STROUBLES CREEK TMDL ACTION PLAN

(2023-2028 MS4 General Permit)
TMDL Project Name: Stroubles Creek Watershed
EPA TMDL Approval Date: 01/28/2004

A Plan for Achieving Sediment Load Reductions to Meet the Virginia Tech TMDL Waste Load Allocation

Virginia Tech

This document satisfies the requirements of Part II.B of the General Virginia Pollution Discharge Elimination System Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (9VAC25-890). This document serves as a specific Total Maximum Daily Load Action Plan to identify the best management practices and other interim milestone activities to be implemented to address the sediment waste load allocation assigned to Virginia Tech's regulated MS4 area in the *Benthic TMDL for Stroubles Creek in Montgomery County, Virginia*, approved by the Environmental Protection Agency on January 28, 2004.

Updated: March 2025

EXECUTIVE SUMMARY

Virginia Tech (VT), is authorized to discharge stormwater from its municipal separate storm sewer system (MS4) under the Virginia Pollutant Discharge Elimination System (VPDES) General Permit for Discharge of Stormwater from Small MS4s (MS4 GP). To maintain permit compliance, VT Facilities - Site and Infrastructure Development (VT SID) implements a MS4 Program Plan that includes best management practices (BMPs) to address the six minimum control measures (MCMs) and special conditions for the Benthic Total Maximum Daily Load (TMDL) for Stroubles Creek. The Benthic TMDL for Stroubles Creek, approved by the US Environmental Protection Agency (EPA) in 2004, was required to be developed under the authority of the Clean Water Act (CWA) in response to the creek's listing as impaired by the Virginia Department of Environmental Quality (DEQ) for not meeting water quality standards.

The EPA describes a TMDL as a "pollution diet" that identifies the maximum amount of a pollutant the waterway can receive and still meet water quality standards. In the case of the Stroubles Creek TMDL, sediment was identified as the pollutant of concern and MS4s within the watershed of the impaired segment of the creek were assigned a waste load allocation (WLA). A WLA determines the required reduction in sediment loadings from the MS4s to meet water quality standards and is represented as a 54% sediment reduction in the Stroubles Creek TMDL. The MS4 General Permit serves as the regulatory mechanism for addressing the load reductions described in the TMDL, predominantly through the requirement of a TMDL Action Plan.

The revised Chesapeake Bay TMDL Special Condition Guidance Memo No. 20-2003, dated February 06, 2021, no longer supports the 'mass loading' approach relative to assessing sediment removal. The guidance directs assessment of POC reductions using a 'lane miles' approach. This revised assessment methodology has dramatically reduced the anticipated POC reductions credited to street sweeping. As a result, in 2024 VT made the decision to utilize the Duck Pond Water Quality Improvements project, an Existing BMP Retrofit Project (major restoration), as the primary practice to achieve the water quality standard described in the TMDL. The VT Stroubles Creek TMDL Action Plan addresses each of the special conditions described in the MS4 General Permit and prescribes scheduled steps that will be taken to achieve the sediment load reduction target. Implementation of this Action Plan is consistent with the provisions of an iterative MS4 Program, which constitutes compliance with the MS4 General Permit requirements for reducing pollutants to the maximum extent practicable.

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Acronyms

BMP	Best Management Practice
CBP	Chesapeake Bay Program
CN	Curve Number
CWA	Clean Water Act
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
EBRP	Existing BMP Retrofit Project
EPA	United States Environmental Protection Agency
ESC	Erosion and Sediment Control
GIS	Geographic Information System
GP	General Permit
GPS	Global Positioning System
GWLF	Generalized Watershed Loading Function
HSG	Hydrological Soil Group
IDDE	Illicit Discharge Detection and Elimination
IP	Implementation Plan
LA	Load Allocation
MCM	Minimum Control Measure
MEP	Maximum Extent Practicable
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MS4 GP	General Permit for Discharge of Stormwater from Small MS4s
NLCD	National Land Cover Dataset
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PEOP	Public Education and Outreach Plan
POC	Pollutant of Concern
SWCB	State Water Control Board
SWM	Stormwater Management
SWPPP	Stormwater Pollution Prevention Plan
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Sediment
VAC	Virginia Administrative Code
VDOT	Virginia Department of Transportation
VPDES	Virginia Pollutant Discharge Elimination System
VSMP	Virginia Stormwater Management Program
VT	Virginia Polytechnic Institute and State University (Virginia Tech)
VT BSE	Virginia Tech Department of Biological Systems Engineering
VT SID	Virginia Tech Facilities Services - Site and Infrastructure Development
WLA	Wasteload Allocation
WTM	Watershed Treatment Model

1.0 INTRODUCTION AND PURPOSE

> *"Stroubles Creek is a tributary of the New River, which flows north into the Kanawha River. The Kanawha flows into the Ohio River, which flows into the Mississippi River, which in turn discharges into the Gulf of Mexico."*
> - Benthic TMDL for Stroubles Creek in Montgomery County, Virginia

Mandated by Congress under the Clean Water Act (CWA), the National Pollutant Discharge Elimination System (NPDES) stormwater program includes the Municipal Separate Storm Sewer System (MS4), Construction, and Industrial General Permits. In Virginia, the NPDES Program is administered by the Department of Environmental Quality (DEQ) through the Virginia Stormwater Management Program (VSMP) and the Virginia Pollutant Discharge Elimination System (VPDES) Program. Virginia Polytechnic Institute and State University, commonly known as Virginia Tech (VT), is authorized to discharge stormwater from its MS4 under the VPDES General Permit for Discharge of Stormwater from Small MS4s (MS4 GP). As part of the permit authorization, VT developed and implements an MS4 Program Plan that includes best management practices (BMPs) to address the six minimum control measures (MCMs) and special conditions for applicable total maximum daily loads (TMDLs) outlined in the MS4 GP. Implementation of these BMPs is consistent with the provisions of an iterative MS4 Program, which constitutes compliance with the standard of reducing pollutants to the "maximum extent practicable," or MEP.

1.1 Stroubles Creek TMDL

A TMDL is defined as the total amount of a given pollutant that a waterbody can assimilate and still meet water quality standards. Typically, TMDLs are represented numerically in three main components: Waste Load Allocations (WLAs), a Load Allocation (LA), and a Margin of Safety (MOS). A WLA is the allocated amount of pollutant from areas discharging through a pipe or other conveyance considered a point source. Point sources include sewage treatment plants, industrial facilities, and storm sewer systems. In contrast, a LA is the amount of pollutant from existing non-point sources and natural background sources, such as farmland runoff and atmospheric deposition. For the Stroubles Creek TMDL, an explicit MOS of 10% of the calculated TMDL pollutant load was used to reflect uncertainty in representative modeling computations. As a point source discharge, MS4 permittees are assigned a WLA representing the annual loading of the pollutant of concern (POC) that can be discharged from its regulated MS4 area.

The Virginia DEQ listed a 4.98-mile segment of Stroubles Creek on their biennial 303(d) list in 1996 due to benthic impairments. Subsequent to the initial listing, a TMDL for Stroubles Creek, entitled *Benthic TMDL for Stroubles Creek in Montgomery County, Virginia*, was developed and is referred to herein as the Stroubles Creek TMDL. The Stroubles Creek TMDL was approved by the

US Environmental Protection Agency (EPA) on January 28, 2004 and by the State Water Control Board (SWCB) on June 17, 2004. As part of the approved TMDL, VT's permitted MS4 (VAR040049) was assigned a WLA for sediment discharge to Stroubles Creek.

The Stroubles Creek TMDL assigns an aggregated WLA for permitted MS4s within the watershed that includes MS4 discharges from VT, the Town of Blacksburg, and the Virginia Department of Transportation (VDOT). The TMDL presents the WLA as an annual sediment load resulting from a "percent reduction" of the existing and projected future load from the MS4s to meet water quality standards for the watershed. The percent reduction from the aggregated MS4 load is a 54% reduction of sediment, the pollutant of concern.

1.2 TMDL Special Conditions

The special conditions of the MS4 GP are triggered where a permittee has been assigned a WLA under the TMDL. Since the Stroubles Creek TMDL assigned a WLA to VT's MS4, per Part II.B of the MS4 GP, VT is required to "develop a local TMDL action plan designed to reduce loadings for pollutants of concern" (Part II.B.1) and to "complete implementation of the TMDL action plans as soon as practicable. TMDL action plans may be implemented in multiple phases over more than one permit cycle using the adaptive iterative approach provided adequate progress is achieved in the implementation of BMPs designed to reduce pollutant discharges in a manner that is consistent with the assumptions and requirements of the applicable TMDL" (Part II.B.2).

Per Part II.B.3 of the MS4 GP, "each local TMDL action plan developed by the permittee shall include the following:

a. The TMDL project name;

b. The EPA approval date of the TMDL;

c. The wasteload allocated to the permittee (individually or in aggregate), and the corresponding percent reduction, if applicable;

d. Identification of the significant sources of the pollutants of concern discharging to the permittee's MS4 and that are not covered under a separate VPDES permit. For the purposes of this requirement, a significant source of pollutants means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL;

e. The BMPs designed to reduce the pollutants of concern in accordance with Parts II B 4, B 5, and B 6;

f. Any calculations required in accordance with Part II B 4, B 5, or B 6;

g. For action plans developed in accordance with Part II B 4 and B 5, an outreach strategy to enhance the public's education (including employees) on methods to eliminate and reduce discharges of the pollutants; and

h. A schedule of anticipated actions planned for implementation during this permit term."

Additionally, per Part II.B.5 of the MS4 GP, the following items specific to local sediment, phosphorus, and/or nitrogen TMDLs apply:

a. The permittee shall reduce the loads associated with sediment, phosphorus, or nitrogen through implementation of one or more of the following:
   - One or more of the BMPs from the Virginia Stormwater BMP Clearinghouse listed in 9VAC25-870-65 or other approved BMPs found on the Virginia Stormwater BMP Clearinghouse website;
   - One or more BMPs approved by the Chesapeake Bay Program; or
   - Land disturbance thresholds lower than Virginia's regulatory requirements for erosion and sediment control and post development stormwater management.

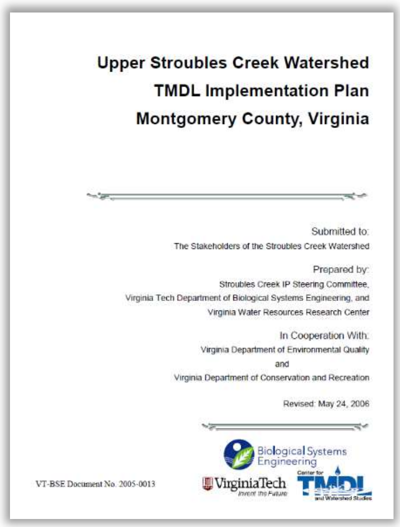
b. The permittee may meet the local TMDL requirements for sediment, phosphorus, or nitrogen through BMPs implemented to meet the requirements of the Chesapeake Bay TMDL in Part II A as long as the BMPs are implemented in the watershed for which local water quality is impaired.

c. The permittee shall calculate the anticipated load reduction achieved from each BMP and include the calculations in the action plan required in Part II B 3 f.

d. No later than 36 months after the effective date of this permit, the permittee shall submit to the department the anticipated end dates by which the permittee will meet each WLA for sediment, phosphorus, or nitrogen."

VT submits reporting on the implementation of the MS4 program annually to the Virginia DEQ. The TMDL Action Plan shall be submitted by May 1, 2025 and in subsequent years when any significant modifications occur. Implementation and measures of effectiveness will be reported annually as described in Section 5.2.

1.3 Stroubles Creek TMDL Implementation Plan


Upper Stroubles Creek Watershed
TMDL Implementation Plan
Montgomery County, Virginia

Submitted to:
The Stakeholders of the Stroubles Creek Watershed

Prepared by:
Stroubles Creek IP Steering Committee,
Virginia Tech Department of Biological Systems Engineering, and
Virginia Water Resources Research Center

In Cooperation With:
Virginia Department of Environmental Quality
and
Virginia Department of Conservation and Recreation

Revised: May 24, 2006

VT-BSE Document No. 2005-0013

Following approval of a TMDL, various stakeholders may create an Implementation Plan (IP). Although such plans are alluded to in the Federal CWA legislation, they are not a specific requirement. However, such IPs are a state requirement through Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act. The Stroubles Creek IP was developed by the Stroubles Creek IP Steering Committee, Virginia Tech Department of Biological Systems Engineering (VT BSE), and the Virginia Water Resources Research Center in cooperation with the Virginia DEQ and Virginia Department of Conservation and Recreation (DCR). The Stroubles IP, entitled the *Upper Stroubles Creek*

Watershed TMDL Implementation Plan Montgomery County, Virginia, is intended to contain actions that will be effective in reduction of sediment loads to Stroubles Creek, ultimately achieving reductions necessary to meet water quality standards.

The Stroubles Creek IP presents an implementation schedule for identified actions as measurable milestones. Scheduled actions specified for VT, along with the current implementation status, are listed in the Tables in Appendix A. As recognized in the Stroubles Creek IP, it is difficult to quantify load reductions achieved with the implementation of the identified actions in the IP. The status of each action indicates VT efforts to the MEP for consistency with the IP. The Action Plan presented herein will identify additional actions quantitatively, consistent with the MS4 GP to demonstrate VT's plans to achieve the WLA.

2.0 MS4 PROGRAM ASSESSMENT

VT maintains compliance with the MS4 GP with implementation of BMPs defined in the VT MS4 Program Plan. A majority of the program BMPs can be considered nonstructural, in contrast to structural BMPs. Structural BMPs, such as retention ponds, capture pollutants after they have washed off the ground surface and been conveyed to the pond through stormwater runoff. Alternatively, nonstructural BMPs can be considered as "source controls" where the pollutant is either prevented from accumulating or is collected from the ground surface prior to exposure to precipitation that would convey the pollutant downstream. Source controls are typically performed at some defined frequency to minimize pollutant build-up and downstream wash-off during a rainfall event. Examples of nonstructural BMPs include community education programs, staff training, good housekeeping and pollution prevention procedures, catch basin cleanout, and street sweeping.

Consistent with the special conditions described in Section 1.2, the following sub-sections characterize VT's existing MS4 program in context of the Stroubles Creek TMDL POC, sediment.

2.1 MS4 General Permit Minimum Control Measures

VT maintains compliance with the MS4 GP through implementation of their VT MS4 Program that addresses the Minimum Control Measures (MCMs) outlined in the permit. Inherently, each is applicable to addressing reduction or elimination of sediment. Applicability is summarized as:

- ✓ MCM 1: VT has identified sediment as a high-priority water quality issue in the program's Public Education and Outreach Plan (PEOP). As such, public education and outreach incorporates sediment concerns related to water quality in outreach to the identified target audiences, consisting of students, faculty and staff.
- ✓ MCM 2: Written procedures for public participation events are developed in conjunction with the PEOP and incorporate sediment as a water quality issue.

- ✓ MCM 3: VT conducts dry-weather outfall screenings for non-stormwater discharges, including sediment, and implements written procedures for detecting and eliminating identified discharges. VT has also conducted a campus assessment to identify potential sources of sediment. Where applicable per the permit, stormwater pollution prevention plans (SWPPPs) are developed to address potential pollutant discharges, including discharges of sediment. VT also disseminates information to the public for the reporting of illicit discharges. A prohibition of illicit discharges on the campus is established through the Illicit Discharge Detection and Elimination (IDDE) Policy (Policy).
- ✓ MCM 4: Regulated land disturbance projects on campus are required to be consistent with the VT Standards and Specifications for erosion and sediment control (ESC) and stormwater management (SWM), which require approved plans that minimize sediment discharge from construction activity and post-construction. Inspections are required to be performed during construction activity and on any post-construction facilities built to address stormwater management.
- ✓ MCM5: The VT Annual Standards and Specifications for ESC and SWM require regulated land disturbance projects to address post-construction water quality. The MCM also requires a long-term inspection and maintenance program for stormwater management facilities to ensure functionality.
- ✓ MCM 6: VT developed good housekeeping procedures that are incorporated into staff training. The potential for discharge of sediment was included in the campus assessment to identify high priority facilities that will be targeted for site-specific SWPPPs.

2.2 Enhanced Public Outreach

VT's MS4 program has enhanced public education and outreach and employee training programs to promote methods to eliminate or reduce the discharge of sediment from the MS4. Enhancement is described as follows:

- ✓ Public Education & Outreach Plan: The PEOP incorporated into VT's MS4 Program Plan identifies sediment as a high priority water quality issue. The PEOP includes annual efforts to reach out to target audiences with information related to the Stroubles Creek TMDL, including methods to reduce the discharge of sediment. Examples of outreach opportunities regularly utilized by VT's MS4 Program Plan include:
    - In-class guest speaker presentations to students on-campus
    - Steppin' Out
    - VT Dining Table Cards and Dormitory Handouts
    - Earth Week and Sustainability Week events
    - Storm Drain Marking
    - The Big Plant
    - ReNew the New

- Stormwater Days – an event for middle school students
- NRV Home Expo

2.3 Facility Assessments and Identification of Significant Sources

VT has performed a campus-wide evaluation for the identification of areas that are significant and/or potential sources of sediment. The evaluation was consistent with the MS4 GP Special Condition Part II.B.3. Areas identified from the evaluation included isolated areas requiring stabilization or perimeter controls.

VT has also identified high priority areas as part of their MS4 Program consistent with Part I.E.6.c of the previous MS4 GP. The facilities are considered to have a high potential to discharge pollutants and site-specific SWPPPs have been developed to minimize pollutant discharges.

Additional detail on the facility assessments is available upon request from VT SID.

3.0 WASTE LOAD ALLOCATION

The Stroubles Creek TMDL assigns an aggregated WLA for permitted MS4s within the watershed that combines MS4 discharges from VT, the Town of Blacksburg, and VDOT. The TMDL presents the WLA as an annual sediment load resulting from a "percent reduction" of the existing and projected future load from the MS4s to meet water quality standards. The percent reduction from the aggregated MS4 load is a 54% reduction of total future sediment loadings. A future date is not explicitly identified in the Stroubles Creek TMDL. However, future loadings are described as based on land use trends identified and projected by the Town of Blacksburg through 2046.

3.1 TMDL Model Approach

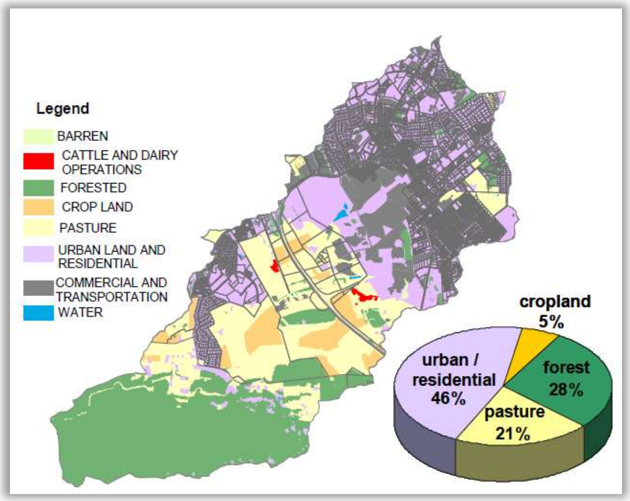
The Stroubles Creek TMDL describes a modeling approach that used the Toms Creek watershed in Blacksburg, Virginia, as part of a "reference watershed" approach since Toms Creek met the water quality standard. Each land use in the Tom's Creek watershed was scaled by a factor of 1.19 for size-equivalent comparison to the Stroubles Creek watershed. The Generalized Watershed Loading Function (GWLF) computer model was used for comparative modeling using modeling parameters for each watershed. Hydrologic and sediment-related parameter values generally were selected from GWLF user manual guidance. No calibration of hydrologic parameters was performed. Loads were consolidated to be characterized from the following land uses: agriculture, non-MS4 regulated urban areas, forest, channel erosion, MS4s, and point sources regulated under VPDES permits. Loads from forested areas were not given load reductions in the Stroubles Creek TMDL, as is the norm, and instead reductions focused on anthropogenic sources of the POC. Since individual VPDES permitted discharges are already permitted, they also were not subject to further reductions. Table 1 summarizes the recommended sediment reductions to meet the target of the modeled reference watershed (accounting for a 10% MOS).

Table 1: TMDL Load Allocation from Stroubles Creek TMDL

Consolidated Source Category Land Use	TMDL Sediment Load Allocation (% reduction)
Agriculture	77%
Urban (non-MS4 area)	54%
Forest	0%
Channel Erosion	77%
MS4	54%
VPDES Point Sources	0%

3.1.1 TMDL Model Land Use Data

The Stroubles Creek TMDL model developed land use data using 1998 digital ortho-photo quarter quads, with the Stroubles Creek watershed developed by DCR and Toms Creek by VT BSE. Data was developed to delineate areas per land use and assigned a percentage of imperviousness per land use type. The four TMDL land use categories which included imperviousness were categorized as low, medium, and high density residential, and commercial. According to page 57 of the Stroubles Creek TMDL, the WLA was calculated as half of the modeled sediment load from impervious land uses within MS4 permit areas.



Land use in Stroubles Creek watershed, as presented in the Stroubles Creek TMDL.

3.1.2 Other Notable TMDL Model Parameters

GWLF is a continuous simulation model that uses daily time steps for weather data and water balance calculations. The daily rainfall data used was predominantly obtained from the National Weather Service station in Blacksburg (440766). The Stroubles Creek TMDL model used the Natural Resources Conservation Service (NRCS) Technical Release 55 curve number (CN) methodology for computing runoff. The CN values are determined using land cover type and the soils' hydrologic soil group (HSG) classification, which indicates infiltration rates.

3.2 TMDL MS4 WLA Computations

TMDL loadings for MS4 areas were calculated in aggregate from impervious area loads within MS4 boundaries. Impervious area sediment loads were modeled explicitly in the GWLF model using an exponential buildup-washoff algorithm with sediment build-up assigned per land use as kg/ha-day. Both existing and future loads (see Table 2) were computed for MS4s and are described in the TMDL as:

- Existing (baseline) load (average loads from January 1985 through December 1994) - The MS4 loads were calculated for existing conditions and assumed to represent loads prior to implementation of MS4 regulations since MS4 programs were not yet implemented within the watershed.
- Future Conditions Load – Future loads for MS4s were based on an assessment that considered trends and future zoning plans (through 2046) for the Town of Blacksburg. The assessment resulted in projected changes in land use which were included in the model to calculate future loads. Changes generally show a decrease in forest and

agriculture land use as urban area increases. Future load modeling (post-baseline loads) incorporates implementation of the MS4 program and credits the program with a 50% reduction of sediment loads.

According to the Stroubles Creek TMDL, the WLA was calculated as half of the modeled baseline sediment load from impervious land uses within MS4 permit areas, or 210.88 tons/year TSS. The difference in the WLA and future sediment load is a 54% reduction from the future load.

Table 2: Aggregated MS4 Loading Computations

Baseline Aggregated MS4 Sediment Load (tons/year)	Projected Future Aggregated MS4 Sediment Load (tons/year)	Aggregated MS4 Sediment WLA (tons/year)
421.76	454.60	210.88

3.3 VT Disaggregated WLA

The TMDL-assigned WLA is aggregated for MS4s in the watershed, including VT, the Town of Blacksburg, and VDOT. Therefore, with the goal of achieving the WLA, it is necessary for VT to determine the proportion of the load appropriate for VT. Ideally, the proportion would be determined by the TMDL itself; however, since the WLA is aggregated, the “percent reduction” becomes the guiding target to achieve the WLA and a modeling effort is necessary to determine the MEP the WLA proportion applicable to VT.

3.3.1 Watershed Treatment Model (WTM)

Since neither the Stroubles Creek TMDL model nor the land use data used in the model are available, VT estimated both the historic baseline load and projected future load using the Watershed Treatment Model (WTM) developed by the Center for Watershed Protection. The WTM has been recommended by DEQ for use with Action Plan development and is an effective tool for assessing pollutant loads and reductions, allowing for quantification of both structural and non-structural BMPs Additional information about the WTM is available at: http://www.cwp.org/online-watershed-library/cat_view/65-tools/91-watershed-treatment-model.

3.3.2 Computational Approach

The computational approach to estimate the VT MS4 sediment loadings with the WTM sought to follow an approach as consistent as possible with the Stroubles Creek TMDL model. The Stroubles Creek TMDL describes the loadings from MS4 areas as computed from impervious areas, as referenced below:

- "Future loads for the MS4 permits were calculated in aggregate from impervious area loads ..." (Stroubles Creek TMDL, Page 50)
- ''The waste load allocation (WLA) was calculated as half of the modeled sediment load [baseline load] from impervious land uses within MS4 permit areas …" (Stroubles Creek TMDL, Page 57)
- "The MS4 loads were calculated for existing conditions and assumed to represent loads prior to implementation of MS4 regulations." (Stroubles Creek TMDL, Page 57)
- "Existing loads were modeled as if the MS4 permits and any accompanying BMPs were not active." (Stroubles Creek TMDL, Page 50)
- "Existing MS4 loads were assumed to represent loads generated in areas covered by the MS4 permits prior to implementation of the Phase II MS4 regulations. The allocated MS4 load was based on the assumption that implementation of BMPs under the MS4 regulations to the "maximum extent practicable" would reduce existing loads by 50% and prevent any increases in the projected future scenario in Table 7.3 [454.6 tons/year TSS]." (Stroubles Creek TMDL, Page 59)

Based on the references listed above, the following determinations were made regarding the Stroubles Creek TMDL modeling for MS4 areas:

- ✓ Sediment loadings were computed from impervious land uses within the MS4 boundaries. These land uses are limited to residential (low, medium, and high density) and commercial areas in the TMDL (Stroubles Creek TMDL, Page 46).
- ✓ Existing (baseline) loadings were computed without MS4 programs considered in place within the MS4s.
- ✓ The WLA was established as 50% of the baseline load, with the assumption that the WLA would be achieved from the baseline based on MS4 implementation.
- ✓ The future aggregated MS4 load (454.6 tons/year) is a 7.8% increase from the existing aggregated MS4 load (421.76 tons/year). The MS4 program is considered in place for modeled future load; therefore, the increase represents reductions necessary in excess of those credited with MS4 implementation.

For consistency with the TMDL, each of the determinations are incorporated into the loading computations using the WTM and subsequent computations described in the following sub-sections.

3.3.3 Data Input to WTM

Data input into the WTM includes the following:

- Annual Rainfall: Consistent with the Stroubles Creek TMDL (Section 3.4), average annual rainfall at the National Weather Service Station in Blacksburg is 40.43 inches.
- Study area: Defined as the area of the Virginia Tech campus within the Stroubles Creek watershed, excluding areas covered under VPDES Industrial Stormwater Discharge permits.
    - The study area for the purpose of loading computations is also limited to land uses that include impervious cover (developed land uses), consistent with the TMDL. Although VT's regulated MS4 area is technically only those areas discharging to the storm sewer system, the entire campus within the boundary is considered the study area for consistency with the TMDL. A map depicting the MS4 boundary within the TMDL watershed is provided in Appendix B.
- Land Use: Data used to classify the study area for the WTM was from the 2006 National Land Cover Dataset (NLCD), released on February 14, 2010. The data was the best readily available land use dataset to replicate the baseline condition with TMDL land use type consistency. The data set can be considered conservative since impervious areas likely increased from the study period. A map depicting the land use data in the study area is provided in Appendix C. VT reserves the right to re-compute loadings and required reductions in the case that more accurate historical land use data becomes available.
    - Imperviousness: The 2006 NLCD land use classification descriptions provide a range for the percentage of imperviousness for each land use. For the purposes of characterizing the study area, the middle value (e.g. a 35% value was used for a range of 20% to 49% imperviousness).

The VT Stroubles Creek WTM model is incorporated into this Action Plan, by reference and the model may be updated from time to time as more accurate data becomes available.

3.3.4 Computational Results for Required Reductions

Data input into the WTM resulted in an annual baseline sediment loading of 102.63 tons/year for VT's MS4. The value computed by WTM represents approximately 25% of the aggregated WLA from the Stroubles Creek model for MS4s. The value appears appropriate based on visual inspection of the land use map on page 15 of the Stroubles Creek TMDL and the fraction of VT's drainage area within the watershed. To determine the WLA, the following steps were taken:

I. Recalling the WLA as half of the existing baseline load and that the baseline load did not consider BMP implementation. Therefore, the sediment WLA for VT is:

$$Disaggregated\ WLA = \frac{102.63\ \frac{tons}{year}}{2} = 51.32\ tons/year$$

II. The future load is computed as an increase in the baseline sediment load equivalent to the percent increase (7.8%) in the TMDL as:

$$VT\ Future\ load = 102.63\frac{tons}{year} + \left(102.63\frac{tons}{year} \times 0.078\right) = 110.64\ \frac{tons}{year}$$

III. The Stroubles Creek TMDL credits the MS4 program a 50% reduction from the baseline load. The reduction credited to the MS4 program is therefore 51.32 tons/year. The remaining sediment load is determined as:

$$Remaining\ load = 110.64\frac{tons}{year} - 51.32\frac{tons}{year} = 59.32\ \frac{tons}{year}$$

IV. Therefore, the remaining reduction necessary to achieve the WLA is determined as:

$$Remaining\ req'd\ reduction\ = 59.32\frac{tons}{year} - 51.32\frac{tons}{year} = 8.01\ \frac{tons}{year}$$

With the continued implementation of the VT MS4 Program, additional reductions will be required to achieve a minimum of 8.01 tons/year of sediment to achieve the WLA under future conditions, as described in the TMDL.

4.0 EVALUATED METHODS TO ACHIEVE THE WLA

VT has served as an active participant in efforts to address the impairments described in the Stroubles Creek TMDL through maintained compliance with the MS4 GP and with implementation of the BMPs described in the Stroubles Creek TMDL implementation plan. The TMDL explicitly credits the MS4 program with a 50% reduction from the baseline load. However, additional BMPs are required to achieve the remaining reduction necessary to meet the WLA.

A practice likely to provide significant sediment reductions is an Existing BMP Retrofit Project (major restoration). This practice is being recorded to have begun after the adoption of the Stroubles Creek TMDL and has been performed on an as-needed-based frequency.

4.1 Existing BMP Retrofit Project (major restoration)

Virginia Tech is utilizing the BMP Retrofit Curves to determine the actual sediment removal efficiency Duck Pond Existing BMP Retrofit Project. Based on these calculations the restored Duck Pond achieves 73.47 tons/year of sediment removal that will be applied to achieving our WLA target. Please see in Appendix D the memo titled Stroubles Creek Benthic TMDL – Duck Pond Sediment Reduction & Crediting Methodology for additional details concerning sediment removal calculations.

5.0 ACTION PLAN

A determination of the disaggregated WLA for VT and evaluation of the current activities to reduce sediment loads finds that the Existing BMP Retrofit Project (major restoration) is able to achieve the Stroubles Creek TMDL WLA. For planning purposes, an estimated "end date" for achieving the WLA will be June 30, 2070.

5.1 Progress Reporting

The sediment removal phase of the Duck Pond Existing BMP Retrofit Project (major restoration) has been completed. Additional progress will be reported annually by October 1st in the MS4 Annual Report.

5.2 Schedule

Since the approval of the Stroubles Creek TMDL, VT has made significant progress in the reduction of sediment loads from its MS4. These reductions are demonstrated qualitatively in the MS4 Program assessment described in Section 2 and with the status summary of measurable milestones listed in the Stroubles Creek Implementation Plan (Appendix A).

Table 3: Schedule for the VT Stroubles Creek TMDL Action Plan Street Sweeping Program

Step	General Description	Measurable Goal	Completion Date
1	Major Restoration of the Duck Pond	Complete the Duck Pond water quality improvements.	July 31,2024
2	Re-evaluate the Duck Pond sediment removal	Re-evaluate the Duck Pond sediment removal capacity.	July 31, 2034

6.0 REFERENCES

VA DEQ. 2021. Chesapeake Bay TMDL Special Condition Guidance. Guidance Memo 20-20033.

VA DEQ and VA DCR. 2003. Benthic TMDL for Stroubles Creek in Montgomery County, Virginia.

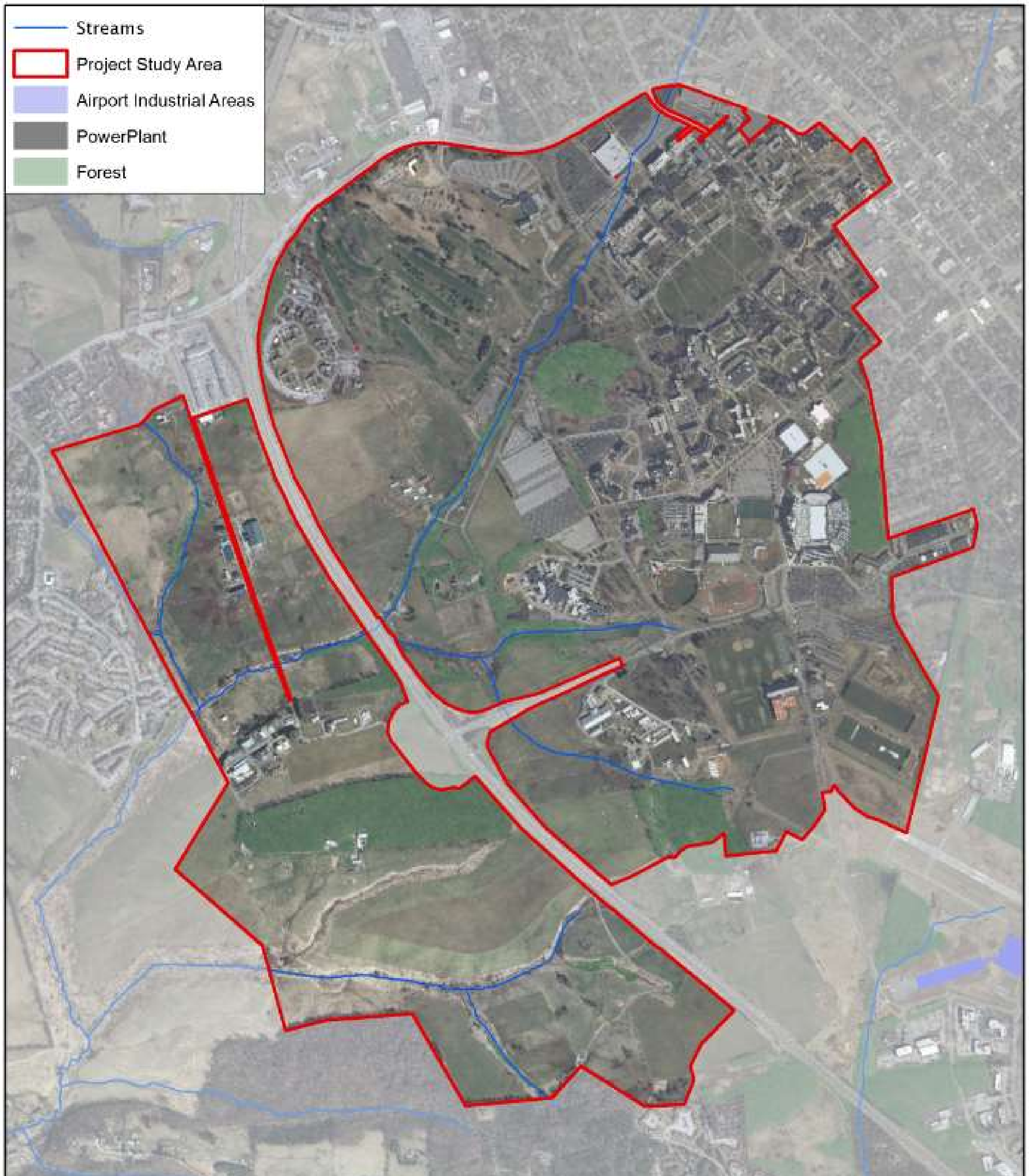
VA DEQ and VA DCR. 2006. Upper Stroubles Creek Watershed TMDL Implementation Plan, Montgomery County, Virginia.

Appendix A: Stroubles Creek IP BMP Accomplishments

Table 1: Measurable milestones listed for Virginia Tech in the Stroubles Creek IP and subsequent action taken.

Actions (2006 – 2010)	
Measurable Milestone	**Action Taken**
Assess capacity of culverts at Route 460.	Campus-wide stormwater model/analysis in progress.
Develop an official Adopt-A-Stream program for service organizations on campus.	Virginia Tech manages a 1.2-mile portion of Stroubles Creek through the Adopt-A-Stream Program. This is an ongoing effort.
Upgrade sanitary sewer line from Prices Fork Road to West Campus Drive.	The sewer line was replaced under a 3 part agreement between the Town, Sanitation Authority and Virginia Tech.
Plan, install, and monitor demonstration water quality, LID, and other innovative storm water management practices.	Virginia Tech has installed several stormwater BMPs that are inspected on a scheduled basis.
Arrange for external review and evaluation of the E&S Program as implemented in the watershed.	An internal audit by an outside consultant was conducted in 2012.
Calibrate the water, storm, and sanitary sewer models for campus for analysis of water consumption and discharge.	A water model has been developed and is updated as needed.
Link GIS mapping capabilities with discharge model to track illicit discharges and scheduled maintenance for storm water facilities.	Virginia Tech implemented an Infiltration & Inflow study in 2008 and tracks illicit discharges in GIS.
Construct a combined salt storage facility with TOB to prevent runoff.	A combined salt storage facility was established in 2008.

Appendix B: Virginia Tech MS4 Boundary within the TMDL Watershed



EEE Consulting, Inc.
Environmental, Engineering and Educational Solutions

Projection: NAD 1983 StatePlane Virginia North FIPS 4501 Feet

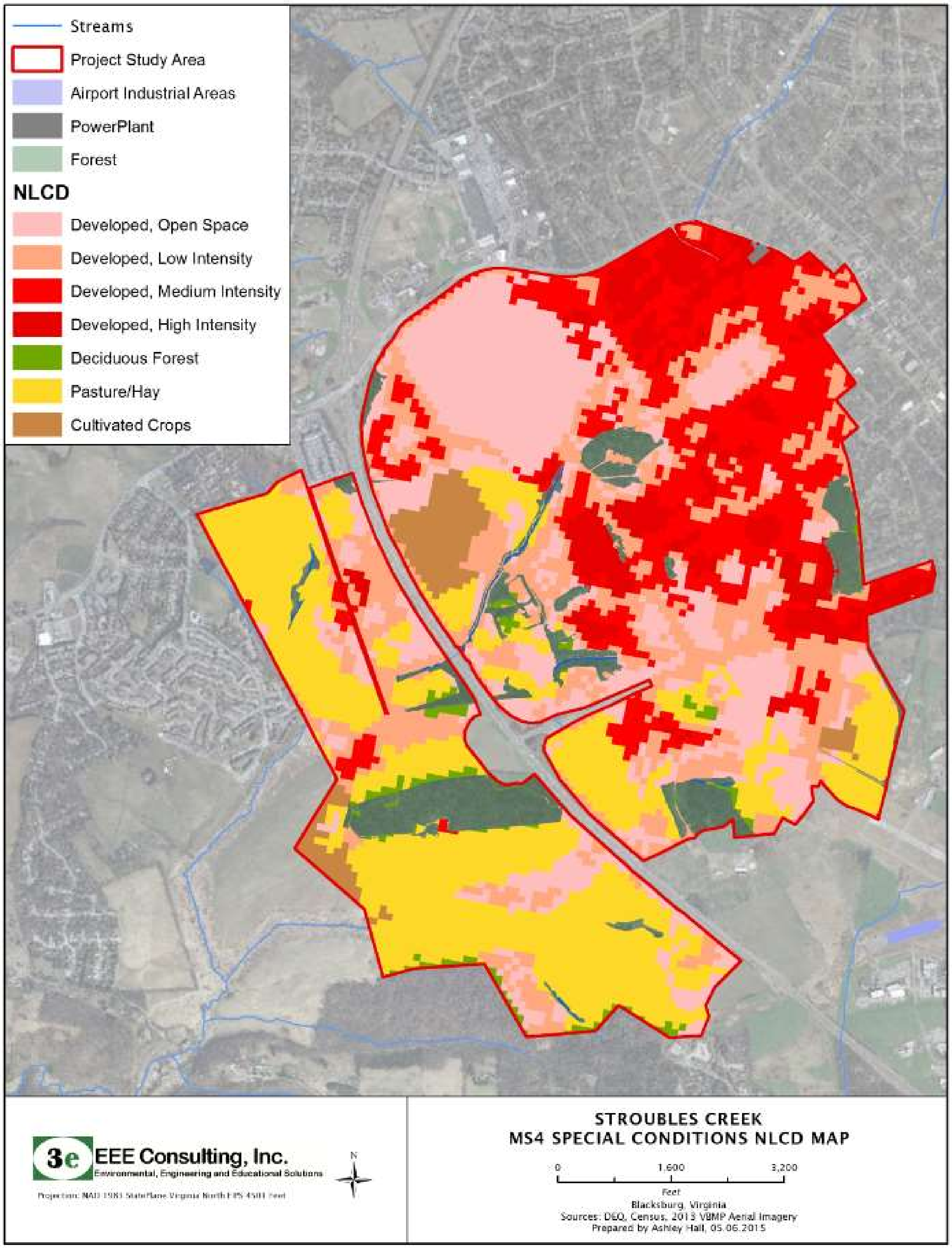
N

STROUBLES CREEK
MS4 SPECIAL CONDITIONS OVERVIEW MAP

0 1,400 2,800
Feet

Blacksburg, Virginia
Sources: DEQ, Census, 2013 VBMP Aerial Imagery
Prepared by Ashley Hall, 05.06.2015

Appendix C: Land Use Map Used for WTM Input


Streams
Project Study Area
Airport Industrial Areas
PowerPlant
Forest
NLCD
Developed, Open Space
Developed, Low Intensity
Developed, Medium Intensity
Developed, High Intensity
Deciduous Forest
Pasture/Hay
Cultivated Crops
3e EEE Consulting, Inc.
Environmental, Engineering and Educational Solutions
Projection: NAD 1983 StatePlane Virginia North FIPS 4501 Feet
N
STROUBLES CREEK
MS4 SPECIAL CONDITIONS NLCD MAP
0
1,600
3,200
Feet
Blacksburg, Virginia
Sources: DEQ, Census, 2013 VBMP Aerial Imagery
Prepared by Ashley Hall, 05.06.2015

Appendix D: Stroubles Creek Benthic TMDL – Duck Pond Sediment Reduction & Crediting Methodology

Wetland Studies and Solutions, Inc.® a DAVEY company

MEMORANDUM

TO: Susan Edwards – Virginia Department of Environmental Quality

FROM: Virginia Tech

RE: Stroubles Creek Benthic TMDL – Duck Pond Sediment Reduction & Crediting Methodology

DATE: April 23, 2024

The purpose of this memo is to present methodology and obtain the Virginia Department of Environmental Quality's (DEQ) concurrence for Virginia Tech (VT) to obtain sediment credits for the proposed Duck Pond dredging project. The sediment credits obtained with the dredging project are proposed to be utilized towards meeting a portion VT's Total Maximum Daily Load (TMDL) Wasteload Allocation (WLA) of the "*Benthic TMDL for Stroubles Creek*" (Stroubles Creek TMDL). In addition, the information presented in this memo will be used to demonstrate progress towards meeting the TMDL WLA for Municipal Separate Storm Sewer System (MS4) annual reporting purposes. Once the methodology presented herein is supported by DEQ and the dredging project is complete, VT will provide final calculations in the VT Stroubles Creek TMDL Action Plan (Action Plan). The concept of receiving local TMDL credits for pond dredging was discussed with Jeff Selengut (DEQ) on an August 7th, 2023, phone call between WSSI and DEQ. Mr. Selengut did not foresee any issues with crediting a pond dredging project for local TMDLs under the "major restoration" criteria described in the "*Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects*." In addition, Mr. Selengut conferred with TMDL staff whom he also mentioned did not foresee any issues.

Background

In 2004, the Stroubles Creek TMDL was approved by the State Water Control Board, and this TMDL assigns an aggregated WLA for permitted MS4s within the Stroubles Creek watershed. The MS4 WLA includes discharges from VT, the Town of Blacksburg, and the Virginia Department of Transportation (VDOT). The TMDL presents the WLA as an annual sediment load resulting from a "percent reduction" of the existing and projected future load from each MS4 to meet water quality standards for the watershed. Subsequently, VT developed an Action Plan that analyzed the TMDL and calculated that an annual reduction of 8.01 tons/year is required to meet the TMDL WLA.

The Virginia Tech Duck Pond is comprised of two ponds (upper and lower ponds) and is situated downgradient of the main campus area. The ponds drain to two sub-watersheds: Webb Branch enters the upper pond and Central Branch discharges into the lower pond. The upper pond was constructed in the 1800s as a source of ice for campus operations and the lower pond was constructed in 1937 as part of the nearby Drill Field project. The ponds are separated by a concrete staircase, which was built in the 1980s. Although the ponds were constructed at two separate times, they function together like a treatment train to detain water and deposit sediment. Due to the age of its construction, the Duck Pond was not designed to DEQ BMP Clearinghouse wet pond standards, but it operates as a wet pond with additional dry storage. The upper pond acts as a forebay for water entering the lower pond. The lower pond is fed by the upper pond to the west and Central Branch to the east, which outfalls into the lower pond via a natural channel. This natural channel is undergoing an evaluation for stream and buffer restoration. The Duck Pond can be considered a BMP as it meets Virginia Stormwater Management Regulation 9VAC25-870 which defines a "*stormwater management facility*" as "*a control measure that controls stormwater runoff and changes the characteristics of that runoff including the quantity and quality, the period of release or the velocity of flow.*" Furthermore, the **TMDL acknowledges the VT Duck Pond as providing sediment treatment and assigns it a 50% efficiency in reductions to sediment loads and channel erosion**. However, documentation supporting the assumed 50% removal efficiency was not included in the Stroubles Creek TMDL.

Virginia Tech is currently soliciting a contractor to dredge approximately 30,000 cubic yards of sediment from the Duck Pond to restore the upper and lower ponds to the previously restored volumetric storage capacity, which is estimated to be approximately 70,000 cubic yards based on the best available data. Upon completion of the dredging, a topographic survey will be provided by the contractor to determine the actual new volumetric storage capacity of Duck Pond.

VT Duck Pond Sediment Crediting Methodology – Major Sediment Cleanout (Retrofit Project)

Virginia Tech proposes the use of BMP Retrofit Curves to determine the actual sediment removal efficiency upon completion of the dredging project. The actual efficiency will then be compared to the assumed TMDL efficiency (50%) to determine the extra sediment removal rate obtained from this restoration project, which can be applied towards meeting the Stroubles Creek TMDL in accordance with the methodology below.

In 2021, DEQ published Guidance Memo No. 20-2003 – Chesapeake Bay TMDL Special Condition Guidance (GM20-2003) which states, *"This document may also be used as a reference to meet the Chesapeake Bay TMDL load allocation for unregulated urban entities <u>as well as local TMDL waste load allocations for nutrients and sediment</u>.*" This document describes BMPs' crediting mechanisms and efficiencies, which are based on the latest research and information from expert panels. The following appendices will be utilized when calculating sediment reduction credits for the VT Duck Pond dredging project:

- <u>Appendix V.B - Chesapeake Bay Program, Retrofit Curves/Equations:</u> This appendix provides a crediting mechanism through retrofit curves/equations for older BMPs and states, *"This credit calculation method should be used when a BMP cannot meet the Virginia Stormwater BMP Clearinghouse criteria. The Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects (October 2012) provided "Retrofit Curves" as an acceptable method for determining BMP efficiency."* The referenced expert panel report describes existing BMP retrofits as facilities: (a) Converted into a different BMP that employs more effective treatment mechanism(s), (b) Enhanced by increasing its treatment volume and/or increasing its hydraulic retention time, or (c) Restored to renew its performance through major sediment cleanouts, vegetative harvesting, filter media upgrades, or full-scale replacement. Furthermore, the expert panel report classifies "Major Sediment Cleanout" under the retrofit section as the *"Removal of sediment, muck and debris that is equal to or greater than 1/10 the volume of the facility."* Therefore, the VT Duck Pond dredging project would qualify as an "Existing BMP Retrofit" project. The methodology for this credit requires calculating the runoff depth, classifying the BMP, and calculating the BMP efficiency utilizing the provided curves.

- Appendix V.D – BMP Enhancement, Conversion, and Restoration: The appendix provides a crediting mechanism for **restoration projects** which states the credits given are "*…an incremental rate (enhanced BMP efficiency minus existing BMP efficiency). The permittee should apply the difference between the existing BMP's efficiency and the enhanced or converted BMP's efficiency to the load that is draining to the BMP to calculate the POC reduction that will be credited.*" However, the section also states, "*to receive credit for BMP restoration, the project must meet the criteria for a "**major restoration**." Please see the Recommendations of the Expert Panel to Define Removal Rates for Urban Stormwater Retrofit Projects to determine if a project qualifies as a major restoration."* In the referenced expert panel report, a "major restoration" is defined as the removal of sediment, muck, and debris that is equal to or greater than 1/10 the volume of the facility." The proposed dredge will increase the ponds' current capacity by approximately 43% of its original volume.

Preliminary Duck Pond Dredging Calculations & Retrofit Curve Analysis

Runoff Depth Calculation and Sediment Removal Efficiency

The Virginia Tech Duck Pond had a storage capacity of approximately 70,000 CY but has accumulated sediment from runoff since the last dredging in 1988. A bathymetric survey has determined that the removal of 30,000 cubic yards is required to restore Duck Pond's storage capacity. The retrofit curves were analyzed to determine the Duck Pond's sediment removal efficiency and if the retrofit curve efficiency exceeds the assumed 50% efficiency utilized in the TMDL model. The retrofit curve is calculated based on a Runoff Depth Treated calculated from Runoff Storage and Impervious Area as shown in the equation below:

$$RD = \frac{(RS)(12)}{IA}$$

Utilizing a runoff storage of 70,000 CY and impervious landcover area data taken from the TMDL Table 6.2 for sub-watersheds 6 and 7, the runoff depth treated can be calculated as follows:

$$RD = \frac{(43.39\ AC - ft)(12)}{641\ AC}$$

$$RD = 0.812$$

The retrofit curves are based on two classifications of BMPs: Runoff Reduction Practices, and Stormwater Treatment Practices. Duck Pond acts as a wet pond and therefore should use the curve for Stormwater Treatment Practices. For sediments, the Stormwater Treatment Practice equation is below:

$$\%\,removal = 0.0304(RD^5) - 0.2619(RD^4) + 0.9161(RD^3) - 1.6837(RD^2) + 1.7072(RD) - 0.0091$$

Utilizing the Runoff Depth for the full capacity (post dredge), the retrofit curve data calculation demonstrates an efficiency of 65.4%. This percentage exceeds the 50% removal efficiency that was assumed in the TMDL. Based on this latest best available data from DEQ and expert panels, the actual efficiency of Duck Pond is 15.4% higher than the efficiency assumed in the TMDL.

$$\% \, Excess \;\; Removal = Retrofit \; Removal - 50\% \; Assumed \; Removal$$

$$\% \, Excess \;\; Removal = 65.4\% - 50\%$$

$$\underline{\boldsymbol{\% \, Excess \;\; Removal = 15.4\%}}$$

<u>Sediment Loading and Total Sediment Removed Calculation</u>

The TMDL provides two sets of loading rates for Duck Pond. The first is the GWLF model sediment loading provided on a sub-watershed scale in metric tons from Table C.7 in the TMDL. When utilizing the data for sub-watersheds 6 and 7 only (converted to U.S. tons and acres), the loading rate is 0.270 tons/acre/year (See Attachment 1). The second loading rate is provided narratively on PDF page 35 of the TMDL and states the rate of sediment entering Duck Pond is between 4,418 and 13,260 metric tons/year. The low range of these values (4,418 metric tons/year) equates to a loading rate of 2.76 U.S. tons/acre/year (See Attachment 1). To be conservative, the loading rate from Table C.7 in the TMDL will be used for this example calculation. Sediment loading can then be calculated utilizing GM20-2003 Appendix V.D methodology as follows:

$$Removal \left(\frac{tons}{yr}\right) = \% \; excess \; removal * loading \; rate \left(\frac{\frac{tons}{acre}}{yr}\right) * watershed \; area \; (Acre)$$

$$Removal \left(\frac{tons}{yr}\right) = 15.4\% * 0.270 \frac{\frac{tons}{acre}}{yr} * 1767.05 \; AC$$

$$Removal \left(\frac{tons}{yr}\right) = 73.47$$

<u>Conclusion</u>

Virginia Tech is proposing to take credit for the difference between the actual 67.4% efficiency after the major restoration (dredging) project and the assumed 50% efficiency in the TMDL (i.e. 15.4% removal efficiency demonstrated in the above calculation). To maintain the calculated efficiency, VT will provide maintenance as needed to keep Duck Pond functioning as a sediment removal BMP.

Thank you for the opportunity to provide this memo. Please feel free to reach out with any questions.

Sincerely,

Katelyn Muldoon

Katelyn Kast Muldoon M.S.
MS4 Program Administrator
Water Resources Specialist

Attachment 1: Sediment Loading Rate Calculation

Attachment 1: Sediment Loading Rate Calculation

Land Use Category	Pervious vs Impervious	From TMDL Table 6.2 Hectares STE 6	STE 7	From TMDL Table C.7 Sediment Load (Metric Tons/yr) STE 6	STE 7
Hi Till Cropland	Pervious	0	0	0	0.1
Low Till Cropland	Pervious	0	0	0	0.5
Pasture, Improved	Pervious	46.1	0	14.9	0
Pasture, Unimproved	Pervious	0.2	0	0.6	0
Pasture, overgrazed	Pervious	0	0	0	0
Urban Grass	Pervious	63.9	41.8	52.1	36.7
Hay	Pervious	0	0	0	0
Forest	Pervious	25.1	5.1	1.6	0.2
Transitional	Pervious	3.1	1.2	1	0
LDR-pervious	Pervious	10.8	12.5	3.1	2.9
MDR - pervious	Pervious	118	65.6	22.6	12.1
HDR - pervious	Pervious	11.5	18.3	2.1	3.5
Commercial - pervious	Pervious	18.2	14.3	1.6	1.9
LDR - impervious	Impervious	1.5	1.7	0	0
MDR - impervious	Impervious	50.6	28.1	0.3	0
HDR - impervious	Impervious	21.3	33.9	0.1	0
Commercial - impervious	Impervious	68.4	53.9	0.2	0
Chan				0	0
Ms4				38.6	79.1
PS				106.3	50.4
TOTAL		438.7	276.4	245.1	187.4

AREA CALCULATIONS	STE 6	STE 7	Total Hectares	Total Acres
Pervious	296.9	158.8	455.7	1126.06
Impervious	141.8	117.6	259.4	640.99
Watershed			715.1	1767.05

LOADING RATE CALCULATIONS	metric t/Ac/yr	US T/AC/yr
STE 6 and 7 Sediment Load From Table C.7	0.245	0.270
Sediment Load from Sentence in TMDL on page 35	2.500	2.756

Retrofit Curves	Full Volume (Post Dredge)	Current Volume (Existing Conditions)
Total Volume CY	70000	40000
Total Volume Acre-Ft	43.39	24.79
Runoff Depth (in)	0.812	0.464
TSS ST Retrofit Curve	0.654	0.501
Efficiency Above TMDL Assumed 50%	0.154	0.001

Sediment Crediting Calculations	Full Volume (Post Dredge) Ton/yr	Current Volume (Existing Conditions) Ton/yr
Sediment Credit TMDL Table C.7	73.63	0.32
Sediment Credit TMDL pg 35	752.09	3.30