pond (RR)**				
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	2.23	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	3,461	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	5.22	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	2.84	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	2.38	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	3,461	
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	20.28	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)				
30	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
40	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	2.23	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	0.00	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	1.04	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	5.22	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	2.84	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	2.84	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	2.38	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	20.28
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	20.28

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	2.23	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	2.23	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	1.13	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	0.00	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	8,305

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	3,461	0	0	0	0	3,461
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	5.22	0.00	0.00	0.00	0.00	5.22
TP LOAD REDUCTION ACHIEVED (lb/yr)	2.84	0.00	0.00	0.00	0.00	2.84
TP LOAD REMAINING (lb/yr)	2.38	0.00	0.00	0.00	0.00	2.38
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	20.28	0.00	0.00	0.00	0.00	20.28

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	~~5.22~~	2.73 (See Site Data Sheet)
TP LOAD REDUCTION REQUIRED (lb/yr)	~~1.04~~	1.27 (See Site Data Sheet)
TP LOAD REDUCTION ACHIEVED (lb/yr)	2.84	
TP LOAD REMAINING (lb/yr):	~~2.38~~	-0.11
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	0.00	**

** TARGET TP REDUCTION EXCEEDED BY ~~1.79~~ 1.57 LB/YEAR **

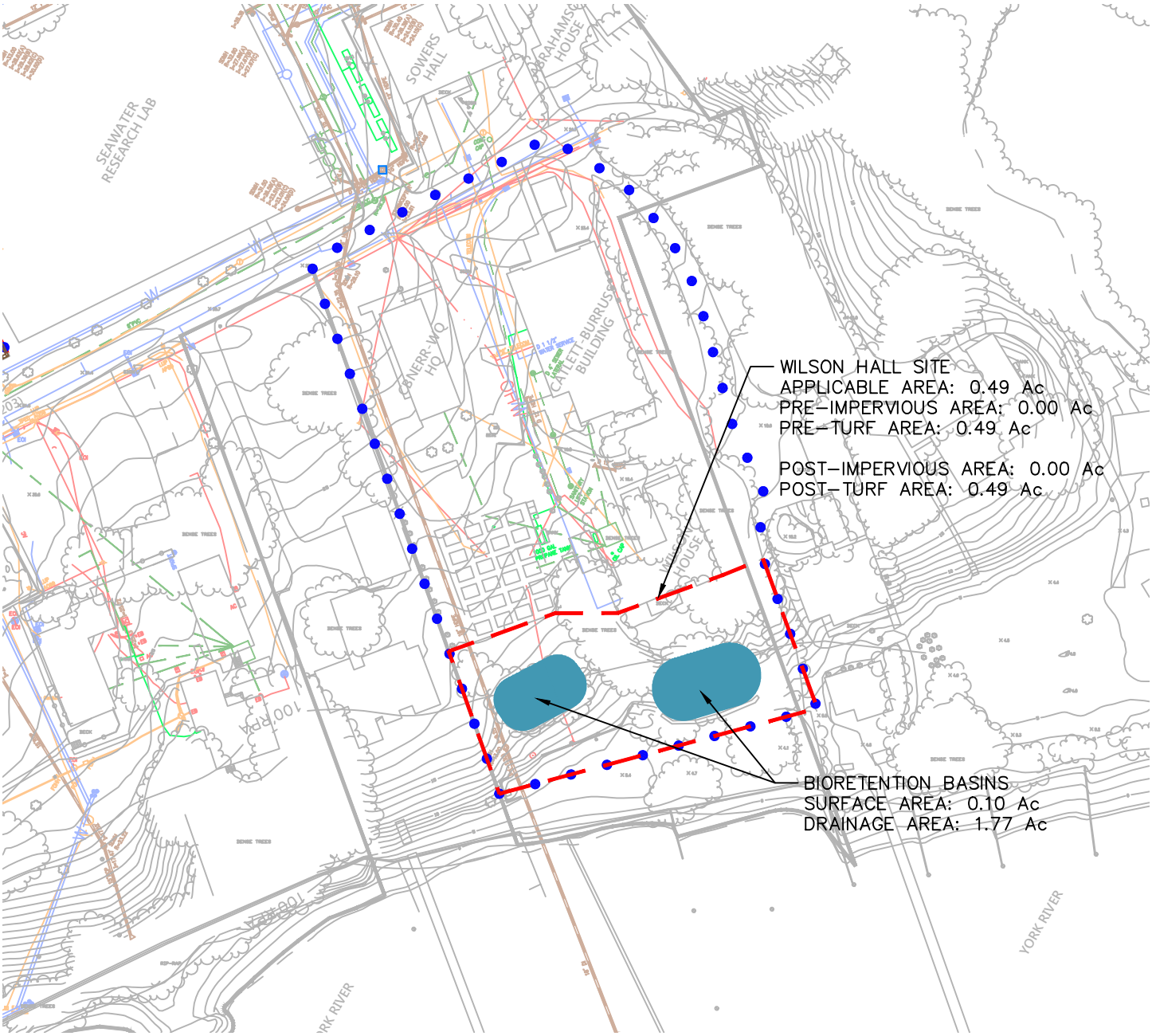
Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	37.33
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	20.28
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	17.05

VIMS | William & Mary
Virginia Institute of Marine Science

Wilson House

vhb



Legend

BIORETENTION BASIN
PERMEABLE PAVERS
WATER QUALITY INLET
DRAINAGE AREAS
EXISTING BMP
APPLICABLE AREAS

0 50 100 Feet

Wilson House Bioretention Retrofit

Stormwater Improvement Project
Virginia Institute of Marine Science
Stormwater Management
Master Plan 2016

DEQ Virginia Runoff Reduction Method Re-Development Compliance Spreadsheet - **Version 3.0**

☑ 2011 BMP Standards and Specification ☑ 2013 Draft BMP Standards and Specifications

Project Name:	VIMS SWMP 2016 -Bioretention Retrofit
Date:	9/27/2016
Linear Development Project?	No

CLEAR ALL

data input cells
constant values
calculation cells
final results

Site Information

Post-Development Project (Treatment Volume and Loads)

Enter Total Disturbed Area *(acres)* → 0.49

Check:
BMP Design Specifications List: 2013 Draft Stds & Specs
Linear project? No
Land cover areas entered correctly? ✓
Total disturbed area entered? ✓

Maximum reduction required: 10%
The site's net increase in impervious cover (acres) is: 0
Post-Development TP Load Reduction for Site (lb/yr): -0.03

TP LOAD REDUCTION NOT REQUIRED

Pre-ReDevelopment Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.49				0.49
Impervious Cover (acres)	0.00				0.00
					0.49

Post-Development Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space (acres) -- undisturbed, protected forest/open space or reforested land	0.00				0.00
Managed Turf (acres) -- disturbed, graded for yards or other turf to be mowed/managed	0.49				0.49
Impervious Cover (acres)	0.00				0.00
Area Check	OK.	OK.	OK.	OK.	0.49

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Total Phosphorus (TP) EMC (mg/L)	0.26
Total Nitrogen (TN) EMC (mg/L)	1.86
Target TP Load (lb/acre/yr)	0.41
Pj (unitless correction factor)	0.90

Runoff Coefficients (Rv)

	A Soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95	0.95	0.95	0.95

LAND COVER SUMMARY -- PRE-REDEVELOPMENT

Land Cover Summary-Pre

Pre-ReDevelopment	Listed	Adjusted[1]
Forest/Open Space Cover (acres)	0.00	0.00
Weighted Rv(forest)	0.00	0.00
% Forest	0%	0%
Managed Turf Cover (acres)	0.49	0.49
Weighted Rv(turf)	0.15	0.15
% Managed Turf	100%	100%
Impervious Cover (acres)	0.00	0.00
Rv(impervious)	0.95	0.95
% Impervious	0%	0%
Total Site Area (acres)	**0.49**	**0.49**
Site Rv	**0.15**	**0.15**

LAND COVER SUMMARY -- POST DEVELOPMENT

Land Cover Summary-Post (Final)

Post ReDev. & New Impervious	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.49
Weighted Rv (turf)	0.15
% Managed Turf	100%
Impervious Cover (acres)	0.00
Rv(impervious)	0.95
% Impervious	0%
Final Site Area (acres)	**0.49**
Final Post Dev Site Rv	**0.15**

Land Cover Summary-Post

Post-ReDevelopment	
Forest/Open Space Cover (acres)	0.00
Weighted Rv(forest)	0.00
% Forest	0%
Managed Turf Cover (acres)	0.49
Weighted Rv (turf)	0.15
% Managed Turf	100%
ReDev. Impervious Cover (acres)	0.00
Rv(impervious)	0.95
% Impervious	0%
Total ReDev. Site Area (acres)	**0.49**
ReDev Site Rv	**0.15**

Land Cover Summary-Post

Post-Development New Impervious	
New Impervious Cover (acres)	0.00
Rv(impervious)	--

Treatment Volume and Nutrient Load

Pre-ReDevelopment Treatment Volume (acre-ft)	0.0061	0.0061	**Final Post-Development Treatment Volume (acre-ft)**	0.0061
Pre-ReDevelopment Treatment Volume (cubic feet)	267	267	**Final Post-Development Treatment Volume (cubic feet)**	267
Pre-ReDevelopment TP Load (lb/yr)	**0.17**	**0.17** *	**Final Post-Development TP Load (lb/yr)**	**0.17** *
Pre-ReDevelopment TP Load per acre (lb/acre/yr)	0.34	0.34 *	Final Post-Development TP Load per acre (lb/acre/yr)	0.34
Baseline TP Load (lb/yr) (**0.41 lbs/acre/yr** applied to pre-redevelopment area excluding pervious land proposed for new impervious cover)		*0.20*		

Treatment Volume and Nutrient Load

Post-ReDevelopment Treatment Volume (acre-ft)	0.0061	**Post-Development Treatment Volume (acre-ft)**	--
Post-ReDevelopment Treatment Volume (cubic feet)	267	**Post-Development Treatment Volume (cubic feet)**	--
Post-ReDevelopment Load (TP) (lb/yr)*	**0.17**	**Post-Development TP Load (lb/yr)**	--
Post-ReDevelopment TP Load per acre (lb/acre/yr)	0.34		
Max. Reduction Required (Below Pre-ReDevelopment Load)	**10%**		
* **TP Load Reduction Required for Redeveloped Area (lb/yr)**	**-0.03**	**TP Load Reduction Required for New Impervious Area (lb/yr)**	**0**

[1] *Adjusted Land Cover Summary:*
Pre ReDevelopment land cover minus pervious land cover (forest/open space or managed turf) acreage proposed for new impervious cover.

Adjusted total acreage is consistent with Post-ReDevelopment acreage (minus acreage of new impervious cover).

Column I shows load reduction requriement for new impervious cover (based on new development load limit, 0.41 lbs/acre/year).

* *Reduction below new development load limitation not required*

Post-Development Requirement for Site Area

TP Load Reduction Required (lb/yr) -0.03 ** *TP LOAD REDUCTION NOT REQUIRED*

Nitrogen Loads (Informational Purposes Only)

Pre-ReDevelopment TN Load (lb/yr)	1.20	Final Post-Development TN Load (Post-ReDevelopment & New Impervious) (lb/yr)	1.20

Drainage Area A

Drainage Area A Land Cover (acres)

	A Soils	B Soils	C Soils	D Soils	Totals	Land Cover Rv
Forest/Open Space (acres)					0.00	0.00
Managed Turf (acres)	1.24				1.24	0.15
Impervious Cover (acres)	0.53				0.53	0.95
				Total	1.77*	

CLEAR BMP AREAS

Total Phosphorus Available for Removal in D.A. A (lb/yr)	1.57
Post Development Treatment Volume in D.A. A (ft^3)	2,503

Stormwater Best Management Practices (RR = Runoff Reduction) Drainage Area A includes up-gradient area from outside site limits --Select from dropdown lists--

Practice	Runoff Reduction Credit (%)	Managed Turf Credit Area (acres)	Impervious Cover Credit Area (acres)	Volume from Upstream Practice (ft^3)	Runoff Reduction (ft^3)	Remaining Runoff Volume (ft^3)	Total BMP Treatment Volume (ft^3)	Phosphorus Removal Efficiency (%)	Phosphorus Load from Upstream Practices (lb)	Untreated Phosphorus Load to Practice (lb)	Phosphorus Removed By Practice (lb)	Remaining Phosphorus Load (lb)	Downstream Practice to be Employed	Nitrogen Removal Efficiency (%)	Nitrogen Load from Upstream Practices (lbs)	Untreated Nitrogen Load to Practice (lbs)	Nitrogen Removed By Practice (lbs)	Remaining Nitrogen Load (lbs)
1. Vegetated Roof (RR)														**1. Vegetated Roof (RR)**				
1.a. Vegetated Roof #1 (Spec #5)	45				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
1.b. Vegetated Roof #2 (Spec #5)	60				0	0	0	0		0.00	0.00	0.00		0		0.00	0.00	0.00
2. Rooftop Disconnection (RR)														**2. Rooftop Disconnection (RR)**				
2.a. Simple Disconnection to A/B Soils (Spec #1)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.b. Simple Disconnection to C/D Soils (Spec #1)	25			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.c. To Soil Amended Filter Path as per specifications (existing C/D soils) (Spec #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.d. To Dry Well or French Drain #1, Micro-Infilration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.e. To Dry Well or French Drain #2, Micro-Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
2.f. To Rain Garden #1, Micro-Bioretention #1 (Spec #9)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
2.g. To Rain Garden #2, Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
2.h. To Rainwater Harvesting (Spec #6)	0			0	0	0	0	0	0.00	0.00	0.00	0.00		0	0.00	0.00	0.00	0.00
2.i. To Stormwater Planter, Urban Bioretention (Spec #9, Appendix A)	40			0	0	0	0	25	0.00	0.00	0.00	0.00		40	0.00	0.00	0.00	0.00
3. Permeable Pavement (RR)														**3. Permeable Pavement (RR)**				
3.a. Permeable Pavement #1 (Spec #7)	45			0	0	0	0	25	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
3.b. Permeable Pavement #2 (Spec #7)	75				0	0	0	25		0.00	0.00	0.00		25		0.00	0.00	0.00
4. Grass Channel (RR)														**4. Grass Channel (RR)**				
4.a. Grass Channel A/B Soils (Spec #3)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.b. Grass Channel C/D Soils (Spec #3)	10			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
4.c. Grass Channel with Compost Amended Soils as per specs (see Spec #4)	20			0	0	0	0	15	0.00	0.00	0.00	0.00		20	0.00	0.00	0.00	0.00
5. Dry Swale (RR)														**5. Dry Swale (RR)**				
5.a. Dry Swale #1 (Spec #10)	40			0	0	0	0	20	0.00	0.00	0.00	0.00		25	0.00	0.00	0.00	0.00
5.b. Dry Swale #2 (Spec #10)	60			0	0	0	0	40	0.00	0.00	0.00	0.00		35	0.00	0.00	0.00	0.00
6. Bioretention (RR)														**6. Bioretention (RR)**				
6.a. Bioretention #1 or Micro-Bioretention #1 or Urban Bioretention (Spec #9)	40	1.24	0.53	0	1,001	1,502	2,503	25	0.00	1.57	0.86	0.71		40	0.00	11.24	7.19	4.05
6.b. Bioretention #2 or Micro-Bioretention #2 (Spec #9)	80			0	0	0	0	50	0.00	0.00	0.00	0.00		60	0.00	0.00	0.00	0.00
7. Infiltration (RR)														**7. Infiltration (RR)**				
7.a. Infiltration #1 (Spec #8)	50			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
7.b. Infiltration #2 (Spec #8)	90			0	0	0	0	25	0.00	0.00	0.00	0.00		15	0.00	0.00	0.00	0.00
8. Extended Detention Pond (RR)														**8. Extended Detention Pond (RR)**				
8.a. ED #1 (Spec #15)	0			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00
8.b. ED #2 (Spec #15)	15			0	0	0	0	15	0.00	0.00	0.00	0.00		10	0.00	0.00	0.00	0.00

9. Sheetflow to Filter/Open Space (RR)													
9.a. Sheetflow to Conservation Area, A/B Soils (Spec #2)	75			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.b. Sheetflow to Conservation Area, C/D Soils (Spec #2)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	
9.c. Sheetflow to Vegetated Filter Strip, A Soils or Compost Amended B/C/D Soils (Spec #2 & #4)	50			0	0	0	0	0	0.00	0.00	0.00	0.00	

9. Sheetflow to Filter/Open Space (RR)					
0	0.00	0.00	0.00	0.00	
0	0.00	0.00	0.00	0.00	
0	0.00	0.00	0.00	0.00	

TOTAL IMPERVIOUS COVER TREATED (ac)	0.53	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	1.24	AREA CHECK: OK.
TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	1,001	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.57	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.86	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.71	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

TOTAL RUNOFF REDUCTION IN D.A. A (ft^3)	1,001	
NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	7.19	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE CALCULATIONS (Information Only)

10. Wet Swale (no RR)													
10.a. Wet Swale #1 (Spec #11)	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
10.b. Wet Swale #2 (Spec #11)	0			0	0	0	0	40	0.00	0.00	0.00	0.00	

10. Wet Swale (Coastal Plain) (no RR)				
25	0.00	0.00	0.00	0.00
35	0.00	0.00	0.00	0.00

11. Filtering Practices (no RR)													
11.a.Filtering Practice #1 (Spec #12)	0			0	0	0	0	60	0.00	0.00	0.00	0.00	
11.b. Filtering Practice #2 (Spec #12)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

11. Filtering Practices (no RR)				
30	0.00	0.00	0.00	0.00
45	0.00	0.00	0.00	0.00

12. Constructed Wetland (no RR)													
12.a.Constructed Wetland #1 (Spec #13)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
12.b. Constructed Wetland #2 (Spec #13)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	

12. Constructed Wetland (no RR)				
25	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00

13. Wet Ponds (no RR)													
13.a. Wet Pond #1 (Spec #14)	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
13.b. Wet Pond #1 (Coastal Plain) (Spec #14)	0			0	0	0	0	45	0.00	0.00	0.00	0.00	
13.c. Wet Pond #2 (Spec #14)	0			0	0	0	0	75	0.00	0.00	0.00	0.00	
13.d. Wet Pond #2 (Coastal Plain) (Spec #14)	0			0	0	0	0	65	0.00	0.00	0.00	0.00	

13. Wet Ponds (no RR)					
30	0.00	0.00	0.00	0.00	
20	0.00	0.00	0.00	0.00	
40	0.00	0.00	0.00	0.00	
30	0.00	0.00	0.00	0.00	

14. Manufactured Treatment Devices (no RR)													
14.a. Manufactured Treatment Device-Hydrodynamic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	
14.b. Manufactured Treatment Device-Filtering	0			0	0	0	0	50	0.00	0.00	0.00	0.00	
14.c. Manufactured Treatment Device-Generic	0			0	0	0	0	20	0.00	0.00	0.00	0.00	

14. Manufactured BMP (no RR)				
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00
0	0.00	0.00	0.00	0.00

TOTAL IMPERVIOUS COVER TREATED (ac)	0.53	AREA CHECK: OK.
TOTAL MANAGED TURF AREA TREATED (ac)	1.24	AREA CHECK: OK.
TOTAL PHOSPHORUS REMOVAL REQUIRED ON SITE (lb/yr)	0.31	
TOTAL PHOSPHORUS AVAILABLE FOR REMOVAL IN D.A. A (lb/yr)	1.57	
TOTAL PHOSPHORUS REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00	
TOTAL PHOSPHORUS REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.86	
TOTAL PHOSPHORUS LOAD REDUCTION ACHIEVED IN D.A. A (lb/yr)	0.86	
TOTAL PHOSPHORUS REMAINING AFTER APPLYING BMP LOAD REDUCTIONS IN D.A. A (lb/yr)	0.71	

SEE WATER QUALITY COMPLIANCE TAB FOR SITE COMPLIANCE CALCULATIONS

NITROGEN REMOVED WITH RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	7.19
NITROGEN REMOVED WITHOUT RUNOFF REDUCTION PRACTICES IN D.A. A (lb/yr)	0.00
TOTAL NITROGEN REMOVED IN D.A. A (lb/yr)	7.19

Site Results (Water Quality Compliance)

Area Checks	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	AREA CHECK
FOREST/OPEN SPACE (ac)	0.00	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER (ac)	0.53	0.00	0.00	0.00	0.00	OK.
IMPERVIOUS COVER TREATED (ac)	0.53	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA (ac)	1.24	0.00	0.00	0.00	0.00	OK.
MANAGED TURF AREA TREATED (ac)	1.24	0.00	0.00	0.00	0.00	OK.
AREA CHECK	OK.	OK.	OK.	OK.	OK.	

Site Treatment Volume (ft^3)	2,503

Runoff Reduction Volume and TP By Drainage Area

	D.A. A	D.A. B	D.A. C	D.A. D	D.A. E	TOTAL
RUNOFF REDUCTION VOLUME ACHIEVED (ft^3)	1,001	0	0	0	0	1,001
TP LOAD AVAILABLE FOR REMOVAL (lb/yr)	1.57	0.00	0.00	0.00	0.00	1.57
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.86	0.00	0.00	0.00	0.00	0.86
TP LOAD REMAINING (lb/yr)	0.71	0.00	0.00	0.00	0.00	0.71
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	7.19	0.00	0.00	0.00	0.00	7.19

Total Phosphorus

FINAL POST-DEVELOPMENT TP LOAD (lb/yr)	~~1.57~~	0.17 (See Site Data Sheet)
TP LOAD REDUCTION REQUIRED (lb/yr)	~~0.31~~	-0.02 (See Site Data Sheet)
TP LOAD REDUCTION ACHIEVED (lb/yr)	0.86	
TP LOAD REMAINING (lb/yr):	~~0.71~~	-0.69
REMAINING TP LOAD REDUCTION REQUIRED (lb/yr):	0.00	**

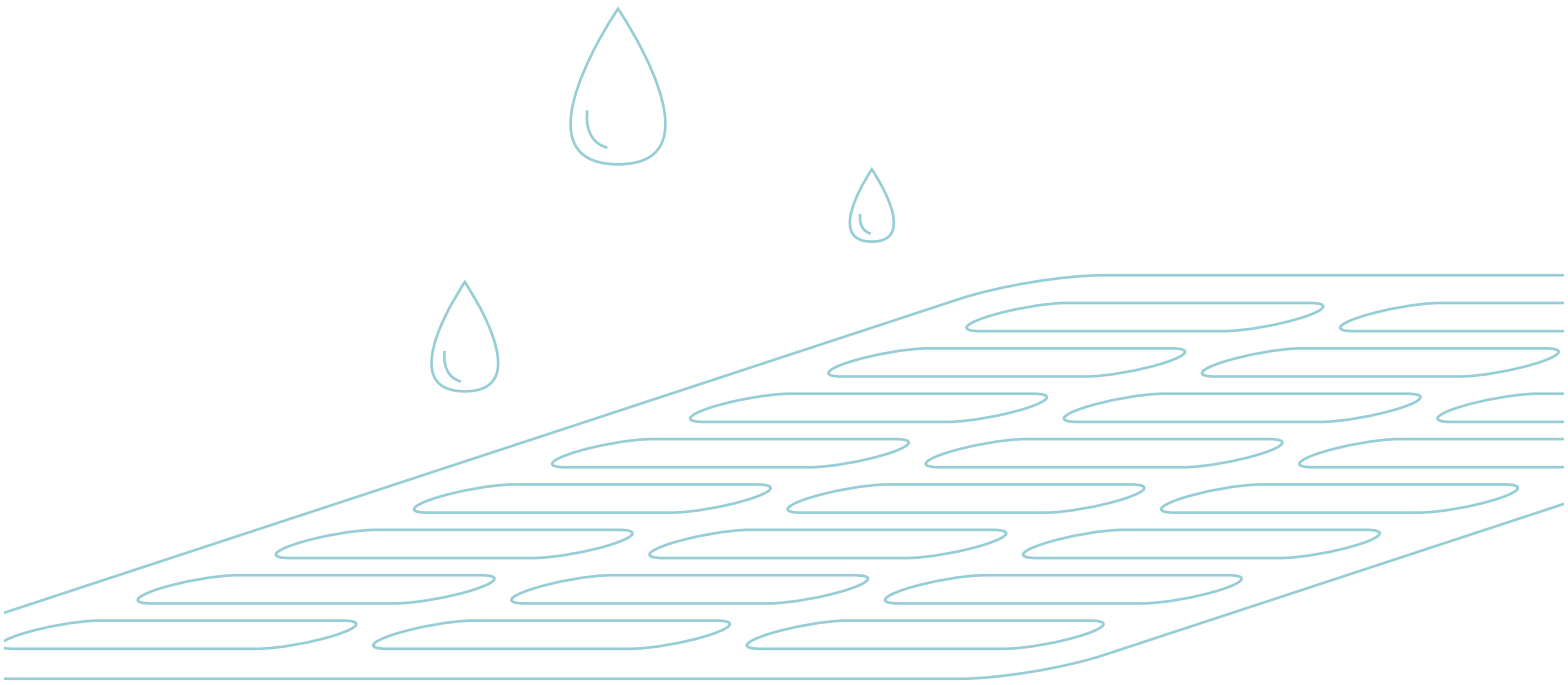
** TARGET TP REDUCTION EXCEEDED BY ~~0.55~~ 0.86 LB/YEAR **

Total Nitrogen (For Information Purposes)

POST-DEVELOPMENT LOAD (lb/yr)	11.25
NITROGEN LOAD REDUCTION ACHIEVED (lb/yr)	7.19
REMAINING POST-DEVELOPMENT NITROGEN LOAD (lb/yr)	4.06

Appendix C:

References



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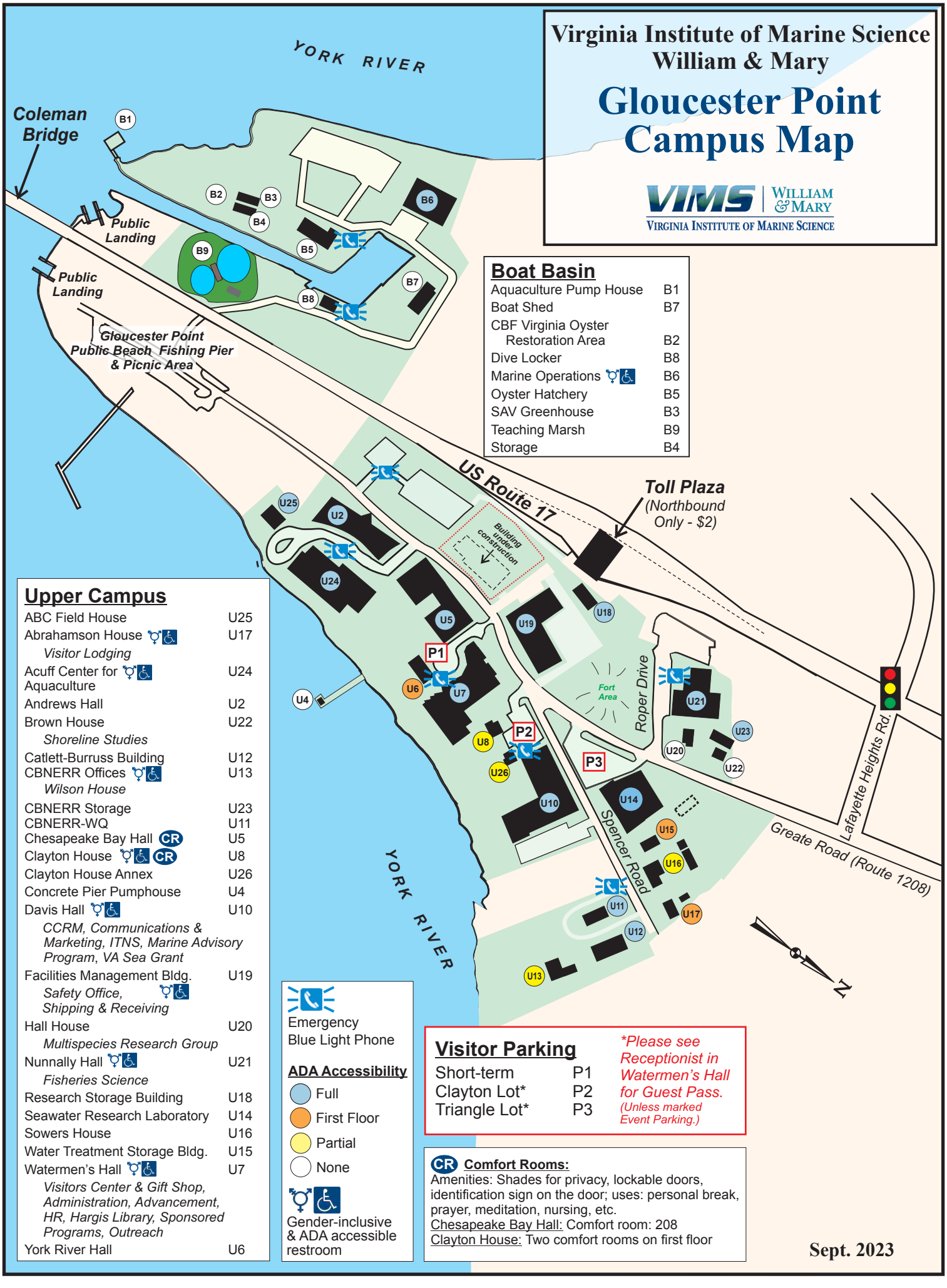
Campus Map

vhb

Virginia Institute of Marine Science
William & Mary

Gloucester Point Campus Map

VIMS | William & Mary
Virginia Institute of Marine Science



Boat Basin

Aquaculture Pump House	B1
Boat Shed	B7
CBF Virginia Oyster Restoration Area	B2
Dive Locker	B8
Marine Operations	B6
Oyster Hatchery	B5
SAV Greenhouse	B3
Teaching Marsh	B9
Storage	B4

Upper Campus

ABC Field House	U25
Abrahamson House	U17
Visitor Lodging	
Acuff Center for Aquaculture	U24
Andrews Hall	U2
Brown House	U22
Shoreline Studies	
Catlett-Burruss Building	U12
CBNERR Offices	U13
Wilson House	
CBNERR Storage	U23
CBNERR-WQ	U11
Chesapeake Bay Hall (CR)	U5
Clayton House (CR)	U8
Clayton House Annex	U26
Concrete Pier Pumphouse	U4
Davis Hall	U10
CCRM, Communications & Marketing, ITNS, Marine Advisory Program, VA Sea Grant	
Facilities Management Bldg.	U19
Safety Office, Shipping & Receiving	
Hall House	U20
Multispecies Research Group	
Nunnally Hall	U21
Fisheries Science	
Research Storage Building	U18
Seawater Research Laboratory	U14
Sowers House	U16
Water Treatment Storage Bldg.	U15
Watermen's Hall	U7
Visitors Center & Gift Shop, Administration, Advancement, HR, Hargis Library, Sponsored Programs, Outreach	
York River Hall	U6

Emergency Blue Light Phone

ADA Accessibility

- Full
- First Floor
- Partial
- None

Gender-inclusive & ADA accessible restroom

Visitor Parking

Short-term	P1
Clayton Lot*	P2
Triangle Lot*	P3

Please see Receptionist in Watermen's Hall for Guest Pass.
(Unless marked Event Parking.)

(CR) Comfort Rooms:
Amenities: Shades for privacy, lockable doors, identification sign on the door; uses: personal break, prayer, meditation, nursing, etc.
Chesapeake Bay Hall: Comfort room: 208
Clayton House: Two comfort rooms on first floor

Sept. 2023

Cost Estimates

VIMS | William & Mary
Virginia Institute of Marine Science

Capital Improvement Projects

vhb

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

Construction Cost Opinion

DATE PREPARED : October 03, 2016

PROJECT/PROJECT # : 33872.04

BASIS FOR ESTIMATE:
X STUDY
PRELIMINARY DESIGN
FINAL DESIGN

LOCATION : Gloucester Point, VA

CLIENT: Virginia Institute of Marine Sciences

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion CIP.xls]SUMMARY

ITEM NO	ITEM DESCRIPTION	UNIT	UNIT COST	PHOSPHORUS REMOVAL ACHIEVED (LBS)	COST PER POUND REMOVED ($/LB)
	CAPITAL IMPROVEMENT PROJECTS				
2023					
1	WATERMEN'S HALL ADDITION AND AMPITHEATER (2023)	SUBTOTAL	$524,683	1.04	$504,503
2	OYSTER HATCHERY (2023)	SUBTOTAL	$229,853	0.77	$298,510
		2023 SUBTOTAL	**$754,536**	**1.81**	**$803,013**
2028					
3	FIELD SUPPORT ADMIN BUILDING (2028)	SUBTOTAL	$263,642	0.72	$366,170
4	NUNALLY HALL (2028)	SUBTOTAL	$419,299	0.81	$517,653
		2023 SUBTOTAL	**$682,941**	**1.53**	**$883,823**
		CAPITAL IMPROVEMENT PLAN TOTAL COST	**$1,437,477**		

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

Construction Cost Opinion

PROJECT/PROJECT # : 33872.04

LOCATION : Gloucester Point, VA

CLIENT: Virginia Institute of Marine Sciences

DATE PREPARED : October 03, 2016

BASIS FOR ESTIMATE:
X STUDY
PRELIMINARY DESIGN
FINAL DESIGN

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion CIP.xls]Watermens

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL OF COSTS	COMMENTS
	WATERMEN'S HALL ADDITION AND AMPITHEATER (2023)					
1	MOBILIZATION	1	LS	$10,000	$10,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	SOUTH BIORETENTION BASIN (MATERIALS & INSTALLATION)	1,853	SF	$35	$64,855	
5	NORTH BIORETENTION BASIN (MATERIALS & INSTALLATION)	1,915	SF	$35	$67,025	
6	PERMEABLE PAVEMENT (MATERIALS & INSTALLATION)	7,933	SF	$25	$198,325	
						Pounds Phosphorus Removed
						1.04
						Cost per Pound of Phosphorus Removed
						$504,502.79

	TOTAL	**$380,205**
15% Design Contingency		$57,031
8% General Conditions		$30,416
15% Construction Contingency		$57,031
	TOTAL	**$524,683**

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

Construction Cost Opinion

PROJECT/PROJECT # : 33872.04

LOCATION : Gloucester Point, VA

CLIENT: Virginia Institute of Marine Sciences

DATE PREPARED : October 03, 2016

BASIS FOR ESTIMATE:

X STUDY

PRELIMINARY DESIGN

FINAL DESIGN

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion CIP.xls]Oyster

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL OF COSTS	COMMENTS
	OYSTER HATCHERY (2023)					
1	MOBILIZATION	1	LS	$10,000	$10,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	BIORETENTION BASIN (MATERIALS & INSTALLATION)	1,641	SF	$35	$57,435	
5	PERMEABLE PAVEMENT (MATERIALS & INSTALLATION)	2,365	SF	$25	$59,125	
						Pounds Phosphorus Removed
						0.77
						Cost per Pound of Phosphorus Removed
						$298,510.13

	TOTAL	**$166,560**
15% Design Contingency		$24,984
8% General Conditions		$13,325
15% Construction Contingency		$24,984
	TOTAL	**$229,853**

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

Construction Cost Opinion

PROJECT/PROJECT # : 33872.04

LOCATION : Gloucester Point, VA

CLIENT: Virginia Institute of Marine Sciences

DATE PREPARED : October 03, 2016

BASIS FOR ESTIMATE:

X STUDY

PRELIMINARY DESIGN

FINAL DESIGN

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion CIP.xls]FSA

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL OF COSTS	COMMENTS
	FIELD SUPPORT ADMIN BUILDING (2028)					
1	MOBILIZATION	1	LS	$10,000	$10,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	EAST BIORETENTION BASIN (MATERIALS & INSTALLATION)	1,285	SF	$35	$44,975	
5	WEST BIORETENTION BASIN (MATERIALS & INSTALLATION)	1,202	SF	$35	$42,070	
6	PERMEABLE PAVEMENT (MATERIALS & INSTALLATION)	2,160	SF	$25	$54,000	
						Pounds Phosphorus Removed
						0.72
						Cost per Pound of Phosphorus Removed
						$366,169.58

TOTAL	**$191,045**
15% Design Contingency	$28,657
8% General Conditions	$15,284
15% Construction Contingency	$28,657
TOTAL	**$263,642**

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

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DATE PREPARED : October 03, 2016

BASIS FOR ESTIMATE:
X STUDY
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FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion CIP.xls]Nunally

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	SUBTOTAL OF COSTS	COMMENTS
	NUNALLY HALL (2028)					
1	MOBILIZATION	1	LS	$10,000	$10,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	BIORETENTION BASIN (MATERIALS & INSTALLATION)	3,179	SF	$35	$111,265	
5	PERMEABLE PAVEMENT (MATERIALS & INSTALLATION)	5,703	SF	$25	$142,575	
						Pounds Phosphorus Removed
						0.81
						Cost per Pound of Phosphorus Removed
						$517,653.33

TOTAL	**$303,840**
15% Design Contingency	$45,576
8% General Conditions	$24,307
15% Construction Contingency	$45,576
TOTAL	**$419,299**

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Stormwater Improvement Projects

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VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

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LOCATION : Gloucester Point, VA

CLIENT: Virginia Institute of Marine Sciences

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion SIP.xls]SUMMARY

ITEM NO	ITEM DESCRIPTION	UNIT	UNIT COST	PHOSPHORUS REMOVAL ACHIEVED (LBS)	COST PER POUND REMOVED ($/LB)
	STORMWATER IMPROVEMENT PROJECTS				
1.	WILSON HALL - Bioretention Basin Retrofit	TOTAL	$302,807	0.86	$352,101
2.	SEAWATER LABORATORY - Permeable Pavement	TOTAL	$337,341	0.73	$462,111
3.	CHESAPEAKE BAY HALL - Water Quality Inlets	TOTAL	$220,800	0.47	$469,787
4.	BOAT BASIN - Permeable Pavement	TOTAL	$1,943,592	2.84	$684,363
	STORMWATER IMPROVEMENT PLAN TOTAL COST		**$2,804,540**	**4.90**	**$1,968,362**

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2016 VIMS Stormwater Master Plan

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LOCATION : Gloucester Point, VA

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DATE PREPARED : October 03, 2016

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PRELIMINARY DESIGN

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FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion SIP.xls]Wilson

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST	COMMENTS
	WILSON HALL - Bioretention Basin Retrofit					
1	MOBILIZATION	1	LS	$20,000	$20,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	NORTH BIORETENTION (MATERIALS & INSTALLATION)	2,593	SF	$35	$90,755	
5	SOUTH BIORETENTION (MATERIALS & INSTALLATION)	1,962	SF	$35	$68,670	
						Pounds Phosphorus Removed
						0.86
						Cost per Pound of Phosphorus Removed
						$352,101
				TOTAL	**$219,425**	
				15% Design Contingency	$32,914	
				8% General Conditions	$17,554	
				15% Construction Contingency	$32,914	
				TOTAL	**$302,807**	

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

Construction Cost Opinion

PROJECT/PROJECT # : 33872.04

LOCATION : Gloucester Point, VA

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X STUDY
PRELIMINARY DESIGN
FINAL DESIGN

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion SIP.xls]Seawater Lab

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST	COMMENTS
	SEAWATER LABORATORY - Permeable Pavement					
1	MOBILIZATION	1	LS	$20,000	$20,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$5,000	$5,000	
4	PERMEABLE PAVEMENT (MATERIALS & INSTALLATION)	8178	SF	$25	$204,450	
						Pounds Phosphorus Removed
						0.73
						Cost per Pound of Phosphorus Removed
						$462,111

TOTAL	**$244,450**
15% Design Contingency	$36,668
8% General Conditions	$19,556
15% Construction Contingency	$36,668
TOTAL	**$337,341**

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

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DATE PREPARED : October 03, 2016

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FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion SIP.xls]CBH

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST	COMMENTS
	CHESAPEAKE BAY HALL - Water Quality Inlets					
1	MOBILIZATION	1	LS	$20,000	$20,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	WATER QUALITY INLET (MATERIALS & INSTALLATION)	4	EA	$25,000	$100,000	
						Pounds Phosphorus Removed
						0.47
						Cost per Pound of Phosphorus Removed
						$469,787

TOTAL	**$160,000**
15% Design Contingency	$24,000
8% General Conditions	$12,800
15% Construction Contingency	$24,000
TOTAL	**$220,800**

VHB - Stormwater Group

2016 VIMS Stormwater Master Plan

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DATE PREPARED : October 03, 2016

BASIS FOR ESTIMATE:

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PRELIMINARY DESIGN

FINAL DESIGN

FILE NAME: \\VABEDATA\projects\33872.04 VIMS SWMP\tech\SWMP\Cost Estimates\[Cost Opinion SIP.xls]Boat Basin

ITEM NO	ITEM DESCRIPTION	QUANTITY	UNIT	UNIT COST	COST	COMMENTS
	BOAT BASIN - Permeable Pavement					
1	MOBILIZATION	1	LS	$20,000	$20,000	
2	DEMOLITION	1	LS	$15,000	$15,000	
3	UTILITY ADJUSTMENTS	1	LS	$25,000	$25,000	
4	PERMEABLE PAVEMENT (MATERIALS & INSTALLATION)	53,936	SF	$25	$1,348,400	
						Pounds Phosphorus Removed
						2.84
						Initial Cost per Pound of Phosphorus Removed
						$684,363
				TOTAL	**$1,408,400**	
				15% Design Contingency	$211,260	
				8% General Conditions	$112,672	
				15% Construction Contingency	$211,260	
				TOTAL	**$1,943,592**	

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Virginia's Major Watersheds

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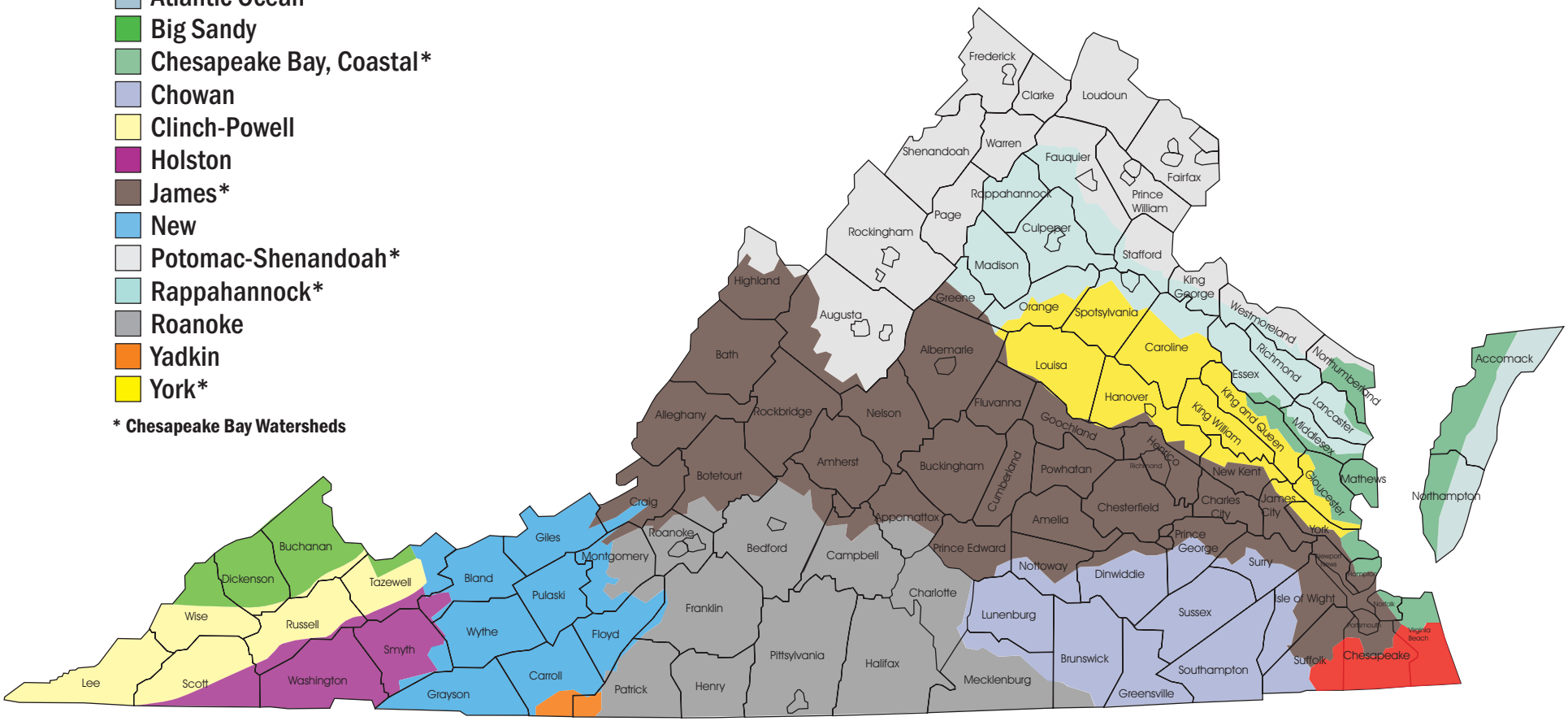
Virginia's Major Watersheds

- Albemarle Sound, Coastal
- Atlantic Ocean
- Big Sandy
- Chesapeake Bay, Coastal*
- Chowan
- Clinch-Powell
- Holston
- James*
- New
- Potomac-Shenandoah*
- Rappahannock*
- Roanoke
- Yadkin
- York*

* Chesapeake Bay Watersheds



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