VERMONT AGENCY OF TRANSPORTATION TS4 STORMWATER MANAGEMENT PROGRAM (SWMP)

National Pollutant Discharge Elimination System (NPDES) General Permit 3-9007

Prepared for:
Vermont Agency of Transportation

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1.0 PURPOSE, PERMIT OVERVIEW, AND AUTHORITY

The Vermont Agency of Natural Resources (VT ANR) Department of Environmental Conservation issued the National Pollutant Discharge Elimination System (NPDES) General Permit 3-9007 (GP 3-9007) for Stormwater Discharges from the State Transportation Separate Storm Sewer System (TS4; the Permit) on November 29, 2017. GP 3-9007 for stormwater discharges from the Vermont Agency of Transportation (VTrans; the Agency) owned or controlled impervious surfaces. Per Part 1 of the Permit, the purpose of the Permit is to provide efficiencies in overall program management by combining post-construction operational stormwater requirements for VTrans that are associated with its designated regulated small municipal separate storm sewer systems (MS4s); industrial activities, commonly regulated under the Multi-Sector General Permit 3-9003 (MSGP 3-9003); and previously permitted, new, redeveloped, and/or expanded impervious surfaces, commonly regulated under State Operational Stormwater Permits (e.g., General Permit 3-9015, General Permit 3-9010, and Individual Stormwater Discharge Permit [INDS]).

The Permit is issued pursuant to the Vermont Water Pollution Control statute, 10 V.S.A. Chapter 47, specifically §§ 1258 and 1264; the Vermont Water Pollution Control Permit Regulations (Environmental Protection Rules, Chapter 13), including the rule governing general permits in Section 13.12; the Vermont Stormwater Management Rule (Environmental Protection Rules, Chapter 18); the Vermont Stormwater Management Rule for Stormwater-Impaired Waters (Environmental Protection Rules, Chapter 22); the federal Clean Water Act (CWA), as amended, 33 U.S.C. § 1251 *et seq.*; and related regulations of the United States Environmental Protection Agency (U.S. EPA) at 40 C.F.R. 122.

2.0 COVERAGE UNDER THIS PERMIT

As outlined in Part 2 of the Permit, the Permit applies to:

- VTrans-owned or controlled state highways, sidewalks, multi-use pedestrian paths, welcome centers, airports, gravel pits, mineral mining, maintenance facilities, park & rides, truck weigh stations, and VTrans-owned facilities leased to third parties, including welcome centers and airport facilities (hangars and terminals), and excludes rail lines, rail yards, public transit facilities, and rail trails.
- State highways and VTrans-owned or controlled non-road impervious surfaces in the urbanized areas and stormwater-impaired watersheds of Burlington, Colchester, Essex, Essex Junction, Milton, Shelburne, South Burlington, Williston, Winooski, the University of Vermont, the Burlington International Airport, Jericho, Underhill, St. Albans, the Town of St. Albans, the Town of Rutland, and the City of Rutland.
- VTrans-owned or controlled airport facilities and non-metallic mineral mining facilities.

3.0 APPLICATION REQUIREMENTS

VTrans and its consultants have prepared the enclosed Stormwater Management Program (SWMP) to address Part 5 of the Permit. The SWMP is a comprehensive plan for all stormwater discharges that are covered under the Permit to address information required within specific parts of the Permit. It is intended that this SWMP will advance and evolve through the term of the Permit. VTrans will coordinate the implementation of this SWMP with the related activities of the Municipal and Non-Traditional MS4s in Vermont, as necessary where overlap with these MS4s may occur.

VTrans is committed to stewardship of the natural and cultural resources of the State of Vermont. This commitment is reflected in the VTrans Strategic Goals and Agency-wide objectives where it is stated that VTrans will "preserve, maintain and operate the transportation system in a cost effective and environmentally responsible manner" by "minimizing the environmental impacts of the transportation system."

Per Part 3 of the Permit, VTrans is submitting the following materials to VT ANR in conjunction with this SWMP to serve as an application for authorization to discharge stormwater from the TS4:

3.1 NOTICE OF INTENT

In conjunction with submittal of this SWMP to VT ANR, VTrans has provided a completed and signed Notice of Intent (NOI) in accordance with submittal requirements of Subpart 3.1 and deadlines of Subpart 3.2 of the Permit.

3.2 ATTACHMENTS

Necessary attachments are included with this SWMP as follows:

- Attachment A: List of Waters (Table 1 and Table 2)
- Attachment B: Chittenden County MS4 Stormwater Program Agreement (July 1, 2017)
- Attachment C: VTrans Bridge Washing Best Management Practices and VT ANR Vehicle Washing Policy
- Attachment D: VTrans Flow Restoration Plan
- Attachment E: VTrans Phosphorus Control Plan (to be provided by April 2020)

3.3 APPLICATION FEE

In addition to the SWMP, NOI, and attachments, VTrans is also providing payment of the applicable fee (per 3 V.S.A. § 2822(j)(2)) via electronic transfer of funds.

4.0 DISCHARGE REQUIREMENTS

REQUIREMENT – *Per Part 4 of the Permit, impaired waters are those waters that VT ANR has identified pursuant to Section 303(d) of the Clean Water Act as not meeting the Vermont Water Quality Standards (VWQS). Impaired waters encompass both those with approved Total Maximum Daily Loads (TMDLs) or Water Quality Restoration Plans (WQRPs), and those for which TMDL development has been identified as necessary, but for which a TMDL has not yet been approved by the U.S. EPA.*

Per the Permit, except for Part 9, a VTrans project is considered to discharge to an impaired water if the first water of the State to which runoff discharges is identified as an impaired water. For discharges that enter a separate storm sewer system prior to discharge, the first water of the State to which runoff is discharged is the waterbody that receives the stormwater discharge from the storm sewer system.

VTRANS RESPONSE – To address this requirement, VTrans has developed and provided a complete list of first waters to which designated MS4 areas discharge, refer to Table 1 in Attachment A.

4.1 DISCHARGES TO IMPAIRED WATERS WITH AN APPROVED TOTAL MAXIMUM DAILY LOAD WITH WASTELOAD ALLOCATION

REQUIREMENT – *Per Subpart 4.2 of the Permit, for any discharge from the TS4 to impaired waters with an approved TMDL, VTrans shall control discharges consistent with the assumptions and requirements of any wasteload allocation (WLA) applicable to VTrans in the TMDL. VTrans shall describe in the SWMP all measures that are being used to address this requirement.*

If the applicable TMDL specifies a WLA or other requirements either individually or categorically for the TS4 discharge, VTrans shall describe in its annual reports all control measures which have been or are planned to be implemented to control discharges consistent with the assumptions and requirements of the TMDL WLA. VTrans shall include in the annual reports and the SWMP the rationale supporting VTrans' assessment that such controls are adequate to meet the applicable TMDL requirements.

VTRANS RESPONSE – To address this requirement, discharges from the TS4 to impaired waters with an approved TMDL, including descriptions of the measures being used to address requirements where applicable, are listed in Tables 1 and 2 in Attachment A.

VTrans will report annually on control measures that have been or are planned to be implemented to control discharges consistent with the assumptions and requirements of the TMDL WLA.

4.2 DISCHARGES TO IMPAIRED WATERS WITH AN APPROVED TOTAL MAXIMUM DAILY LOAD WITHOUT WASTELOAD ALLOCATION

REQUIREMENT – *Per Subpart 4.2 of the Permit, if the applicable TMDL does not specify a WLA or other requirements either individually or categorically for the TS4 discharge and VTrans has complied with the terms and conditions of this permit, and has undertaken VT ANR-approved measures and documented them in the SWMP to address the pollutant(s) of concern addressed by the TMDL, then compliance with these conditions will be presumed adequate to meet the requirements of this permit.*

VTRANS RESPONSE – To address this requirement, Tables 1 and 2 in Attachment A provide a list of discharges from the TS4 to impaired waters with approved TMDLs, where the TMDL does not specify a WLA or other requirements for the TS4 discharge. These tables also provide a summary of VT ANR-approved measures that VTrans is implementing and documenting in the SWMP to address the pollutant(s) of concern addressed by the TMDL.

4.3 DISCHARGES TO IMPAIRED WATERS WITHOUT AN APPROVED TOTAL MAXIMUM DAILY LOAD

REQUIREMENT – *Per Subpart 4.2 of the Permit, if the TS4 discharges to an impaired water that is without an approved TMDL, but that is listed as impaired on the "State of Vermont 303(d) List of Impaired Waters, Part A – Impaired Surface Waters in Need of TMDL," VTrans shall address in its SWMP and annual reports how any identified and mapped VTrans' discharges that cause or contribute to the impairment will be controlled to ensure compliance with the VWQS.*

VTRANS RESPONSE – To address this requirement, Tables 1 and 2 in Attachment A provide a list of identified and mapped discharges from the TS4 to impaired waters that are listed on the "State of Vermont 303(d) List of Impaired Waters, Part A – Impaired Surface Waters in Need of TMDL." Where VTrans' discharges may cause or contribute to the impairment, measures VTrans is implementing to ensure compliance with the VWQS are summarized in these tables and embedded in this SWMP.

5.0 STORMWATER MANAGEMENT PROGRAM (SWMP)

REQUIREMENT – *Per Subpart 5.1 of the Permit, VTrans shall develop a written SWMP to include information required, as necessary, under Part 3 of the Permit; the information required under Part 4 of the Permit to address discharges to impaired waters; the required elements under the six minimum control measures in Part 6 of the Permit; the industrial control measures in Part 7 of the Permit, including the Stormwater Pollution Prevention Plan (SWPPP); the operation stormwater requirements under Part 8 of the Permit; and the Flow Restoration Plan (FRP) and Phosphorus Control Plan (PCP) developed in accordance with Part 9 of the Permit.*

VTRANS RESPONSE – See each corresponding part within this SWMP for required information. To meet requirements of Subpart 5.2 of the Permit, VTrans will perform an annual review of the SWMP in conjunction with preparation of the annual report required under Subpart 10.2.

6.0 MINIMUM CONTROL MEASURES

REQUIREMENT – *Per Part 6 of the Permit, VTrans shall develop, implement, and enforce a SWMP, which shall include the six minimum control measures, designed to reduce the discharge of pollutants from the TS4 to the maximum extent practicable (MEP), to protect water quality, and to satisfy the appropriate water quality requirements of the Clean Water Act. For purposes of the six minimum control measures, implementation of Best Management Practices (BMPs) consistent with the provisions of the SWMP shall constitute compliance with the standard of reducing pollutants to the MEP. The SWMP must include the following information for each of the six minimum control measures:*

1. *The person or persons responsible for implementing or coordinating the SWMP and the BMPs for the SWMP.*

   VTRANS RESPONSE – Fulfilling the requirements of the SWMP is a cross agency effort, requiring the support of multiple internal stakeholders to implement the minimum control measures. The Maintenance and Operations Bureau Environmental Program's Water Quality Unit plays the lead role in coordination and is the ultimate responsible party for implementation of the TS4 SWMP.

2. *The BMPs that VTrans or another entity will implement for each of the six minimum control measures.*

   VTRANS RESPONSE – Please see responses under each minimum control measure below.

3. *The measurable goals for each of the BMPs including, as appropriate, the months and years in which the required actions will be undertaken, including interim milestones and the frequency of the action.*

   VTRANS RESPONSE – Please see responses under each minimum control measure below.

4. *A rationale for how and why VTrans selected each of the BMPs and measurable goals for the SWMP. The rationale should describe: (1) the stormwater problems to be addressed by the BMPs, (2) the major alternative BMPs to the ones selected and why they were not adopted, (3) the behavioral and institutional changes necessary to implement the BMPs, and (4) expected water quality outcomes.*

   VTRANS RESPONSE – VTrans has been complying with these minimum control measures under the MS4 permit since 2003 and collaborating with the Agency of Natural Resources on the effectiveness of the selected BMPs. We have found based on experience and trial and error that the selected BMPs are best suited to address permit specified stormwater problems and achieve expected water quality outcomes for the

transportation sector. VTrans is committed to stewardship of the natural and cultural resources of the State of Vermont. This commitment is reflected in the VTrans Strategic Goals and Agency-wide objectives where it is stated that VTrans will "preserve, maintain and operate the transportation system in a cost effective and environmentally responsible manner" by "minimizing the environmental impacts of the transportation system." This commitment is also supported by increases in water quality staff and the creation of a Water Quality Unit.

The six minimum control measures include:

1. Public Education and Outreach on Stormwater Impacts (MCM 6.A)
2. Public Involvement and Participation (MCM 6.B)
3. Illicit Discharge Detection and Elimination (MCM 6.C)
4. Construction Site Stormwater Runoff Control (MCM 6.D)
5. Post-Construction Stormwater Management for New Development and Redevelopment (MCM 6.E)
6. Pollution Prevention and Good Housekeeping for VTrans' Operations (MCM 6.F)

MCM 6.A: PUBLIC EDUCATION AND OUTREACH ON STORMWATER IMPACTS

REQUIREMENT – *Per Subpart 6.3.A of the Permit, VTrans shall develop and implement a public education campaign reasonably designed to educate frequent facility users about the impacts of stormwater discharges on water bodies. The program shall include the steps that facility users can take to reduce pollutants in stormwater runoff including an explanation of the problem of stormwater volume and solutions for reducing the amount of runoff volume reaching waters of the State.*

For the purpose of this SWMP, the definition of "public" includes "the employees, clients and visitors to the TS4 property, and any contractors working at the facility where the TS4 is located."

VTRANS RESPONSE – To meet this requirement VTrans has been and will continue to implement the following practices.

1. Maintain a web site with locally relevant stormwater management information and promote its existence and use.

   Measurable Goal: VTrans will update the web site annually.

   Reporting: There are no reporting requirements.

2. Establish educational kiosks or demonstration projects at public facilities. VTrans has established educational kiosks and demonstration projects at public facilities at the St. Albans Park and Ride and the Williston I-89 northbound welcome center.

   Measurable Goal: VTrans will continue to consider additional opportunities for education kiosks and demonstration projects throughout the state.

Reporting: VTrans will report annually on these opportunities.

3. Participate in the Chittenden County Regional Stormwater Education Program (RSEP) described in the March 10, 2013, memorandum of understanding between designated small MS4s, VTrans, and Chittenden County Regional Planning Commission or subsequent amendment, or in a regional public education and outreach strategy approved by VT ANR; see Attachment B.

   Measurable Goal: VTrans will continue to participate in the Chittenden County MS4 Stormwater Program Agreement, effective July 1, 2017 (see Attachment B).

   Reporting: VTrans will report annually on accomplishments achieved under this activity.

MCM 6.B: PUBLIC INVOLVEMENT AND PARTICIPATION

REQUIREMENT – *Per Subpart 6.3.B of the Permit, VTrans shall develop and implement a public involvement and participation program, and the program shall, at a minimum, comply with applicable state and local public notice requirements.*

VTRANS RESPONSE – For the purpose of this SWMP, the definition of "public" includes "the employees, clients and visitors to the TS4 property, and any contractors working at the facility where the TS4 is located."

To meet this requirement VTrans has been and will continue to:

4. Participate in the Chittenden County Regional Stormwater Public Involvement and Participation Program ("Stream Team") described in the July 2011 memorandum of understanding between designated small MS4s, VTrans, and the Chittenden County Regional Planning Commission or subsequent amendment, or in a regional public involvement and participation program approved by VT ANR; see Attachment B.

   Measurable Goal: VTrans will continue to participate in the Chittenden County MS4 Stormwater Program Agreement, effective July 1, 2017 VTrans will continue to participate in the Chittenden County MS4 Stormwater Program Agreement, effective July 1, 2017 (see Attachment B).

   Reporting: VTrans will report annually on accomplishments achieved under this activity.

MCM 6.C: ILLICIT DISCHARGE DETECTION AND ELIMINATION

REQUIREMENT – *Per Subpart 6.3.C, VTrans shall develop, implement, and enforce a program to detect and eliminate illicit discharges into the stormwater systems of the TS4.*

VTRANS RESPONSE – To meet this requirement, VTrans will:

1. Develop and maintain a storm sewer geographic information systems (GIS) map of the separate storm sewer systems within the VTrans' designated regulated small MS4s and showing the location of all outfalls and the names and location of all waters of the State

that receive discharges from those outfalls, and, to the extent practicable, map the remainder of the stormwater systems of the TS4. This will be made available to the public through the VTrans website.

Measurable Goal: The MS4 was mapped under the 2003 MS4 permit and then updated to add in additional MS4 areas for the 2012 MS4 permit. VTrans will maintain the current MS4 mapping and expand it to capture the statewide system as resources are available.

Reporting: VTrans will report annually on progress and accomplishments.

2. Adopt a policy prohibiting non-stormwater discharges, except for those listed in Subpart 2.2.B of the Permit, into the stormwater systems of the TS4 and implement appropriate enforcement procedures and actions.

   Measurable Goal: VTrans will work with internal and external stakeholders to draft and implement a policy and appropriate enforcement procedures beyond its current Title 19 Highway Access Permitting authority, which VTrans currently relies on to prohibit and enforce against non-stormwater discharges, and put a policy in place as soon as is feasible within the term of this permit given the possible need for legislative action.

   Reporting: VTrans will report annually on progress and accomplishments.

3. Develop and implement a plan pursuant to Subpart 6.3.C.1.c to detect and address non-stormwater discharges, with emphasis on outfalls in the stormwater-impaired watersheds, and random illegal dumping to the stormwater systems of the TS4, such as the dumping of RV wastes, used oil, and paint.

   Measurable Goals: VTrans completed testing of outfalls for illicit discharges in the MS4 areas. Outside of the MS4 areas, VTrans will assess opportunities for conducting a similar testing approach. VTrans will develop a reporting and enforcement standard operating procedure (SOP) in collaboration with ANR Enforcement Division, other state agencies and local officials to address non-stormwater discharges coming from outside of our Rights-of-Way (ROW) where we are lacking legal authority.

   In addition, the Agency has a HazMat Unit that addresses spill response, prevention and source control such as used oil, fuel storage and dumping of hazardous materials. See MCM 6.F for more information.

   Reporting: VTrans will report annually on progress and accomplishments including the number of illicit discharges encountered each year and status of rolling out this program outside of the MS4 area. VTrans will report annually on the status of developing the SOP and monitoring activities conducted and corrective actions taken

4. Inform public employees and the general public of hazards associated with illegal discharges and improper disposal of waste.

Measurable Goals: VTrans will develop an informational flyer to give to Title 19 Section 1111 permit holders that discusses these hazards. VTrans will report annually on the number of permits issued in the MS4 area and outside the MS4 area.

In addition, the Agency conducts various trainings for public employees and the general public. See MCM 6.A, 6.D, 6.E, and 6.F.

Reporting: VTrans will report annually on progress and accomplishments

5. VTrans will address the following categories of non-stormwater discharges, if VTrans identifies them as significant contributors of pollutants to the TS4 stormwater systems:

   - Water line flushing
   - Landscape irrigation
   - Diverted stream flows
   - Rising ground waters
   - Uncontaminated ground water infiltration
   - Uncontaminated pumped ground water
   - Discharges from potable water sources
   - Foundation drains
   - Air conditioning condensation
   - Irrigation water
   - Springs
   - Water from crawl space pumps
   - Footing drains
   - Lawn watering
   - Individual residential car washing
   - Flows from riparian habitats and wetlands
   - Dechlorinated swimming pool discharges
   - Street wash water
   - Discharges from firefighting activities

   Discharges from bridge washing and vehicle washing are not authorized under this permit; to address these discharges, the Agency will follow the VTrans Bridge Washing BMPs and VT ANR's Vehicle Washing Policy (see Attachment C). Any other discharge to the Agency's TS4 that is not authorized under this permit will be treated as an unpermitted discharge and dealt with per the requirements of this permit.

   VTrans will continue to implement an existing program that issues permits for residential and commercial access to the State ROW. VTrans also issues permits for non-VTrans projects within the ROW. The program includes review of proposals for open and/or closed connection to the VTrans TS4 from residential and commercial property owners. To the extent allowable under State or local law, VTrans uses this Title 19 Section 1111 Permitting authority to effectively prohibit non-stormwater discharges into the VTrans TS4 storm sewer system and implement appropriate enforcement procedures and actions to satisfy the terms of the Permit. This is implemented through the imposition of Special

Conditions (put in place in 2007) under its Title 19, Section 1111 Permitting Authority on all identified proposed and existing connections to the VTrans TS4 stormwater system.

Measurable Goals: VTrans will continue to monitor for these categories of discharges, investigate the significance of each and take appropriate enforcement action for those that warrant action. Collaboration with VT ANR Enforcement Division, other State Regulatory Agencies and Local Official may be required to take the lead role on enforcement.

Reporting: VTrans will report annually on any non-stormwater discharges discovered and actions taken.

MCM 6.D: CONSTRUCTION SITE STORMWATER RUNOFF CONTROL

REQUIREMENT – *Per Subpart 6.3.D of the Permit, VTrans shall develop, implement, and enforce a program to reduce pollutants in any stormwater runoff from construction activities that result in a land disturbance of greater than or equal to one acre. Reduction of stormwater discharges from construction activity disturbing less than one acre shall be included if that construction activity is part of a larger common plan of development or sale that would disturb one acre or more.*

VTRANS RESPONSE – To meet this requirement, VTrans has and will continue to:

1. Implement procedures to assure that construction activities undertaken by VTrans are properly permitted and in compliance with the terms of their stormwater construction permits.

   Measurable Goals: VTrans will comply with the Construction General Permit (GP 3-9020) and/or Individual Stormwater Discharge Permit (INDC) coverage.

   Reporting: VTrans will report annually a list of projects in the TS4 with Construction General Permit (GP 3-9020) and/or Individual Stormwater Discharge Permit (INDC) coverage.

2. Review existing policies to determine their effectiveness in managing construction-related erosion prevention and sediment control (EPSC), and controlling waste such as discarded building materials, concrete truck washout, chemicals, litter, and sanitary waste at construction sites that may cause adverse impacts to water quality.

   Measurable Goals: VTrans will continue to review existing policies on their effectiveness in meeting this standard and update as needed.

   Reporting: VTrans will report annually on policies reviewed and any changes that are made.

3. Review its policies for their consistency with the requirements of the VT ANR general permits for stormwater runoff from large and small construction sites and construction EPSC guidelines for low-impact development.

Measurable Goals: VTrans will continue to review existing policies on their effectiveness in meeting this standard and update as needed.

Reporting: VTrans will report annually on policies reviewed and any changes that are made.

4. Implement a plan that addresses stormwater runoff from VTrans' construction activities not subject to state or federal EPSC requirements.

   The VTrans EPSC Protocol, established in February 2007 and revised in May 2009 sets guidelines for Consultants, VTrans Designers, VTrans Construction Management Staff and District field staff for creating and implementing consistent EPSC Plans that meet the requirements of CGP 3-9020 and for those projects disturbing less than one acre with any potential to impact resources.

   Measurable Goal: VTrans will continue to follow the EPSC Protocol Statewide under the TS4.

   Reporting: VTrans will report annually on the number of projects following the EPSC Protocol

5. VTrans will continue to conduct environmental compliance site visits to projects during construction which includes review of EPSC measures. The primary purpose of these visits is to ensure that VTrans protects natural resources and complies with state and federal regulations through implementation of project EPSC Plan and compliance with environmental permit conditions.

   Measurable Goals: The VTrans Construction Engineers will visit VTrans-contracted construction projects to provide input, training, support, and resources relative to EPSC.

   Reporting: VTrans will report annually on the number of construction sites visited within the TS4.

6. VTrans offers a broad range of formal and informal training on EPSC and stormwater management design to Agency staff. These training classes have been led by both VTrans and non-VTrans subject experts from around the country, and have been attended by other regulators and consultants. VTrans provides an extensive amount of annual EPSC training to maintenance and construction employees through internal training meetings. VTrans staff are also encouraged to seek training opportunities outside the Agency. Additionally, every other year VTrans provides a one-day training workshop for construction contractors that includes a session on EPSC and compliance with regulations. Annual training for Maintenance District personnel training includes a session on stormwater management, EPSC, and compliance with regulations governing these activities.

   Measurable Goal: VTrans will continue to conduct and attend stormwater management – EPSC training.

Reporting: VTrans will report annually on EPSC training offered including class titles, attendance, and target audience.

MCM 6.E: POST-CONSTRUCTION STORMWATER MANAGEMENT FOR NEW DEVELOPMENT AND REDEVELOPMENT

REQUIREMENT – *Per the NOI, If the TS4 is incorporating a Stormwater system that was previously authorized under a State Stormwater permit, the Stormwater management practices associated with the permit listed below shall be listed in VTrans Stormwater Management Program (SWMP) under Minimum Control Measure 5, Post-Construction Stormwater Management.*

VTRANS RESPONSE – To meet these requirements, VTrans created a list of the stormwater treatment practices covered by the TS4 permit (refer to Attachment F).

Measurable Goal: VTrans will ensure compliance with the VT ANR post-construction stormwater permit program for these practices.

Reporting: Refer to part 8 for this information.

REQUIREMENT – *Per Subpart 6.3.E of the Permit, VTrans shall develop, implement, and enforce a program to address post-construction stormwater runoff from new development and redevelopment projects that involve land disturbance of greater than or equal to one acre and that are not subject to regulation under the VT ANR post-construction stormwater management permit program. The program must ensure that controls are required that will prevent or minimize water quality impacts.*

VTrans shall develop, implement, and enforce a program to reduce pollutants in any post-construction stormwater runoff from only those activities that result in land disturbance of greater than or equal to one acre and that are not subject to regulation under the VT ANR post-construction stormwater permit program.

VTRANS RESPONSE – To meet these requirements, VTrans will:

1. Review existing policies to determine their effectiveness in managing stormwater runoff that discharges from new development and redevelopment projects to prevent adverse impacts to water quality; determine their consistency with the requirements of VT ANR's rules and general permits regulating post-construction stormwater runoff; assess whether changes can be made to such policies, regulations, and ordinances in order to support low-impact design options; and assess whether changes can be made to current street design and parking lot guidelines and other requirements that affect the creation of impervious surfaces to support low-impact design.

   <u>The VTrans Project Post-Construction (Operational) Stormwater Protocol:</u> VTrans projects that fall within VT ANR's jurisdictional thresholds for post-construction stormwater management are permitted by the VT ANR Stormwater Program. VTrans designers follow the VTrans Project Post-Construction (Operational) Stormwater Protocol to facilitate

coordination with VT ANR. VTrans designers will follow the current *Vermont Stormwater Management Manual Rule and Guidance*.

Measurable Goal: VTrans will update this protocol in the first two years of the permit term to ensure effectiveness under this measure.

Reporting: VTrans will report annually on progress and accomplishments

Stormwater Program Evaluation: From the fall of 2015 through March 2017, VTrans completed a process evaluation and benchmarking of the current state of stormwater management efforts during project development. The Stormwater Program Evaluation's purpose was to highlight opportunities for improving consistency in how stormwater management is addressed across different Programs or Units while remaining consistent with VT ANR's existing and proposed stormwater management rules and policies, and identify potential efficiencies that might be gained in making changes to existing stormwater management activities within VTrans.

Measurable Goal: VTrans Project Delivery Bureau's (PDB) Environmental Section and Maintenance and Operations Bureau's (MOB) Environmental Program will use the results of this evaluation to further develop and implement VTrans' Stormwater Management Program and ensure future compliance with all stormwater regulations over the term of this permit.

Reporting: VTrans will report annually on progress and accomplishments

2. Develop and implement procedures to identify new development and redevelopment projects that disturb greater than or equal to one acre and that are not subject to regulation under VT ANR's post-construction stormwater management permit program.

   VTrans Gap SOP: VTrans has developed and implemented an internal Gap SOP to address the permit jurisdictional threshold gap between the VT ANR GP 3-9015 jurisdictional thresholds and the EPA one acre of land disturbance permit threshold that exist within the MS4 areas. This internal procedure protects water quality by incorporating post-construction stormwater management measures on VTrans projects in the VTrans MS4 to comply with the Vermont Stormwater Management Manual to the extent that is practical.

   Measurable Goals: VTrans will update and develop a plan to expand upon this procedure to include areas statewide that are within the TS4 within the second year of this permit.

   Reporting: VTrans will report annually on progress and accomplishments

3. Adopt a plan for stormwater runoff from new development and redevelopment projects that disturb greater than or equal to one acre and that are not subject to regulation under VT ANR's post-construction stormwater permit program to:

- Prevent or minimize water quality impacts from post-construction stormwater runoff from such developments,
- Utilize an appropriate combination of structural, non-structural, and low-impact BMPs, and
- Ensure adequate long-term operation and maintenance of BMPs.

VTrans Gap SOP: VTrans has developed and implemented an internal Gap SOP to address the permit jurisdictional threshold gap between the VT ANR GP 3-9015 jurisdictional thresholds and the EPA one acre of land disturbance permit threshold that exist within the MS4 areas. This internal procedure protects water quality by incorporating post-construction stormwater management measures on VTrans projects in the VTrans MS4 to comply with the Vermont Stormwater Management Manual to the extent that is practical.

Measurable Goals: VTrans will update and develop a plan to expand upon this procedure to include areas statewide that are within the TS4 within the second year of this permit.

Reporting: VTrans will report annually a list of projects that followed the internal Gap SOP.

4. Develop and implement procedures for inspecting development and redevelopment projects for compliance with the conditions of VTrans' policies for stormwater runoff that discharges from new development and redevelopment projects that disturb greater than or equal to one acre.

   Asset Management Tool: VTrans has developed and will implement an asset management tool that ensures adequate inspections and long-term operation and maintenance of BMPs.

   Measurable Goal: VTrans will continuously maintain update the asset management tool to keep it up to date.

   Reporting: None

5. VT ANR post-construction stormwater permit program: Develop and implement procedures to ensure that development and redevelopment activities are undertaken by VTrans, including road projects, are properly permitted, constructed, and maintained for stormwater runoff that discharges from new development and redevelopment projects that disturb greater than or equal to one acre.

   Measurable Goal: VTrans will ensure compliance with the VT ANR post-construction stormwater permit program.

   Reporting: Refer to part 8 for this information.

6. Training: VTrans will continue to conduct and attend Stormwater Management and EPSC Training.

VTrans offers a broad range of formal training on EPSC and stormwater management design to Agency staff. These training classes are instructed by VTrans and non-VTrans subject experts from around the country. When space allows, the training classes are open to employees of VT ANR, FHWA, USDA NRCS, and consulting companies. VTrans also provides an extensive amount of annual EPSC training to maintenance and construction employees through internal training meetings. VTrans staff is encouraged to seek training opportunities outside the Agency. Additionally, each year VTrans provides a one-day training workshop for construction contractors that includes a session on EPSC with regulations. Annual training for Maintenance District personnel training includes a session on stormwater management, EPSC, and compliance with regulations.

Measurable Goals: VTrans will conduct and attend trainings on an annual basis

Reporting: VTrans will report annually on number of trainings, class titles, target audience, and attendance.

MCM 6.F: POLLUTION PREVENTION/ GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS

REQUIREMENT – *Per Subpart 6.3.F of the Permit, VTrans shall develop and implement an operation and maintenance program that includes a training component and has the ultimate goal of preventing or reducing pollutant runoff from all VTrans' operations related to the TS4.*

VTRANS RESPONSE –

1. By implementing this TS4 SWMP, VTrans has developed and is implementing a program that includes:

    - A list of the VTrans operations covered by the program,
    - A training component, maintenance activities, maintenance schedules, and long-term inspection procedures for controls to reduce floatable and other pollutants;
    - Controls for reducing or eliminating the discharge of pollutants from the TS4; and
    - Procedures for compliance with applicable state and federal laws for the proper disposal of waste, including dredged spoil, accumulated sediments, floatables, and other debris.

    Measurable Goals: Maintain and comply with the SWMP

    Reporting: Report as outlined under the various Parts of the SWMP.

2. Prohibit the use of any phosphorus-containing fertilizer, unless warranted by a current soil test, where lawn or garden fertilizers are used in the facility operation. If a phosphorus fertilizer is used, a soil test shall be performed annually, and a copy of the test will be submitted with the annual report.

Measurable Goals: As an erosion control practice, VTrans may use fertilizer containing phosphorus in establishing turf. However, VTrans will not use phosphorus fertilizer associated with turf management unless a current soil test warrants the use of it.

Reporting: A copy of the test will be submitted with the annual report if phosphorus-containing fertilizer is used for turf management.

3. Provide a copy of its operation and maintenance program to prevent or reduce pollutant runoff from VTrans' operations as part of its SWMP.

Stormwater Pollution Prevention Plan (SWPPP) and a Spill Prevention Control & Countermeasure Plan (SPCCP). VTrans has developed SWPPPs for all facilities located within the MS4 area and SPCCPs for facilities that contain bulk fuel and/or bulk brine statewide. VTrans has been conducting trainings on these plans and facility inspections on an annual basis. For the remaining state garages located outside of the MS4 but within the TS4, VTrans will develop a SWPPP and will conduct annual trainings inspections.

Facilities Audit Tool – VTrans will develop a GIS-based audit tool for use in creating SWPPPs and informing SPCCP updates.

Measurable Goals: VTrans will continue to conduct annual trainings and inspections at facilities currently covered under SWPPPs in the MS4 and SPCCPs statewide. VTrans will maintain and update these documents on an annual basis. For facilities that are not currently covered under a SWPPP, VTrans will develop plans for 4 facilities a year using the new Facilities Audit Tool.

Reporting: VTrans will provide VT ANR with an annual status report of trainings monitoring activities, corrective actions, and new SWPPPs developed.

Good Housekeeping Measures:

- Follow the VTrans Bridge Washing BMPs for all bridge washing activities (see Attachment C).
- Follow the VT ANR Vehicle Washing Policy for the washing of fleet vehicles (see Attachment C).
- Implement a tiered winter maintenance plan with a goal to be more efficient with winter maintenance usage of snow and ice controls.
- Conduct street sweeping on VTrans roads.
- Conduct storm drain inspections and cleaning.
- Properly dispose of materials collected during street sweeping and storm drain cleaning per VT ANR Guidelines.
- Implement roadside bank stabilization projects that have a water quality benefit.

Measurable Goals: VTrans will implement good housekeeping measures and consider the development of additional measures.

Reporting: Report annually on salt and sand usage for winter road maintenance, total volume of material removed from street sweeping and storm drain cleaning, slope

stabilization and erosion repair projects completed, and any additional measures established.

4. VTrans Hazmat Unit Staff develop Spill Prevention Control Countermeasure Plans (SPCCPs) and conduct trainings and inspections annually and as needed under these SPCC Plans. Additionally, they monitor and conduct hazmat spill response and illegal dumping on VTrans sites, including incidences that may involve non-VTrans operators (e.g., independent truck drivers traveling on a state highway), with appropriate spill response. The Hazmat Unit also coordinates with project development staff and state and federal regulators when hazardous materials are encountered on VTrans sites.

   Measurable Goals: VTrans will provide VT ANR with an annual status report of monitoring activities conducted and corrective actions taken.

   Reporting: VTrans will report annually on inspections and trainings conducted at facilities and hazmat spills and illegal dumping on VTrans sites to include # of trainings, trainees, and topics.

7.0 INDUSTRIAL ACTIVITY CONTROL MEASURES

REQUIREMENT – Per Part 7 of the Permit, airport transportation facilities and facilities that conduct non-metallic mineral mining and dressing as the primary activity on site and that have the SIC Codes listed in the Permit shall develop and implement Stormwater Pollution Prevention Plans (SWPPPs) and follow all requirements of Part 7 of the Permit.

VTrans shall select, design, install, and implement control measures, including BMPs, to minimize pollutant discharges that address the selection and design considerations, meet the non-numeric effluent limits, meet limits contained in applicable effluent limitations, and meet the water quality-based effluent limitations per the relevant subparts of Part 7 of the Permit.

VTRANS RESPONSE – In response to this requirement, VTrans has developed the following Table, which lists the airport transportation facilities and non-metallic mineral mining and dressing facilities that are included in the VTrans TS4 and that were previously issued an MSGP 3-9003 by VT ANR.

Measurable Goal: maintain SWPP Plans for these facilities and maintain compliance under MSGP requirements.

Reporting: VTrans will report annually on trainings, inspections, monitoring, and any corrective actions taken.

Previously issued MSGP #-9003	Facility Name	Address	City	Primary SIC
VTrans Airport Transportation Facilities				
4579-9003.R	William H. Morse State Airport	1563 Walloomsac Road	Bennington	4512-4581
4582-9003.R	E.F. Knapp State Airport	1979 Airport Road	Berlin	4512-4581
3769-9003.R	Rutland Southern Vermont Regional State Airport	1002 Airport Road	North Clarendon	4512-4581
3836-9003.R	Newport State Airport	2628 Airport Road	Coventry	4512-4581
3065-9003.R	Franklin County State Airport	629 Airport Road	Highgate	4512-4581
3896-9003.R	Caledonia County State Airport	2107 Pudding Hill Road	Lyndonville	4512-4581
4581-9003.R	Middlebury State Airport	467 Airport Road	Middlebury	4512-4581
4272-9003.R	Morrisville-Stowe State Airport	2305 Laporte Road	Morrisville	4512-4581
4580-9003.R	Hartness State Airport	15 Airport Road	Springfield	4512-4581
4574-9003	J.H. Boylan Airport – No Exposure	3597 VT 105	Island Pond	4512-4581
Mineral Mining and Dressing Facilities				
4576-9003.R	East Dorset Sand and Gravel Pit	18 Village Street	East Dorset	1442
4577-9003.R	Hinesburg Sand and Gravel Pit	14573 Route 116	Hinesburg	1442
6054-9003.R	Calais Sand and Gravel Pit	6011 Route 14	Calais	1442

The SWPPPs for these sites can be found at:
https://outside.vermont.gov/agency/VTRANS/external/docs/stormwater/Forms/AllItems.aspx

8.0 STORMWATER DISCHARGES FROM IMPERVIOUS SURFACES

REQUIREMENT – Per Part 8 of the Permit, permit coverage is provided for: (1) previously permitted stormwater runoff discharges and proposed new stormwater runoff discharges from impervious surfaces that trigger jurisdiction as outlined in Subpart 8.1.A of the Permit, (2) stormwater discharges to waters of the State that are not impaired by stormwater and to waters of the State that are listed as principally impaired due to stormwater runoff with a stormwater WQRP or TMDL on the EPA-approved State of Vermont List of Priority Surface Waters (Part D, Impaired Surface Waters with Completed and Approved TMDLs) and that have an approved FRP or other approved implementation plan.

VTRANS RESPONSE – VTrans will maintain compliance with the standards established in this Part.

Reporting: VTrans will report annually a list of projects in the TS4 with VT ANR Operational Permit coverage, including status, inspections, and corrective actions needed or taken.

9.0 TOTAL MAXIMUM DAILY LOAD IMPLEMENTATION

9.1 FLOW RESTORATION PLANS

REQUIREMENT – Per Subpart 9.1 of the Permit, VTrans submitted its FRP on October 1, 2016, pursuant to the requirements of "General Permit 3-9014 for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems" (2012). Upon approval by VT ANR, the FRP will become a part of VTrans' SWMP.

VTRANS RESPONSE – VTrans has infrastructure within the watersheds of the following stormwater-impaired waters: Allen, Bartlett, Centennial, Indian, Moon, Munroe, Potash, Rugg, Stevens, and Sunderland brooks. Per the FRP (see Attachment D), VTrans has been and will continue to implement measures within these watersheds necessary to achieve the flow restoration targets in the stormwater TMDLs for the waters within the VTrans designated regulated small MS4 and submit semi-annual reporting on development and implementation of the FRP per the required deadlines.

Included in the VTrans FRP is a design and construction schedule that provides a long-term plan for implementation. Implementation of the 54 projects included in the VTrans FRP was spaced out over a 16-year timeframe in 7 separate phases, providing adequate time for design, acquisition of necessary permits, regulatory approvals, acquisition of necessary land, and construction.

Reporting: VTrans will report on implementation of the FRP on a semi-annual basis.

REQUIREMENT – Per Subpart 9.1 of the Permit, VTrans shall implement, or otherwise fund, a flow and precipitation monitoring program, subject to approval by VT ANR, in its respective stormwater-impaired watersheds.

VTRANS RESPONSE – All MS4s that discharge to a stormwater-impaired water are required to implement a flow and precipitation monitoring program. In compliance with the January 2, 2014, due date in the MS4 permit, all MS4s, including VTrans, submitted Flow Monitoring Plans. In the 2013-2014 Legislative Session, the Vermont Legislature passed a bill that allows VT ANR to collect funds from MS4s to implement a comprehensive flow monitoring program for MS4s that wish to participate.

In response to this requirement, VTrans participates in this flow monitoring program. Stream flow and precipitation monitoring data collected through this program are available at the following locations:

- Flow monitoring data: http://vt-ms4-flow.stone-env.com/FlowDev/index.html
- Precipitation data: http://vt-ms4-flow.stone-env.com/Precip/index.html

Reporting: Funding expended annual for the Flow Monitoring Program.

9.2 PHOSPHORUS CONTROL PLANS

REQUIREMENT – *Per Subpart 9.2 of the Permit, VTrans shall develop and implement a comprehensive PCP for the TS4 within the Lake Champlain Basin. The PCP shall be developed in phases and submitted to VT ANR per the schedule in Subpart 9.2.C.*

VTRANS RESPONSE – VTrans has infrastructure in all 13 lake segments within the Lake Champlain Basin. VTrans will develop and implement its PCP in phases, beginning with the establishment of baseline phosphorus loading and calculation of the phosphorus load reductions needed to achieve its percent reduction from the TS4 for each Lake segment, which will be submitted by April 1, 2018.

REQUIREMENTS –

1. Establish baseline phosphorus loading assessments for the TS4. Using this baseline, VTrans shall calculate the phosphorus load reduction needed to achieve its percent reduction from the TS4 for each lake segment, listed in the following Table.

Lake Segment	% Reduction
01. South Lake B	21.1%
02. South Lake A	18.1%
03. Port Henry	7.6%
04. Otter Creek	15.0%
05. Main Lake	20.2%
06. Shelburne Bay	20.2%
07. Burlington Bay	24.2%
09. Malletts Bay	20.5%
10. Northeast Arm	7.2%
11. St. Albans Bay	21.7%
12. Missisquoi Bay	34.2%
13. Isle La Motte	8.9%

VTRANS RESPONSE – VTrans is providing VT ANR with required datasets to facilitate establishment of the baseline phosphorus loading assessments for the TS4, and VT ANR will provide the calculated phosphorus base load for the VTrans TS4.

Reporting: VTrans will report on established baseline phosphorus loading for the TS4, and calculation of phosphorus load reduction needed to achieve its percent reduction from the TS4 for each lake segment, by April 1, 2018.

2. Investigate phosphorus loading factors that will inform the prioritization of retrofit projects. Investigation shall include at least a GIS inventory of hydrologic connectivity and areas of active erosion for the TS4.

Based on the GIS inventory and established phosphorus baseline, develop coefficients for loading rates across the TS4 for the various transportation land uses.

VTRANS RESPONSE – VTrans is developing a GIS inventory of hydrologic connectivity and areas of potential localized active erosion for the TS4. VTrans and VT ANR are continuing to investigate the application of these key phosphorus loading factors to inform the prioritization of both field conformation and the prioritization of retrofit projects.

Reporting: VTrans will report on the status of the GIS inventory and on investigation of phosphorus loading factors, complete the GIS inventory of phosphorus loading factors by October 1, 2018, report on development and application of coefficients for distributing phosphorus loading across the TS4, and complete development of coefficients of loading rates by April 1, 2019.

3. *Develop a plan for the entire TS4 within the Lake Champlain Basin that at a minimum estimates the area (acreage or road miles) to be treated and the extent and type of BMPs to meet the entire phosphorus load reduction.*

VTRANS RESPONSE – VTrans will develop a generalized PCP for the entire TS4 within the Lake Champlain Basin that estimates the area to be treated (acreage or road miles) within each Lake segment, and necessary measures to be implemented to achieve the entire phosphorus load reduction no later than June 17, 2036. The generalized PCP will be submitted to VT ANR by April 1, 2020.

Reporting: VTrans will report on development of the generalized PCP and submit the generalized PCP by April 1, 2020.

4. *Plan to achieve, on average, a 25% load reduction of the total combined reduction targets in all Lake segments in each 4-year phase, so that, the total reductions equal 100% after all phases are completed. For each phase, VTrans shall:*

- Identify the suite of necessary stormwater BMPs that will be used to meet the required phosphorus load reduction.
- Prepare a design and construction schedule for the stormwater BMPs that have been identified by VTrans as necessary to achieve the phosphorus reduction targets.
- Prepare a financing plan that estimates the costs for implementing the PCP Phase and describes a strategy for financing the PCP Phase. The financing plan shall include the steps VTrans will take to implement the financing plan.
- Identify any parties, other than VTrans, that will be responsible for implementing any portion of the VTrans PCP, and which portion they will be responsible for implementing.

5. *Starting April 1, 2021, VTrans shall submit reports on a semi-annual basis on its development and implementation of the PCP. The reports shall be submitted on forms provided by VT ANR to enable VT ANR to track phosphorus reductions across the Basin.*

VTRANS RESPONSE – The generalized PCP for the entire TS4 in the Lake Champlain Basin will be developed into a series of four-year implementation plans for each Lake segment

that achieve, on average, a 25 percent load reduction of the total combined reduction targets in all Lake segments. The first four-year implementation plan will be submitted to VT ANR by October 1, 2020. The implementation plan for each four-year phase will include:

- Identification of the suite of necessary BMPs that will be used to meet the required phosphorus load reduction
- A design and construction schedule for BMPs identified as necessary to achieve the phosphorus reduction targets
- A financing plan that estimates costs for implementing the PCP Phase and describes a strategy for financing implementation, including the steps VTrans will take to implement the financing plan
- Identification of parties other than VTrans responsible for implementing any portion of the VTrans PCP, and identification of portions the other parties are responsible for implementing.

  Reporting: VTrans will report on development and implementation of the four-year implementation plans, submit the first four-year implementation plan (Phase I) by October 1, 2020, and submit semi-annual reports on Phosphorus Control Plan implementation by April 1, 2021, and every six months thereafter (April 1 and October 1).

10.0 RECORD KEEPING AND REPORTING

REQUIREMENT – *Per subpart 10.1 of the Permit, VTrans shall retain records of all monitoring information, copies of all reports required by the Permit, copies of Discharge Monitoring Reports (DRMs), a copy of its authorization and amended authorizations under this Permit, and records of all data used to complete the applications NOI for this Permit, for a period of at least three years from the date of the sample, measurement, report or application, or for the term of this permit, whichever is longer. VTrans shall retain copies of all written records relating to the stormwater collection, treatment, and control systems, and BMPs, including calculations used to size STPs, authorized under this permit. VTrans shall submit its records to VT ANR when specifically asked to do so. VTrans shall retain a copy of this SWMP and a copy of the permit language at a location accessible to VT ANR. VTrans shall make its records, including the NOI and SWMP, available to the public, if requested to do so in writing.*

VTRANS RESPONSE – VTrans will comply with this requirement.

REQUIREMENT – *Per subpart 10.2 of the Permit, VTrans shall submit its annual reports to the Vermont Department of Environmental Conservation, Watershed Management Division, Stormwater Management Program by April 1st each year. FRP and PCP reports may be included with the annual report when reporting deadlines coincide. In addition to any FRP and PCP*

reporting requirements, the annual report shall include all annual reporting requirements under Parts 4, 5, 6, and 7 of the Permit, as well as:

A. *The status of VTrans' compliance with permit conditions, an assessment of the appropriateness of the identified BMPs, progress towards achieving implementation of BMPs necessary to meet TMDL requirements and progress towards achieving the statutory goal for the six minimum measures of reducing the discharge of pollutants to the MEP, and the measurable goals for each of the minimum control measures and TMDL implementation measures;*

B. *Any inspection report on the condition of VTrans' stormwater management systems that notes all problem areas and all measures taken to correct any problems and to prevent future problems;*

C. *Results of information collected and analyzed, if any, during the reporting period, including monitoring data used to assess the success of the program at meeting TMDL requirements and the success of the six minimum control measures;*

D. *A summary of the stormwater activities VTrans plans to undertake during the next reporting cycle (including an implementation schedule);*

E. *Proposed changes to this SWMP, including changes to any BMPs or any identified measurable goals that apply to the program elements; and*

F. *Notice that VTrans is relying on another government entity to satisfy some of its permit obligations (if applicable)*.

VTRANS RESPONSE – VTrans will satisfy this requirement in its annual reporting.

ATTACHMENTS

ATTACHMENT A LIST OF WATERS (TABLE 1 AND TABLE 2)

Table 1
First Waters to which Designated MS4 Areas Discharge, Impairment Status, and Pollutants, Measures, and Controls for Impaired Waters
December 1, 2017

Waterbody Name	Pollutant	MS4 Towns	Impairment Status (Yes/No)	Impaired Waterbody Partially Outside MS4 Area	TMDL (Yes/No)	Vtrans/TS4 Allocation (Yes/No)	Measure No. (see Lookup Table)
MUDDY BROOK	CHLORIDE	South Burlington, Williston	Yes		No	No	2
SUNNYSIDE BROOK	CHLORIDE	Colchester	Yes		No	No	2
EAST CREEK	E. COLI	Rutland City	Yes		No	No	3
OTTER CREEK	E. COLI	Rutland City	Yes		No	No	3
WINOOSKI RIVER	E. COLI	Burlington, Colchester, Winooski	Yes		No	No	3
ALLEN BROOK	E. COLI	Williston	Yes		Yes	No	4
ENGLESBY BROOK	E. COLI	Burlington	Yes		Yes	No	5
INNER MALLETTS BAY	E. COLI	Colchester	Yes		Yes	No	5
LAPLATTE RIVER	E. COLI	Shelburne	Yes		Yes	No	5
POTASH BROOK	E. COLI	South Burlington	Yes		Yes	No	5
LOWER LAMOILLE RIVER	LOW D.O.	Milton	Yes		No	No	6
ARROWHEAD MOUNTAIN LAKE (Milton)	MERCURY	Milton	Yes	Yes	Yes	No	7
BURLINGTON BAY - LAKE CHAMPLAIN (Burlington)	MERCURY	Burlington, South Burlington	Yes	Yes	Yes	No	7
LAMOILLE RIVER	MERCURY	Milton	Yes		Yes	No	7
LAPLATTE RIVER	MERCURY	Shelburne	Yes		Yes	No	7
MAIN SECTION - LAKE CHAMPLAIN (South Hero)	MERCURY	Burlington, South Burlington	Yes	Yes	Yes	No	7
MALLETTS BAY - LAKE CHAMPLAIN (Colchester)	MERCURY	Colchester	Yes	Yes	Yes	No	7
NORTHEAST ARM - LAKE CHAMPLAIN (Swanton)	MERCURY	St. Albans Town	Yes	Yes	Yes	No	7
SHELBURNE BAY - LAKE CHAMPLAIN (Shelburne)	MERCURY	Shelburne	Yes	Yes	Yes	No	7
ST. ALBANS BAY - LAKE CHAMPLAIN (St. Albans)	MERCURY	St. Albans Town	Yes	Yes	Yes	No	7
WINOOSKI RIVER	MERCURY	Burlington, Winooski	Yes		Yes	No	7
LAMOILLE RIVER TRIB #4	METALS	Milton	Yes		No	No	8
STEVENS BROOK	METALS (Cd, Ba, CN, Zn)	St. Albans City	Yes		No	No	9
WINOOSKI RIVER UNNAMED TRIB	METALS (Fe, As)	Winooski	Yes		No	No	10
MCCABES BROOK	NUTRIENTS	Shelburne	Yes		No	No	12
JEWETT BROOK	NUTRIENTS, SEDIMENT, E. COLI	St. Albans Town	Yes		No	No	14
RUGG BROOK	NUTRIENTS, SEDIMENT, E. COLI	St. Albans Town	Yes		No	No	14
STEVENS BROOK	NUTRIENTS, SEDIMENT, E. COLI	St. Albans Town	Yes		No	No	14
BURLINGTON BAY - LAKE CHAMPLAIN (Burlington)	PCBs	Burlington	Yes		No	No	15
MAIN SECTION - LAKE CHAMPLAIN (South Hero)	PCBs	Shelburne	Yes	Yes	No	No	15
MALLETTS BAY - LAKE CHAMPLAIN (Colchester)	PCBs	Colchester	Yes	Yes	No	No	15
NORTHEAST ARM - LAKE CHAMPLAIN (Swanton)	PCBs	St. Albans Town	Yes		No	No	15
SHELBURNE BAY - LAKE CHAMPLAIN (Shelburne)	PCBs	Shelburne	Yes		No	No	15
ST. ALBANS BAY - LAKE CHAMPLAIN (St. Albans)	PCBs	St. Albans Town	Yes	Yes	No	No	15
SHELBURNE POND (Shelburne)	PHOSPHORUS	Shelburne	Yes		No	No	16
BURLINGTON BAY - LAKE CHAMPLAIN (Burlington)	PHOSPHORUS	Burlington, South Burlington	Yes	Yes	Yes	Yes	17

Table 1
First Waters to which Designated MS4 Areas Discharge, Impairment Status, and Pollutants, Measures, and Controls for Impaired Waters
December 1, 2017

Waterbody Name	Pollutant	MS4 Towns	Impairment Status (Yes/No)	Impaired Waterbody Partially Outside MS4 Area	TMDL (Yes/No)	Vtrans/TS4 Allocation (Yes/No)	Measure No. (see Lookup Table)
MAIN SECTION - LAKE CHAMPLAIN (South Hero)	PHOSPHORUS	Burlington, South Burlington	Yes	Yes	Yes	Yes	17
MALLETTS BAY - LAKE CHAMPLAIN (Colchester)	PHOSPHORUS	Colchester	Yes	Yes	Yes	Yes	17
NORTHEAST ARM - LAKE CHAMPLAIN (Swanton)	PHOSPHORUS	St. Albans Town	Yes	Yes	Yes	Yes	17
SHELBURNE BAY - LAKE CHAMPLAIN (Shelburne)	PHOSPHORUS	Shelburne	Yes	Yes	Yes	Yes	17
ST. ALBANS BAY - LAKE CHAMPLAIN (St. Albans)	PHOSPHORUS	St. Albans Town	Yes	Yes	Yes	Yes	17
BURLINGTON BAY - LAKE CHAMPLAIN - PINE STREET BARGE CANAL (Burlington)	PRIORITY & NONPRIORITY ORGANICS, METALS, OIL, GREASE, PCBs	Burlington	Yes		No	No	19
ALLEN BROOK	STORMWATER	Williston	Yes		Yes	Yes	24
BARTLETT BROOK	STORMWATER	South Burlington	Yes		Yes	Yes	24
CENTENNIAL BROOK	STORMWATER	Burlington, South Burlington	Yes		Yes	Yes	24
ENGLESBY BROOK	STORMWATER	Burlington	Yes		Yes	Yes	24
INDIAN BROOK	STORMWATER	Essex	Yes		Yes	Yes	24
MOON BROOK	STORMWATER	Rutland City, Rutland Town	Yes		Yes	Yes	24
MOREHOUSE BROOK	STORMWATER	Winooski	Yes		Yes	Yes	24
MUNROE BROOK	STORMWATER	Shelburne	Yes		Yes	Yes	24
POTASH BROOK	STORMWATER	Burlington	Yes		Yes	Yes	24
RUGG BROOK	STORMWATER	St. Albans City	Yes		Yes	Yes	24
STEVENS BROOK	STORMWATER	St. Albans City	Yes		Yes	Yes	24
SUNDERLAND BROOK	STORMWATER	Colchester	Yes		Yes	Yes	24
MUDDY BROOK	TOXICS	Williston	Yes		No	No	26
Alder Brook		Essex	No				
Allen Brook		Colchester	No				
Browns River		Essex, Jericho	No				
Clarendon River		Rutland Town	No				
Cold River		Rutland Town	No				
East Creek		Rutland Town	No				
Hungerford Brook		St. Albans Town	No				
Indian Brook		Colchester	No				
Lamoille River		Milton	No				
Malletts Creek		Colchester	No				
Muddy Brook		South Burlington	No				
Otter Creek		Rutland City, Rutland Town	No				
Pond Brook		Colchester	No				
Rugg Brook		St. Albans Town	No				
Sucker Brook		Williston	No				
Sunderland Brook		Colchester	No				
Unnamed Tributary to Alder Brook		Essex	No				
Unnamed Tributary to Allen Brook		Milton	No				

Table 1
First Waters to which Designated MS4 Areas Discharge, Impairment Status, and Pollutants, Measures, and Controls for Impaired Waters
December 1, 2017

Waterbody Name	Pollutant	MS4 Towns	Impairment Status (Yes/No)	Impaired Waterbody Partially Outside MS4 Area	TMDL (Yes/No)	Vtrans/TS4 Allocation (Yes/No)	Measure No. (see Lookup Table)
Unnamed Tributary to Allen Brook		Williston	No				
Unnamed Tributary to Arrowhead Mountain Lake		Milton	No				
Unnamed Tributary to Browns River		Essex	No				
Unnamed Tributary to East Creek		Rutland Town	No				
Unnamed Tributary to Hungerford Brook		St. Albans Town	No				
Unnamed Tributary to Indian Brook		Essex	No				
Unnamed Tributary to Lamoille River		Milton	No				
Unnamed Tributary to Malletts Bay		Colchester	No				
Unnamed Tributary to Muddy Brook		South Burlington	No				
Unnamed Tributary to Otter Creek		Rutland City	No				
Unnamed Tributary to Otter Creek		Rutland Town	No				
Unnamed Tributary to Pond Brook		Colchester	No				
Unnamed Tributary to Potash Brook		South Burlington	No				
Unnamed Tributary to Rugg Brook		St. Albans Town	No				
Unnamed Tributary to Shelburne Pond		Shelburne	No				
Unnamed Tributary to St. Albans Bay		St. Albans Town	No				
Unnamed Tributary to Stevens Brook		St. Albans Town	No				
Unnamed Tributary to Streeter Brook		Milton	No				
Unnamed Tributary to Sunderland Brook		Colchester	No				
Unnamed Tributary to Tenney Brook		Rutland Town	No				
Unnamed Tributary to Winooski River		Burlington	No				
Unnamed Tributary to Winooski River		Essex	No				
Unnamed Tributary to Winooski River		South Burlington	No				
Unnamed Tributary to Winooski River		Williston	No				
Unnamed Tributary to Winooski River		Winooski	No				
Winooski River		Essex, South Burlington, Colchester	No				

Table 2
Impaired Waters with Mapped and Identified VTrans Discharges Outside Designated MS4 Areas
December 1, 2017

Waterbody Name	Pollutant	Impaired Waterbody Partially Within MS4 Area	Vermont Priority Waters List Part	TMDL (Yes/No)	Vtrans/TS4 Allocation (Yes/No)	Measure No. (see Lookup Table)
UPPER DEERFIELD RIVER	ACID		A	No		1
LOWER SLEEPERS RIVER	E. COLI		A	No		3
PASSUMPSIC RIVER	E. COLI		A	No		3
WINOOSKI RIVER (Above Montpelier WWTF)	E. COLI		A	No		3
FIRST BRANCH WHITE RIVER	E. COLI		A	No		4
METTAWEE RIVER	E. COLI		A	No		4
SECOND BRANCH WHITE RIVER	E. COLI		A	No		4
WINOOSKI RIVER (Marshfield)	E. COLI		A	No		4
FLOWER BROOK	E. COLI		D	Yes	No	5
MAD RIVER	E. COLI		D	Yes	No	5
NO. BRANCH DEERFIELD RIVER	E. COLI		D	Yes	No	5
SAMSONVILLE BROOK	E. COLI		D	Yes	No	5
WEST RIVER	E. COLI		D	Yes	No	5
ARROWHEAD MOUNTAIN LAKE (Milton)	MERCURY	Yes	D	Yes	No	7
BURLINGTON BAY - LAKE CHAMPLAIN (Burlington)	MERCURY	Yes	D	Yes	No	7
HARRIMAN RESERVOIR (Whitingham)	MERCURY		D	Yes	No	7
ISLE LAMOTTE - LAKE CHAMPLAIN (Alburg)	MERCURY		D	Yes	No	7
LAKE SALEM (Derby)	MERCURY		D	Yes	No	7
MAIN SECTION - LAKE CHAMPLAIN (South Hero)	MERCURY	Yes	D	Yes	No	7
MALLETTS BAY - LAKE CHAMPLAIN (Colchester)	MERCURY	Yes	D	Yes	No	7
MISSISQUOI BAY - LAKE CHAMPLAIN (Alburg)	MERCURY		D	Yes	No	7
NORTHEAST ARM - LAKE CHAMPLAIN (Swanton)	MERCURY	Yes	D	Yes	No	7
OTTER CREEK SECTION - LAKE CHAMPLAIN (Ferrisburg)	MERCURY		D	Yes	No	7
PORT HENRY SECTION - LAKE CHAMPLAIN (Ferrisburg)	MERCURY		D	Yes	No	7
SHELBURNE BAY - LAKE CHAMPLAIN (Shelburne)	MERCURY	Yes	D	Yes	No	7
SOUTHERN SECTION - LAKE CHAMPLAIN (Bridport)	MERCURY		D	Yes	No	7
ST. ALBANS BAY - LAKE CHAMPLAIN (St. Albans)	MERCURY	Yes	D	Yes	No	7
UPPER DEERFIELD RIVER	MERCURY		D	Yes	No	7
TRIB #10 TO BREWSTER RIVER (1 MILE)	METALS (IRON)		A	No		11

Table 2
Impaired Waters with Mapped and Identified VTrans Discharges Outside Designated MS4 Areas
December 1, 2017

Waterbody Name	Pollutant	Impaired Waterbody Partially Within MS4 Area	Vermont Priority Waters List Part	TMDL (Yes/No)	Vtrans/TS4 Allocation (Yes/No)	Measure No. (see Lookup Table)
ROARING BROOK	NUTRIENTS		A	No		12
TROUT BROOK	NUTRIENTS		A	No		12
SAMSONVILLE BROOK	NUTRIENTS, SEDIMENT		A	No		13
HOOSIC RIVER	PCBs		A	No		15
ISLE LAMOTTE - LAKE CHAMPLAIN (Alburg)	PCBs		A	No		15
MAIN SECTION - LAKE CHAMPLAIN (South Hero)	PCBs	Yes	A	No		15
MALLETTS BAY - LAKE CHAMPLAIN (Colchester)	PCBs	Yes	A	No		15
NORTHEAST ARM - LAKE CHAMPLAIN (Swanton)	PCBs		A	No		15
OTTER CREEK SECTION - LAKE CHAMPLAIN (Ferrisburg)	PCBs		A	No		15
PORT HENRY SECTION - LAKE CHAMPLAIN (Ferrisburg)	PCBs		A	No		15
SOUTHERN SECTION - LAKE CHAMPLAIN (Bridport)	PCBs		A	No		15
ST. ALBANS BAY - LAKE CHAMPLAIN (St. Albans)	PCBs	Yes	A	No		15
LAKE CARMI (Franklin)	PHOSPHORUS		D	Yes	No	16
BURLINGTON BAY - LAKE CHAMPLAIN (Burlington)	PHOSPHORUS	Yes	D	Yes	Yes	17
ISLE LAMOTTE - LAKE CHAMPLAIN (Alburg)	PHOSPHORUS		D	Yes	Yes	17
MAIN SECTION - LAKE CHAMPLAIN (South Hero)	PHOSPHORUS	Yes	D	Yes	Yes	17
MALLETTS BAY - LAKE CHAMPLAIN (Colchester)	PHOSPHORUS	Yes	D	Yes	Yes	17
MISSISQUOI BAY - LAKE CHAMPLAIN (Alburg)	PHOSPHORUS		D	Yes	Yes	17
NORTHEAST ARM - LAKE CHAMPLAIN (Swanton)	PHOSPHORUS	Yes	D	Yes	Yes	17
OTTER CREEK SECTION - LAKE CHAMPLAIN (Ferrisburg)	PHOSPHORUS		D	Yes	Yes	17
PORT HENRY SECTION - LAKE CHAMPLAIN (Ferrisburg)	PHOSPHORUS		D	Yes	Yes	17
SHELBURNE BAY - LAKE CHAMPLAIN (Shelburne)	PHOSPHORUS	Yes	D	Yes	Yes	17
SOUTHERN SECTION (A) - LAKE CHAMPLAIN (Bridport)	PHOSPHORUS		D	Yes	Yes	17
SOUTHERN SECTION (B) - LAKE CHAMPLAIN (Bridport)	PHOSPHORUS		D	Yes	Yes	17
ST. ALBANS BAY - LAKE CHAMPLAIN (St. Albans)	PHOSPHORUS	Yes	D	Yes	Yes	17
LAKE MEMPHRAMAGOG (Newport)	PHOSPHORUS		D	Yes	Yes	18
DEER BROOK	SEDIMENT		A	No		20
LADD BROOK	SEDIMENT		A	No		21

Table 2
Impaired Waters with Mapped and Identified VTrans Discharges Outside Designated MS4 Areas
December 1, 2017

Waterbody Name	Pollutant	Impaired Waterbody Partially Within MS4 Area	Vermont Priority Waters List Part	TMDL (Yes/No)	Vtrans/TS4 Allocation (Yes/No)	Measure No. (see Lookup Table)
SOUTH MOUNTAIN BRANCH (TRIB # 7) (2.2 MI.)	SEDIMENT		A	No		21
SOUTH MOUNTAIN BRANCH (TRIB # 3)	SEDIMENT		B	No		22
BARNEY BROOK	SEDIMENT, IRON		A	No		21
BIG SPRUCE BROOK	SEDIMENT, IRON		B			22
NO. BRANCH DEERFIELD RIVER	STORMWATER, TEMPERATURE		A	No		25
WEST BRANCH LITTLE RIVER	UNDEFINED		B			22

Measures Lookup and Descriptions for Tables 1 and 2
December 1, 2017

Measure No.	Measure Description
1	No TMDL, no specific actions required
2	MCM #1 and #6 (SWMP Parts 6.A and 6.F); VAOT Snow and Ice Control Plan (SIC Plan)
3	Combined sewer overflow, no specific actions required
4	No specific actions required; VTrans will implement MCM #1 and #3 (SWMP Parts 6.A and 6.C)
5	No VTrans allocation, VTrans will implement MCM #1 and #3 (SWMP Parts 6.A and 6.C)
6	Part B - plan in place to mitigate - no specific actions required
7	No VTrans allocation, no specific actions required
8	No specific actions required - contamination from historic hazardous site
9	No specific actions required - contamination from historic hazardous site
10	Part B - plan in place to mitigate - no specific actions required
11	No specific actions required; BMPs in place to mitigate
12	No specific actions required; VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
13	No specific actions required; VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
14	No specific actions required; VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
15	No specific actions required; MCM #6 for spill prevention and if PCBs encountered
16	No VTrans allocation, VTrans will implement MCM #1 and #6 (SWMP Parts 6.A and 6.F)
17	PCP development and implementation (SWMP Part 9.2)
18	PCP development and implementation beginning in 2022; VTrans will implement MCM #1 and #6 (SWMP Parts 6.A and 6.F)
19	Part B - plan in place to mitigate - no specific actions required
20	Consider including in PCP development and implementation (SWMP Part 9.2)
21	No specific actions required; VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
22	Part B - plan in place to mitigate - no specific actions required. VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
23	No specific actions required; VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
24	FRP implementation (TS4 Permit Part 9.1)
25	Plan in place to mitigate, no specific actions required. VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)
26	No specific actions required; MCM #6 for spill prevention and if toxics encountered
27	Part B - plan in place to mitigate - no specific actions required. VTrans will implement MCM #1, #3, and #6 (SWMP Parts 6.A, 6.C, and 6.F)

ATTACHMENT B CHITTENDEN COUNTY MS4 STORMWATER PROGRAM AGREEMENT (JULY 1, 2017)

CHITTENDEN COUNTY MS4
STORMWATER PROGRAM AGREEMENT
EFFECTIVE July 1, 2017

Preamble

This Stormwater Program Agreement ("Agreement") is entered into by and between a group of Municipal Separate Storm Sewer System ("MS4") permittees ("MS4 Permittees") and the Chittenden County Regional Planning Commission ("CCRPC") to operate an MS4 Stormwater Program ("Program") that conforms with and satisfies the relevant requirements of both Minimum Control Measure One (Public Outreach and Education) and Minimum Control Measure Two (Public Involvement and Participation) of the Phase II NPDES Permit issued by the Vermont Department of Environmental Conservation ("DEC") on December 2012 through General Permit 3-9014 ("MS4 Permit"), as these requirements may be continued, renewed, amended, or otherwise modified during the term of this Agreement.

1. **Prior Agreements** – Effective July 1, 2017, this Agreement

    a. supersedes an MOU signed by the CCRPC and twelve MS4 permittees, effective March 10, 2013 through March 9, 2018, governing the operation of a Regional Stormwater Education Program to satisfy the relevant requirements of Minimum Control Measure One (Public Outreach and Education), and

    b. supersedes an MOU signed by the CCRPC and eleven MS4 permittees, effective July 1, 2011 through June 30, 2016, and an amendment to this MOU extending its effective date through June 30, 2017, governing the operation of a Regional Stormwater Public Involvement and Participation Program to satisfy the relevant requirements of Minimum Control Measure Two (Public Involvement and Participation).

2. **Service Agreement** – This Agreement constitutes a service agreement pursuant to 24 V.S.A. § 4345b (Intermunicipal Service Agreements).

3. **Definitions**—For purposes of this Agreement, the term "MS4 Permittees" includes the Vermont Agency of Transportation, which on December 28, 2016 became eligible for coverage under General Permit 3-9007 for Stormwater Discharges from the State Transportation Separate Storm Sewer System (TS4).

4. **Parties** – The following are the parties to this Agreement:

    a. **MS4 Permittees** – the undersigned MS4 Permittees, and

    b. **CCRPC** – the undersigned regional planning commission.

5. **MS4 Steering Committee**

    a. **Composition** – The Members of the Steering Committee shall consist of one representative from each of the signatory MS4 Permittees to this Agreement. Another MS4 permitee may request to join this Agreement if approved by a two-thirds vote of the Members. The Members shall be

appointed either by the governing bodies of their municipalities at publicly warned meetings or, if a Member representing an MS4 Permittee is non-municipal agency, via a process consistent with that agency's policies. At its first meeting, the Steering Committee shall elect a Chair by a majority vote. The Chair shall serve until such time as the Chair resigns or the Steering Committee elects a new Chair.

b. **Duties** – The Steering Committee shall direct the CCRPC on the development and performance of Program Services in particular and on all other matters bearing on the administration of this Agreement. All actions of the Steering Committee shall be by majority vote unless otherwise specified in this Agreement.

c. **Organization of Meetings** – The Steering Committee shall meet on a quarterly basis at a minimum. The CCRPC shall provide Steering Committee Members with reasonable notice of meetings. Notice shall include a meeting agenda and draft meeting minutes. In addition, the CCRPC shall post notice of Steering Committee meetings on its website and on the Program website.

6. **CCRPC**

a. **Duties** – The CCRPC shall:

1) Administer this Agreement and agreements with contractors (including executing contracts approved by the Steering Committee, receiving and disbursing funds, and monitoring the provision of services) for the benefit of the MS4 Permittees.

2) Provide other services contributing to the operation of the Program (including, but not limited to, social media management, public relations, grant writing, creating and managing a Program website, organizing meetings as set forth in Section 4.c, above, etc.) as directed by the Steering Committee; and at a level consistent with each year's Program Budget as described in Section 8.b, below.

3) Provide a quarterly budget report to the Steering Committee detailing expenses the CCRPC incurred and the payments it has received.

4) Pay contractors and vendors for charges consistent with the relevant contract, using funds from the Program Budget, as defined in Section 8, below.

5) Upon approval of the Steering Committee or its designee, reimburse itself for personnel and other expenses for charges consistent with its duties, using funds from the Program Budget.

6) Consult with the Steering Committee prior to authorizing any contractor activities or charges outside the scope of work of a contract.

7) Notify the Steering Committee when 75% of the annual budget (as defined in Section 8, below) for an individual category of expenses (e.g., contractors, CCRPC fees, advertising, etc.) is reached. When these levels are reached, subsequent expenditures by the CCRPC in that category shall be reviewed and approved by the Steering Committee Chair in advance.

8) At the request of the Steering Committee, assign any or all contracts that the CCRPC has entered into pursuant to this Agreement to the MS4 Permittees who are signatories to this Agreement at the time or to another contractor of the Steering Committee's choosing.

9) Comply with all applicable federal, state, and local laws, including Burlington's Livable Wage Ordinance as applicable.

b. **Compensation** – Through the Program Budget, the MS4 Permittees shall compensate the CCRPC for the actual costs of performing its duties defined in Section 5.a, above; provided, however, that the CCRPC shall not be entitled to compensation that would exceed ten percent (10%) of the Program Budget as specified in Section 8.b, below, without the prior approval of a majority of the Steering Committee.

c. **Invoices** – The CCRPC shall invoice the Program to cover personnel charges, mileage reimbursement, and other direct expenses necessary to perform its duties. Personnel charges for CCRPC staff shall be calculated at a rate of salary plus fringe. The CCRPC shall not charge the Program an Indirect Rate. As set forth in Section 5.b, above, upon approval of the Steering Committee or its designee, the CCRPC may reimburse itself for charges consistent with its duties, using funds from the Program Budget.

7. **Selection of Contractors**

a. The CCRPC, in consultation with the Steering Committee, shall competitively bid for contract(s) for Program services that collectively satisfy the requirements for Minimum Control Measure One (Public Outreach and Education) and Minimum Control Measure Two (Public Involvement and Participation) of the Phase II NPDES Permit then in effect. The parties to the contracts shall be the contractors and the CCRPC. All contracts shall require the contractor to indemnify and hold harmless the MS4 Permittees from any claims related to the contract and to procure and maintain liability insurance for all services performed under the contract.

b. All contracts shall be awarded based on qualifications, price, and the ability of the entity to provide services that meet the relevant MS4 Permit requirements. The selection of contractors shall comply with the procurement policy of the CCRPC and with applicable state and federal procurement laws and procedures.

c. Contracts shall generally be 1 to 5 years in length and shall include, but not be limited to, a Maximum Limiting Amount and the right of the CCRPC to 1) cancel a contract if services are not being adequately provided, 2) specify that payments to contractors shall be made only for services rendered, 3) specify the annual scope of work and budget as approved by the Steering Committee, 4) allow a contract extension if desired, and 5) assign the contract to the MS4 Permittees that are signatories to this Agreement at the time of the assignment or to a contractor of the Steering Committee's choosing.

d. Contracting for services under this Agreement shall comply with the Fair Employment Act and Americans with Disabilities Act: the CCRPC shall comply with the requirement of Title 21 V.S.A Chapter 5, Subchapter 6, relating to fair employment practices, to the full extent applicable. The CCRPC shall also ensure, to the full extent required by the Americans with Disabilities Act of 1990, that qualified individuals with disabilities receive equitable access to the services,

programs, and activities provided by the Steering Committee under this Agreement. This provision shall also be included in all contracts and subcontracts executed under this Agreement.

e. The CCRPC and the Steering Committee recognize the important contribution and vital impact which small businesses have on the State's economy. In this regard, the CCRPC shall ensure a free and open bidding process that affords all businesses equal access and opportunity to compete, except under circumstances where competitive bidding may not be practicable and is not required by applicable procurement policies. The CCRPC and the Steering Committee also recognize the existence of businesses owned by minorities and women, and the CCRPC shall make a good faith effort to encourage these firms to compete for contracts involving state or federal funds and comply with applicable law relating to civil rights and disadvantaged business enterprises.

8. **Program Services** – The Steering Committee, assisted by the CCRPC and its contractors, shall implement a unified Program that satisfies the relevant requirements of Minimum Control Measure One (Public Education and Outreach) and Minimum Control Measure Two (Public Involvement and Participation) of the MS4 Permit.

   The Program Content for each Program Year shall be as defined in writing by a majority of the Steering Committee. The Program Year shall be the State of Vermont's fiscal year. The Program Content shall implement the following deliverables:

   a. **Public Education and Outreach** – Elements shall include, at a minimum:

      1) operating the Program's website, www.smartwaterways.org, or its equivalent; and

      2) advertising in various media.

   b. **Public Involvement and Participation** – Elements shall include, at a minimum:

      1) operating the Program's website, www.ccstreamteam.org, or its equivalent;

      2) hosting and/or organizing workshops, projects, and other events to engage the public; and

      3) recruiting volunteers to support projects, promote events, and/or engage the public.

   c. **End of MS4 permit year annual reporting** – Elements shall include preparation of a narrative report 25 business days prior to the MS4 Permittees' reporting deadline to DEC.

9. **Program Dues, Budget, Costs, and Payments**

   a. **Dues**

      1) For State Fiscal Year, FY18, July 2017-June 2018, the annual dues for each of the undersigned MS4 Permittees shall be $5,500.

2) For the following fiscal years, the annual dues shall be set by a two-thirds majority by October 15th of the preceding calendar year. In the absence of agreement, the dues shall remain at $5,500.

3) The CCRPC shall invoice each MS4 Permittee on or about July 1st of each year with payment to the CCRPC due 30 days later.

4) All Members shall pay equal dues.

b. **Program Budget**

1) The annual Program Budget shall consist of the sum of the annual payments for each Program Year made by MS4 Permittees, plus any funds from other sources made available to the Program by majority vote of the Steering Committee.

2) Prior to the start of each Program Year, the Steering Committee shall adopt a Program Budget governing expenditures for the subsequent Program Year. Budget categories shall include, but not be limited to: CCRPC Duties, Contractual Services, and Expenses.

3) Once the Program Year starts, a majority of the Steering Committee may amend the Program Budget as needed, for example to reflect any surplus or deficits from the prior Program Year, receipt of new sources of funds, or a desired change in the Program Budget, subject to Section 8.a, above.

4) In the event that costs are less than anticipated or that grants or other funding sources become available, a majority of the voting Members of the Steering Committee may decide to reduce each Member's payment by an equal amount or to credit all or part of the following Program Year assessment to each MS4 Permittee.

c. **Maximum Annual Costs and Payments** – Except as otherwise provided by this section, each MS4 Permittee shall within 30 days of receipt of an invoice make a single annual dues payment, as provided by Section 8.a, above.

d. **Other Funds** – Any funds made available to the Program shall be dedicated to reducing the annual costs of each MS4 Permittee participating in the Program, except as a majority of the voting Members of the Steering Committee may decide.

e. **Excess Funds** – Any funds remaining at the end of a Program Year shall be carried over to the next Program Year, unless a majority of the voting Members of the Steering Committee decides otherwise.

f. **Non-appropriation** – The obligations of each MS4 Permittee to make payments under this Agreement shall constitute a current expense of the MS4 Permittee and shall not in any way be construed to be a debt of the MS4 Permittee in contravention of any applicable constitutional or statutory limitation or requirement, or the MS4 Permittee's charter or articles of incorporation; nor shall anything contained in this Agreement constitute a pledge of the credit or tax revenues, funds, or monies of the MS4 Permittee. The decision whether or not to budget and appropriate funds during each fiscal year of the MS4 Permittee is within the discretion of the governing body

of the MS4 Permittee. The obligations of a MS4 Permittee under the Agreement are subject to annual appropriations by the governing body of the MS4 Permittee, except as provided by Section 12 of this Agreement. An MS4 Permittee cannot choose to not appropriate funds and then withdraw in a manner that shifts prior contractual obligations on to the others. Non-appropriation will be considered withdrawal and must be prospective in fairness to all signatories as per Section 13.

10. **Contract Approval** – All CCRPC contracts shall be conditioned upon approval by a majority of the voting Members of the Steering Committee and shall be consistent with Section 6, above.

11. **Termination of CCRPC** – The CCRPC on its own or the Steering Committee by a majority vote of its full Membership may elect to terminate the CCRPC's future participation in this Agreement by providing 90 days' written notice to the other. In the event of termination under this section, the CCRPC shall continue to administer and comply with each existing contract, and the MS4 Permittees shall continue to reimburse the CCRPC from the Program Budget for the actual costs of administering and complying with each contract, as provided by this Agreement, unless and until the CCRPC assigns the contract pursuant to Sections 5.a.8 and 6.c of this Agreement.

12. **Termination of Agreement**

    a. This Agreement shall become null and void with no further obligation of the parties if:

        1) Two-thirds of the Members of the Steering Committee vote to end participation, or

        2) DEC determines that the Program outlined in this Agreement does not meet the relevant requirements for Minimum Control Measure One (Public Education and Outreach) or Minimum Control Measure Two (Public Involvement and Participation), and the parties to this Agreement are unable to craft a Program to satisfy DEC.

    b. In the event of termination, any funds remaining in the Program Budget (after payment of obligations to vendors or to satisfy debts) shall be reimbursed to the MS4 Permittees with each MS4 Permittee receiving a share proportional to the number of MS4 Permittees at the time of termination. For example, if there are twelve MS4 Permittees at the time of termination, each MS4 Permittee shall receive a $1/12^{th}$ share.

13. **Withdrawal of Member** – An MS4 Permittee may withdrawal from participation in this Agreement only at the end of a state fiscal year. If an MS4 Permittee wishes to withdrawal from participation, it shall provide at least 90 days' notice to the other MS4 Permittees and the CCRPC. After withdrawal, a MS4 Permittee shall remain responsible for its share of the costs of contracts that the Steering Committee approved prior to the effective date of the withdrawal.

14. **Effective Date and Duration of Agreement** – The effective date of this Agreement shall be July 1, 2017, and this Agreement shall terminate June 30, 2022.

15. **Amendment** – This Agreement may be amended only upon unanimous action of all the Members.

16. **Counterparts** – This Agreement may be executed in multiple counterparts, each of which is deemed an original and all of which constitute one and the same document. Each such counterpart may be a facsimile or PDF copy, and such facsimile or PDF copy shall be deemed an original.

17. **Public Records** – Any and all records submitted to the CCRPC or MS4 Permittees - including Bids, Proposals, Qualifications, Contracts, etc.-- whether electronic, paper, or otherwise recorded, are subject to the Vermont Public Records Act.

Signature of CCRPC

_____ 5/17/17

Christopher D. Roy, Board Chair, Chittenden County Regional Planning Commission Date

Signatures of Members

Name	Title	The Burlington International Airport	Date
Name	Title	The City of Burlington	Date
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Title	The Village of Essex Junction	Date
Name	Title	The Town of Milton	Date
Name	Title	The Town of Shelburne	Date
Name	Title	The City of South Burlington	Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission	Date

Signatures of Members

Gene Richards, III	Director of Aviation	The Burlington International Airport	4/21/17
Name	Title		Date
Name	Title	The City of Burlington	Date
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Title	The Village of Essex Junction	Date
Name	Title	The Town of Milton	Date
Name	Title	The Town of Shelburne	Date
Name	Title	The City of South Burlington	Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission	Date

Signatures of Members

Name	Title	The Burlington International Airport	Date
S. Curtis Spaulding	Director DPW	The City of Burlington	6/14/17
Name	Title		Date
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Title	The Village of Essex Junction	Date
Name	Title	The Town of Milton	Date
Name	Title	The Town of Shelburne	Date
Name	Title	The City of South Burlington	Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission	Date

Signatures of Members

Name	Title	The Burlington International Airport	Date
Name	Title	The City of Burlington	Date
Dawn H. Francis	Town Manager		6/16/17
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Title	The Village of Essex Junction	Date
Name	Title	The Town of Milton	Date
Name	Title	The Town of Shelburne	Date
Name	Title	The City of South Burlington	Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission — Date

Signatures of Members

Name — Title — The Burlington International Airport — Date

Name — Title — The City of Burlington — Date

Name — Title — The Town of Colchester — Date

Dennis Lutz — PW Director — The Town of Essex — 2 May 2017

Name — Title — The Village of Essex Junction — Date

Name — Title — The Town of Milton — Date

Name — Title — The Town of Shelburne — Date

Name — Title — The City of South Burlington — Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission	Date

Signatures of Members

Name	Title	The Burlington International Airport	Date
Name	Title	The City of Burlington	Date
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Water Quality Supt	James L. Sutton	4/25/17
	Title	The Village of Essex Junction	Date
Name	Title	The Town of Milton	Date
Name	Title	The Town of Shelburne	Date
Name	Title	The City of South Burlington	Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission	Date

Signatures of Members

Name	Title	The Burlington International Airport	Date
Name	Title	The City of Burlington	Date
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Title	The Village of Essex Junction	Date
Name	Acting Title	The Town of Milton	4/19/17 Date
Name	Title	The Town of Shelburne	Date
Name	Title	The City of South Burlington	Date

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Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission — Date

Signatures of Members

Name — Title — The Burlington International Airport — Date

Name — Title — The City of Burlington — Date

Name — Title — The Town of Colchester — Date

Name — Title — The Town of Essex — Date

Name — Title — The Village of Essex Junction — Date

Name — Title — The Town of Milton — Date

Town Manager — 24. May. 2017

Name — Title — The Town of Shelburne — Date

Name — Title — The City of South Burlington — Date

16. **Counterparts** – This Agreement may be executed in multiple counterparts, each of which is deemed an original and all of which constitute one and the same document. Each such counterpart may be a facsimile or PDF copy, and such facsimile or PDF copy shall be deemed an original.

17. **Public Records** – Any and all records submitted to the CCRPC or MS4 Permittees - including Bids, Proposals, Qualifications, Contracts, etc.-- whether electronic, paper, or otherwise recorded, are subject to the Vermont Public Records Act.

Signature of CCRPC

Chris Roy, Board Chair, Chittenden County Regional Planning Commission	Date

Signatures of Members

Name	Title	The Burlington International Airport	Date
Name	Title	The City of Burlington	Date
Name	Title	The Town of Colchester	Date
Name	Title	The Town of Essex	Date
Name	Title	The Village of Essex Junction	Date
Name	Title	The Town of Milton	Date
Name	Title	The Town of Shelburne	Date
Ken Nom	CITY MANAGER		5/15/17
Name	Title	The City of South Burlington	Date

e-Signed by Joe Flynn
on 2017-05-30 16:22:21 GMT

Joe Flynn, Secretary of Transportation, Vermont Agency of Transportation — May 30, 2017 Date

Linda Seavey, Director, Campus Planning Services, The University of Vermont — Date

Name — Title — The Town of Williston — Date

Name — Title — The City of Winooski — Date

Joe Flynn, Secretary of Transportation, Vermont Agency of Transportation — Date

Linda Seavey, Director, Campus Planning Services, The University of Vermont — Date 5.24.17

Name — Title — The Town of Williston — Date

Name — Title — The City of Winooski — Date

Joe Flynn, Secretary of Transportation, Vermont Agency of Transportation	Date
Linda Seavey, Director, Campus Planning Services, The University of Vermont	Date
Richard McGuire Town Manager The Town of Williston	6/5/17 Date
Name Title The City of Winooski	Date

Joe Flynn, Secretary of Transportation, Vermont Agency of Transportation	Date
Linda Seavey, Director, Campus Planning Services, The University of Vermont	Date
Name Title The Town of Williston	Date
Jessie Baker City Manager Name Title The City of Winooski	5/2/17 Date

Attachment C VTrans Bridge Washing Best Management Practices and VT ANR Vehicle Washing policy
December 5, 2017

ATTACHMENT C VTRANS BRIDGE WASHING BEST MANAGEMENT PRACTICES AND VT ANR VEHICLE WASHING POLICY

State of Vermont
Operations Division
Web: http://www.aot.state.vt.us/maint/Operations.htm

Agency of Transportation
One National Life Drive – Dewey Bldg
Montpelier, VT 05633-5001

Best Management Practice: **"BRIDGE WASHING"**

Effective Date: **5/1/2013**

VTrans Authorized Signature: *Scott A. Rogers*

Director, Operations Division

VTRANS STATE HIGHWAY SYSTEM
BRIDGE WASHING
BEST MANAGEMENT PRACTICES (BMPS)

PURPOSE STATEMENTS

Washing bridges is a preventative maintenance task performed on a recurring basis in order to protect bridge decks, components and superstructure against corrosive effects of chlorides, de-icing chemicals and the accumulation of sand on bridge surfaces throughout the winter.

The VTrans State Highway System Bridge Washing BMP guides maintenance activities in order to:

- Define appropriate level of service and performance expectations;
- Maintain safe bridges for the traveling public and bridge maintenance employees;
- Prevent infrastructure deterioration, extend useful life and provide for a better functioning structure;
- Comply with VTrans Policy and Federal or State rules and regulations;
- Reduce Cost (water consumption, energy, equipment and personnel costs);
- Protect water quality and aquatic wildlife habitats;
- Create mechanisms and standards for addressing environmentally sensitive areas;
- Preserve the scenic qualities of the highway corridor.

GUIDING PRINCIPLES

These BMPs have several guiding principles:

- VTrans Bridge Washing Policy;
- State and Federal Regulatory Requirements;
- Create consistent requirements throughout the state that protects water quality;
- Preserve the scenic qualities of the corridor to the extent practicable, while maintaining environmental stewardship and conserving resources.

LEVEL OF SERVICE & PERFORMANCE EXPECTATIONS

Sweep 100% and wash 50% of all bridges annually in the Spring. It is expected that all bridges will be washed at least every other year and that bridge washing operations are compliant with all applicable Safety and Environmental Regulations. Annual Trainings shall be provided to VTrans Maintenance Personnel directly involved in bridge washing activities.

GENERAL STANDARDS

These standards are applicable only to bridges on the VTrans State Highway System, are subject to the conditions and exceptions noted below and are intended to be implemented to the extent reasonable and practicable when not otherwise required by rule, regulation or law. Bridge washing operations shall not violate any written VTrans Policy or State/Federal Rule, Regulation or Permit.

The VTrans District Transportation Administrator (DTA) or its designee must ensure compliance with all VOSHA standards and the Manual for Uniform Traffic Control Devices (MUTCD) by use of contract language and safety plan review meetings with contractors or VTrans personnel. Items to be addressed in addition to VOSHA and MUTCD standards should include, but are not limited to, equipment loading, storage, and access plans; safety plans for working over water; traffic control and mobile operations sign planning, and protection of personnel, infrastructure, and the traveling public.

TARGET AUDIENCE

These BMPs are primarily intended for VTrans Operations Division. In addition, these BMP's may also be applicable to municipally managed structures and Municipal bridge maintenance crews.

Municipalities may wish to refer to these standards and implement the practices mentioned herein. VTrans will not be responsible for monitoring Municipal performance nor compliance under these standards and practices, but may serve as a technical resource for Municipalities regarding the implementation of these practices.

POLICY & REGULATORY REQUIREMENTS

VTrans Policy and State/Federal Regulations will dictate how, where and when these BMSs are applied and to what performance level. The BMPs noted herein are directed at addressing these requirements.

- VTrans Bridge Washing Policy (Attachment A) – applicable statewide
  Requirements have statewide implications and include but are not limited to:
  - Removal and proper disposal of sand, debris and other material from bridge deck prior to use of water to clean bridge surface.
  - Water used to flush salts and de-icing chemicals from the bridge must come from a water source which has no potential to harm the receiving water body.
  - Minimize impact to the receiving waters when washing bridge seats, pier caps, diaphragms and any other superstructure (steel) components of the bridge.

- "Transport of Aquatic Plants and Other Nuisance Species" V.S.A Title 10 Chapter 50 Section 1454 http://www.leg.state.vt.us/statutes/fullsection.cfm?Title=10&Chapter=050&Section=01454 (Attachment B) – applicable statewide.
  On July 1, 2010 the then 22-year old law was amended prohibiting:
  - Transport of any invasive aquatic species in Vermont. Specifically, the law prohibits transport on the outside of boats, personal watercraft, trailer or other equipment. That means the outside of an intake hose on any pump or water truck and any pump equipment used by VTrans to get water from natural water bodies. This is a law that has statewide jurisdiction and may require:
    - Avoid taking water from document water bodies that are known to have aquatic invasive species http://www.anr.state.vt.us/dec/waterq/lakes/docs/ans/lp_transportlaw2010.pdf
    - Drawing water from nearby municipal water supplies or stand pipes installed by various fire districts or other clean/non-contaminated water source.
    - Clean off any equipment used for "working over water" safety programs before moving to next bridge.

- Vermont Water Quality Standards in effect or as may be amended and are applied statewide. http://www.nrb.state.vt.us/wrp/rules.htm

- Federal Clean Water Act – National Pollutant Elimination System – Municipal Separate Storm Sewer System (MS4) General Permit – applicable in designated MS4 areas.
  - Districts with bridges in MS4 areas are **NOT** allowed to discharge bridge deck washing water into waster bodies subject to MS4 Permit requirements. The list of waters is noted on ANR's web site (link below) and is subject to change. This is a regulation that has limited geographical jurisdiction in the state that can and does change periodically. See the Agency of Natural Resources MS4 Map: http://www.vtwaterquality.org/stormwater/docs/ms4/sw_MS4_map.pdf

- Federal Migratory Bird (MBTA)/Bald & Golden Eagle Protection Act and Endangered Species Act – applicable statewide. Both Federal programs are intended to protect species of concern.

  The MBTA provides that it is unlawful to pursue, hunt, take, harass, capture, kill, possess, sell, purchase, barter, import, export, or transport any migratory bird, or any part, nest, or egg or any such bird, unless authorized under a permit issued by the Secretary of the Interior. Some regulatory exceptions apply. Take is defined in regulations as: "pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect." The Bald/Golden Eagle Act is extremely comprehensive, prohibiting the take, possession, sale, purchase, barter, or offer to sell, purchase, or barter, export or import of the bald or Golden eagles at any time or in any manner.
  http://www.fws.gov/migratorybirds/mbpermits/ActSummaries.html

  The migratory bird species protected by the Act are listed in 50 CFR 10.13. View the list of MBTA protected birds and Migratory Bird Program Rule at http://www.fws.gov/migratorybirds/index.html.

  The Endangered Species Act (ESA) and the Vermont Rare, Threatened, and Endangered Species Rules (VRTER) are designed to regulate a wide range of activities affecting animals designated as endangered or threatened, and the habitats upon which they depend. With some exceptions, the ESA and VRTER prohibits taking and other activities affecting these protected species and their habitats unless authorized by a permit. Permitted activities are designed to be consistent with the conservation of the species. Take - From Section 3(18) of the Federal Endangered Species Act means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.
  http://www.fws.gov/endangered/species/index.html and
  http://www.vtfishandwildlife.com/cwp_elem_spec_rte.cfm

  Contact VTrans Program Development Environmental Program Staff Biologist or the Vermont Department of Fish & Wildlife (links below) if you find a nest with or without eggs or young and if you feel you have a rare, threatened or endangered species present (ie. Bats or other listed species using the bridge has habitat). Be advised, you may be instructed to avoid disturbing the nest and to wash areas around the nest, leaving the nest undisturbed.
  http://vtransengineering.vermont.gov/sections/environmental/natural_resources and
  http://www.vtfishandwildlife.com/cwp_contact_us.cfm

- Highway Safety – applicable statewide
  The DTA or its designee must ensure compliance with all VOSHA standards and the Manual for Uniform Traffic Control Devices (MUTCD) by use of contract language and safety plan review meetings with contractors or VTrans personnel. Items to be addressed in addition to VOSHA and MUTCD standards should include, but are not limited to, equipment loading, storage, and access plans; safety plans for working over water; traffic control and mobile operations sign planning, and protection of personnel, infrastructure, and the traveling public.

BRIDGE WASHING PROCEDURES & BEST MANAGEMENT PRACTICES

1. **Prepare for and set up a work plan** for each bridge site addressing, among other things:
   a. Traffic control, fall protection, working over water plan, and other MUTDC/VOSHA requirements.
   b. Location of bridges to be washed and acknowledgement of higher standards if located in a designated MS4.
   c. Consider proximity of bridge to various clean bridge washing water sources (even sources on route),
   d. Consider presence of invasive/nuisance aquatic plants/organisms in local surface water sources;
   e. Consider presence of bird nests or other protected species and complete coordination with the VTrans Program Development Environmental Section's Staff Biologist or Vermont Department of Fish & Wildlife prior to disturbing any nests, birds or other protected species. Bridge washing between April 1 and August 1 is more likely to encounter birds and nesting. Bridge Maintenance Crews that experience recurring bird use, nesting or use by rare, threatened or endangered species may want to consider installing deterrents on that specific bridge.

2. **Identify appropriate water source** for bridges scheduled for washing:
   a. Check for local sources of fresh/clean water and if considering using a local water body as source, check Agency of Natural Resources (ANR) web site for presence of aquatic invasive/nuisance species. If the surface water body intended for use to fill the tanker truck is or is suspected of carrying aquatic invasive/nuisance species then that water body SHALL NOT be used and an alternate clean water source will need to be found, most likely municipal.
   b. When considering water sources, first consideration is to use a clean untreated or de-chlorinated water source from a municipal supply, second from fire stand pipe in the same watershed as the bridge scheduled for washing, and final last option is from a water body under bridge being washed or in the same watershed if the bridge is not over waters and those water bodies are not known or suspected of carrying aquatic invasive/nuisance species.
   c. If the only available option is to us a surface water body to fill a water tanker truck first inspect all hoses, pipes, pumps that will come in contact with the water for any plant material or mud prior to putting this equipment into the water….remove any materials if found and properly dispose of the plant material. Proper disposal means bagged and disposed of in trash receptacle. After pumping is completed, inspect again and remove plant materials and mud if any are found before moving on to the next bridge. Empty tanker truck of all water taken up from surface water body before moving onto the next bridge.
      i. **Inspect** and clean off any aquatic plants, animals, and mud from all equipment before leaving bridge location where water was drawn from.
      ii. **Drain** pumps, hoses and all other water containing devices.
      iii. Dispose of unused water on location if source of water is from non-municipal supply.
      iv. Never dump live fish, vegetation or other organisms from one water body into another.

      The intent of these actions is to clean off any visible large-bodied organisms attached to equipment. Draining can also remove small organisms such as zebra mussel veligers, however, additional steps are needed to remove small-bodied organisms from other parts of the equipment. Those can be easily rinsed off or die out of water in a short period of time. To this end, added precautions that improve treatment effectiveness are to:
      i. **Spray/rinse** equipment with high pressure hot water to clean off mud and kill aquatic invasive species,
      ii. **Flush pump** motor according to owner's manual, and/or
      iii. **Dry** everything for at least five days before reuse or **wipe** with a towel before reuse.
   d. If a surface water body is used as bridge washing water source the pipes/hoses used to withdraw water shall be screened to prevent fish entrainment and to help prevent uptake of vegetation.

3. **Prior to washing bridge surface**, the following activities will be completed:
   a. Sweep sand, debris and deicing chemical contaminated sediment from the bridge.
   b. Sweepings will be removed by hand using shovels, wheelbarrows or bobcat buckets and placed off the roadway shoulder. Larger amounts of sweepings will be spread out along roadway shoulder after trash and larger debris has been removed for proper disposal. Sweepings can also be trucked back to Maintenance Yard and added to sand pile for future re-use (again after trash and larger debris has been removed and properly disposed of). Sweepings will not be swept into open deck drains or over the edge of the bridge.
   c. Prior to washing bridge surfaces, all scuppers and other drains will be blocked with unbroken sand bags to prevent accidental discharge of wash water to surface waters under bridge or onto roadway below bridge.
   d. Brush and vegetation may need to be removed from around wings abutments and piers. Any vegetation management in river buffers should follow the VTrans Riparian Tree and Brush Cutting BMP. http://vtransoperations.vermont.gov/bmp
   e. Invasive terrestrial (plant) species encountered and in need of removal should be managed per the VTrans Invasive Species BMP. http://vtransoperations.vermont.gov/bmp

4. **Prior to washing bridge superstructure**, the following activities will be completed:
   a. If nests are found while on-site working or if you feel you may have a rare, threatened or endangered species present (ie. Indiana Bat or other listed species using the bridge has habitat), contact Vermont Department of Fish & Wildlife http://www.vtfishandwildlife.com/wildlife_nongame.cfm or VTrans Environmental Biologist http://vtransengineering.vermont.gov/sections/environmental/natural_resources.
   b. If bird nests are present they must not be disturbed. Bridge washing operations may proceed so long as nests and birds can be avoided and left undisturbed.
   c. If rare, threatened or endangered species are suspected or are present, Bridge Maintenance Crews must contact VTrans Environmental Biologist or Vermont Department of Fish & Wildlife to confirm species and secure guidance on how to proceed before bridge washing operations commence on that specific bridge.

5. **Washing the bridge surface and superstructure** will follow these procedures:
   a. Water hose nozzles will be aimed to minimize overspray into surface waters or roads below bridge.
   b. Limit psi when washing steel bridge components so as to avoid the accidental dislodging of paint which might end up in the water body beneath the bridge. Pressure washing equipment shall be operated at pressures that do not damage the paint or other coatings on the bridge or undercut the grout or harm the masonry plates beneath the bearings.
   c. Water will be aimed along the curb line to wash any accumulated sand/salt towards the bridge down slope.
   d. Washing will include bridge joints, finger joint troughs, bridge shoe and seats and any bridge components that are within the splash zone.
   e. To the extent practicable, washing of bridges will be scheduled on structures over waterways during the springtime to coincide with high-flow periods or during other high-flow periods following storm events.
   f. Any bridge deficiencies should be repaired or noted and added to the work schedule.
   g. **Bridge deck washing in designated MS4** – All bridge drainage systems shall be blocked during surface washing and to the extent practicable, residual wash water will be diverted to upland areas (i.e. over embankments into vegetated areas or into catch basins) so that sediments may settle out prior to reaching the waterway. Water washed over a vegetated area must not cause scour or contribute to sedimentation of the waterway. This is an absolute requirement in MS4 designated watersheds.
   h. **Bridge deck washing in designated MS4** - REPORT within 5 business days, to VTrans Operations Environmental Program Stormwater Technician any accidental discharges to water bodies and corrective measures taken to cease the discharge and prevent additional discharges.
   i. Clean off any equipment used for "working over water" safety programs before moving to next bridge.

USEFUL LINKS

VTrans Bridge Washing Policy
https://inside.vermont.gov/agency/vtrans/VTransIntranetHome/Ops/Policy%20and%20Procedures%20Manual/BridgeWashing3011.pdf

VSA Title 10 – Aquatic Plants & Aquatic Invasive Species Transport Law
http://www.vtwaterquality.org/lakes/htm/ans/lp_ans-index.htm
http://www.anr.state.vt.us/dec/waterq/lakes/docs/ans/lp_transportlaw2010.pdf

ANR Aquatic Invasive Species Site (Map)
http://www.vtwaterquality.org/lakes/docs/ans/lp_aismapmajorspecies2011.pdf#zoom=100
http://www.vtwaterquality.org/lakes/docs/ans/lp_infestedwaterbodieslist.pdf

Migratory Bird Treaty Act & Bald/Golden Eagle Protection Act
http://www.fws.gov/migratorybirds/index.html
View the list of MBTA protected birds
http://www.fws.gov/migratorybirds/mbpermits/ActSummaries.html

Federal Endangered Species Act
http://www.fws.gov/endangered/species/index.html

Vermont Rare, Threatened, and Endangered Species
http://www.vtfishandwildlife.com/cwp_elem_spec_rte.cfm

State of Vermont DEC - EPA NPDES – State MS4
http://www.vtwaterquality.org/stormwater/htm/sw_ms4.htm

Map of designated MS4's
http://www.vtwaterquality.org/stormwater/docs/ms4/sw_MS4_map.pdf

VT Water Quality Standards
http://www.nrb.state.vt.us/wrp/rules.htm

VTrans Training PowerPoint (most recent posted on VTrans Web Site)
http://vtransoperations.vermont.gov/bmp

OSHA
Contact VTrans Safety Officer
http://vtransoperations.vermont.gov/technical_services/occupational_safety

VTrans Safety Site (working over water, etc)
Contact VTrans Safety Officer
http://vtransoperations.vermont.gov/technical_services/occupational_safety

VTrans Riparian Tree & Brush Cutting BMP
http://vtransoperations.vermont.gov/bmp

VTrans Invasive Species BMP
http://vtransoperations.vermont.gov/bmp

Operations Division Vermont Agency of Transportation	Original Policy Adopted Date: N/a	Original Identification No. 05-MOP--3011
Policy and Procedures Manual	Responsible Section: Maintenance Districts	Policy Name: Bridge Washing
Subject: Training	Approval Date: 11/29/2005	Page(s) 1 of 1

Statutory Reference / Other Authority: Federal and state rules and regulations, and the Manual on Uniform Traffic Control Devices (MUTCD)

Approved by: **Samuel B. Lewis, Director of Operations**

BRIDGE WASHING

Purpose:

Bridge preventive maintenance is critical in extending the life of bridges. Decks, seats, pier caps and troughs need to be periodically cleaned of debris and salt residue. Over the winter, sand and debris accumulate along the deck /curbing interface, as well as on abutments or pier caps, allowing a perfect medium for residual salt to penetrate to the reinforcing steel and cause deterioration of both the steel and structural concrete. It is important that the process of removing of the sand and debris is accomplished early in the spring and in a manner that does not harm the environment or violate state or federal regulations.

Policy:

Sand, debris, and other material must be removed from the bridge deck prior to the use of pressure water which will remove the salt latents from the deck/curbing interface. Appropriate removal of material can be accomplished with hand tools and power or hand brooms. All removed material must be deposited in an area which will not affect the river, brook or other body of water crossed by the bridge. Generally, an appropriate place for depositing the material can be found along the approaches of the bridge. **No foreign material can be deposited over the side of the bridge rail, even if it is not directly over water!**

Water used to flush the salt latents from the deck must come from a source which has no potential to harm the receiving water body. Scuppers will need to be sand bagged or plugged if they have a direct route to the body of water crossed by the bridge.

Care needs to taken when washing bridge seats, pier caps, and diaphragms to minimize any impact on the receiving water.

Traffic control shall follow the guidance provided in the MUTCD.

It is expected that bridges will be washed at least every other year.

Law Prohibits the Transport of Aquatic Plants and Aquatic Invasive Species in Vermont

Invasive species such as Eurasian watermilfoil and zebra mussels are typically spread by "hitchhiking" on boat trailers, propellers and fishing gear that isn't cleaned, or in bilge water, bait buckets, or livewells that aren't drained before moving to a different water body. It often takes only a tiny fragment of an invasive plant, sometimes less than an inch, to start a whole new infestation.

On July 1, 2010, Vermont's 22-year old law prohibiting the transport of important aquatic invasive species changed. Previously, the law prohibited the transport of the invasive plants Eurasian watermilfoil and water chestnut. Come July 1, Vermont's invasive species transport law **prohibits the transport of *all* aquatic plants or aquatic plant parts** on the outside of a vehicle boat, personal watercraft, trailer or other equipment.

The law defines an aquatic plant as " …a plant that naturally grows in water, saturated soils or seasonally saturated soils, including algae and submerged, floating leafed, floating, or emergent plants."

The law change means both the public and those who enforce the law will not have to know how to distinguish one type of aquatic plant from another.

Vermont's invasive species transport law also will continue to prohibit the transport of two animal species, zebra mussels and quagga mussels.

The full law is available here.

A person who violates this law may be subject to a penalty of up to $1,000 per violation (Vermont Statutes Annotated Title 23, Chapter 29 § 3317. Penalties).

More information

- Click here for the full text of Vermont's aquatic invasive species transport law.
- For more information on aquatic invasive species, visit the VT Water Quality Division Web site at http://www.vtwaterquality.org

Attachment D VTrans Flow Restoration Plan
December 5, 2017

ATTACHMENT D VTRANS FLOW RESTORATION PLAN

(Appendices for FRP have been included as a separate attachment)

VTrans
Flow Restoration Plan

MS4 GENERAL PERMIT REQUIREMENT (IV.C.1)

June 1, 2017

Prepared for:
Jennifer Callahan
Vermont Agency of Transportation
Maintenance & Operations Bureau
Highway Division
Dewey Building. One National Life Drive.
Montpelier, VT 05633

Prepared by:
Watershed Consulting Associates, LLC
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Burlington, Vermont 05406
P: 802.497.2367

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A. Disclaimer

The intent of this plan is to present the data collected, evaluations, analysis, designs, and cost estimates for the Vermont Agency of Transportation (VTrans). This document provides information for stormwater retrofit projects proposed to meet VTrans flow restoration obligations in watersheds subject to a Flow Restoration Plan (FRP) under the National Pollutant Discharge Elimination System (NPDES) General Permit 3-9014 (VTDEC 2012). This plan should be considered to be the regulatory document for VTrans to meet FRP obligations under General Permit 3-9014. If VTrans is included in FRPs submitted by other MS4s, the information contained in this plan should supersede that information. In addition, retrofit projects identified in this plan have not been fully assessed for feasibility or completely design. The work completed has been done at a planning level, and will be subject to change based on site conditions, permitting, budgetary constraints and other unforeseen issues.

B. Executive Summary

This Flow Restoration Plan (FRP) for the 10 stormwater impaired watersheds where the Vermont Agency of Transportation (VTrans) owns impervious cover was developed in accordance with requirements in the Municipal Separate Storm Sewer System (MS4) General Permit #3-9014 (2012). Components of this FRP include the identification of retrofits to existing BMPs, identification of new BMP controls, an implementation schedule, a financial plan, and a regulatory analysis. Once approved by the Vermont Department of Environmental Conservation (VT DEC), this FRP will become part of the Stormwater Management Plans (SWMP) for VTrans for these watersheds. The purpose of the FRP is to provide a planning tool for VTrans to implement stormwater BMPs over a 20-year timeframe from the date of permit issuance (December 2012) in the effort to restore these impaired watersheds to their attainment conditions.

Vermont developed Total Maximum Daily Load (TMDL) documents for these stormwater impaired watersheds using flow as a surrogate for pollutant loading. The basis for the TMDL development was the comparison of modeled Flow Duration Curves (FDCs) between impaired and attainment watersheds. The Program for Predicting Polluting Particles Passage through Pits, Puddles, and Ponds, Urban Catchment Model (P8) was used to model gauged and ungauged watersheds in Vermont and develop Flow Duration Curves (FDC) from which a normalized high flow and low flow per drainage area (cfs/mi^2) were extracted. An FDC is a curve displaying the percentage of time during a period that flow exceeds a certain value, with the "low" flow represented by the 95^{th} percentile (Q 95%) of the curve and the "high" flow represented by the 5^{th} percentile (Q 0.3%). The high and low flow values from the FDCs were then compared between impaired watersheds and similar attainment watersheds to determine a percent change (reduction of high flow and increase of low flow). In addition to the modeled flows, future non-jurisdictional growth predictions were made for each watershed and used to predict the flow reductions needed 20 years in the future. The percent change was reported in the Environmental Protection Agency (EPA) approved TMDL for each impaired watershed. In certain watersheds, the future growth prediction was modified as it was deemed excessive based on further review. The flow targets were modified in three watersheds to account for these changes.

The TMDLs for the 10 watersheds discussed in this report were approved between 2006 and 2009. They require high flow reductions ranging by watershed from 1.3% in Indian Brook to 63.0% in Centennial Brook. The TMDLs also suggest an increase in stream flow during base flow conditions. These range by watershed from 1.1% in Indian Brook to 24.3% in Stevens Brook.

As a part of the FRP development, an assessment was completed to determine to what extent current stormwater controls have reduced high flows from the Pre-2002 condition to the current (Post-2002) condition. The Vermont Best Management Practice Decision Support System (BMPDSS) model, a GIS-based hydrologic model used to assess the impact of various stormwater Best Management Practice (BMP) scenarios, was used for the assessment. The

model was created by VT DEC and its partners as part of the initial TMDL development. By watershed, the BMPDSS estimated that between 3.8% (Stevens Brook) and 213.8% (Sunderland Brook) of the total high-flow reduction target was met with existing BMPs designed to meet the Vermont 2002 Stormwater Design Standards when compared to the Pre-2002 condition. The reduction for the VTrans portion of the impervious area ranged from 0% in Centennial Brook and Moon Brook to 377.4% in Sunderland Brook, averaging 49.7% per watershed. In all watersheds except Sunderland Brook, additional BMPs are required to meet 100% of the actionable flow target.

For Sunderland Brook, even though modeled flow targets for the Post-2002 condition model exceeded TMDL flow targets, additional BMPs were also identified for potential future implementation. The MS4 entities are not required to implement any new stormwater controls under the MS4 permit requirement IV.C.1. However, the FRP document provides the MS4s with a list of possible projects that could be constructed in the event that future biomonitoring of the stream reveals non-compliance with Vermont water quality standards.

After the existing model scenarios were reviewed, new BMPs were identified, inspected, and assessed in the BMPDSS. The final proposed BMP list includes 54 projects—31 median filters, 12 detention basins, 5 gravel wetlands, 4 underground detention systems, and 2 infiltration systems. There are also several additional projects in most watersheds that manage minimal amounts of VTrans owned impervious areas, but these projects are not considered to be the responsibility of VTrans to implement and are thus not detailed in this document.

By watershed, the BMPDSS estimated that between 25.9% (Moon Brook) and 482.4% (Sunderland Brook) of the total high-flow target was met with the proposed BMP scenario (Credit model). The high flow reduction target met for the VTrans portion of each watershed ranged from 43.7% in Potash Brook to 847.3% in Sunderland Brook, averaging 201.9% per watershed (Appendix D). VTrans flow reduction targets were met at over 100% in six of the 10 watersheds. Although the VTrans portion of the high flow target was not met fully in the remaining four watersheds, the proposed BMP implementation plan presented represents the most feasible and effective watershed-wide approach to meeting flow reduction targets. The planning level cost for implementation of the 54 BMPs presented in this FRP is $6,871,000.

A ranking was developed to prioritize the proposed projects based on the percentage of VTrans impervious area managed, runoff channel protection volume storage, VTrans high flow target managed, and cost. The ranking is a tool for VTrans to use to prioritize projects for implementation (Appendix F). The prioritization was also used to aid in the development of a Design and Construction Schedule (D&C), for long term implementation of the plan.

C. Background

The purpose of the FRP is to outline a plan for the retrofit of existing unmanaged VTrans impervious cover with stormwater BMPs to meet the VTrans allocated portion of the TMDL

flow targets. The modeled high-flow (Q 0.3%) included flows occurring less than 0.3% of the time, determined to be relatively equivalent to the 1-year design storm flow. As such, BMPs are designed to Channel Protection volume (CP_v) storage standard to address the high-flow reduction target. These BMPs can include detention basins, bioretention filters, infiltration basins, and other management strategies. The TMDLs set forth that watershed hydrology must be controlled in each of the stormwater impaired watersheds to reduce high flow discharges and increase base flow in order to restore degraded water quality and achieve compliance with the Vermont Water Quality Standards.

The 10 stormwater impaired watersheds analyzed in this FRP are primarily located in Chittenden County. Stevens Brook and Rugg Brook are located in Franklin County, and Moon Brook is located in Rutland County. Watersheds range in size from 751 acres to 6230 acres, with impervious area covering from 6% to 31% of these watersheds and averaging 16% coverage by watershed (Table C1). Each of these watersheds requires a collaborate effort to meet flow reduction targets as each has impervious area owned by a minimum of two and a maximum of five MS4 entities. VTrans impervious cover makes up between 0.5% (Moon Brook) and 16% (Rugg Brook) of the total impervious cover within each watershed.

Table C 1 Watershed characteristics for each of the 10 watersheds assessed in this FRP

Watershed Name	Total Watershed Area (acres)	Total Impervious Cover (acres)	Total Impervious Cover (%)	VTrans Impervious Cover (acres)	VTrans Impervious Cover (% of Total Impervious Cover)	MS4 Impervious Owners
Allen Brook	6230	401	6%	49	12%	Williston, VTrans
Bartlett Brook	751	138	18%	5	4%	Town of Shelburne, South Burlington, VTrans
Centennial Brook	879	270	31%	13	5%	UVM, BTV, South Burlington, VTrans, Burlington
Indian Brook	4587	410	9%	31	8%	Town of Essex, Village of Essex Junction, VTrans
Moon Brook [1]	5032	503	16%	2	0.5%	Rutland City, Rutland Town, VTrans
Munroe Brook	3468	270	8%	13	5%	Shelburne, VTrans, South Burlington
Potash Brook	4510	924	20%	76	8%	UVM, BTV, South Burlington, VTrans, Burlington
Rugg Brook	1759	205	12%	32	16%	St. Albans City, St. Albans Town, VTrans

Stevens Brook	1735	309	18%	21	7%	St. Albans City, St. Albans Town, VTrans
Sunderland Brook	1426	314	22%	10	3%	Town of Essex, Village of Essex Junction, Town of Colchester, VTrans

[1] Summaries included in this table include area within the Town of Mendon despite the fact that this town is not an MS4 community. Later tables exclude this area.

D. Allen Brook

1. Allen Brook TMDL Flow Targets

In the effort to restore Allen Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and suggested increases in stream low or base flows (Q 95%). These flow targets (Table D1) serve as the basis for this section (Section D) of the Flow Restoration Plan (FRP).

Table D 1 Allen Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-3.3%	**7.4%**

In Table D1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. The VT DEC, in cooperation with the Town of Williston, estimated a future growth of 35 acres in the watershed based on local development and projected growth for Allen Brook. The approved TMDL flow targets for Allen Brook are shown in Table D1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

Approximately 87.7% of the impervious cover in the Allen Brook Watershed is within the town of Williston and the remaining 12.3% is owned by VTrans (Table D2). The TMDL flow targets were allocated to each MS4 based on their impervious ownership where the town of Williston is responsible for a 2.89% high flow reduction and VTrans is responsible for a 0.41% high flow reduction.

Table D 2 Allen Brook flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
Williston	6013.2	351.3	87.7%	-2.89%	6.49%
VTrans	217.2	49.3	12.3%	-0.41%	0.91%
Watershed Total	**6230.4**	400.6		**-3.30%**	**7.40%**

2. Allen Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. Both the Post-2002 and Credit models are compared to the Pre-2002 model on a percent change basis to determine changes in high and low flows.

2.1. BMPDSS Pre-2002 Model

The VT DEC developed a Pre-2002 condition model for Allen Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The VT DEC also developed a Post-2002 or existing condition model for the watershed. This model scenario included all known existing BMPs designed to the VT Stormwater Standards and providing credit toward the flow target. The Allen Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place managing the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 3.3% in the watershed, current BMPs reduced high flows by 0.29%, which equates to 8.8% of the total required flow reduction (Table D3). Of that reduction, 2% of the VTrans allocation was addressed, reducing high flows by 0.01% of the 0.41% required reduction. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow reduction target.

Table D 3 Allen Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
Williston	-2.89%	-0.28%	-2.61%	9.7%
VTrans	-0.41%	-0.01%	-0.40%	2.0%
Watershed Total	**-3.30%**	**-0.29%**	**-3.01%**	**8.8%**

3. Allen Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final modeled BMP list used for the BMPDSS Credit run included 13 proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 111.2% of the high-flow target, providing a factor of safety. The Credit model showed a high flow reduction of 0.34% for the

VTrans allocation for the Allen Brook Watershed, which equates to 84% of the total VTrans required high flow reduction (Table D4). Progress was not made towards the increase in stream low flow. Although this plan does not address 100% of the VTrans high flow allocation, the proposed scenario was determined to be the most feasible watershed-wide plan.

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table D4.

Table D 4 Allen Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
Williston	-2.89%	-3.33%	0.43%	115.0%
VTrans	-0.41%	-0.34%	-0.06%	84.0%
Watershed Total	**-3.30%**	**-3.67%**	**0.37%**	**111.2%**

3.2. VTrans Proposed BMPs

There are 13 proposed VTrans BMPs summarized in Table D5 and further described in Appendix B (see Appendix A for a map of all 13 BMPs). Of the 13 proposed BMPs, 12 were designed as median filters between the northbound and southbound lanes of I-89. Each of these BMPs manage impervious area entirely owned by VTrans and treats that impervious area on VTrans owned property. CPv will be retained in the swale system and Water Quality Volumes (WQv) will be captured and filtered through the subsurface sand media prior to discharge to the underdrain. WCA-1, WCA-4, and the Town Office BMPs provide overbank flood protection and will either be partially retained and infiltrated or partially bypassed through a raised outlet structure. Extreme storm events will pass safely through the system. It is not possible to accommodate the recharge volume in the median without compromising the interstate select gravel subbase.

The remaining VTrans BMP consists of a retrofit of the existing detention pond at the Williston Rest Area. The rest area was developed by the Vermont Department of Buildings and General Services through a land lease from VTrans. As such, implementation of this BMP will need to be a collaborate effort. As proposed, the pond design is in full compliance with the CPv requirement. Additionally, the design ensures that the 1-year 24-hour storm is released over 24 hours as the pond appears to drain to a wetland area, and thus a warm water habitat. The

calculated CPv based on the modeling analysis is 29,172 cf. The 10-year storm peak discharge will be reduced by 30% and the pond will provide adequate free board and safely pass the extreme storm events (100-year storm). The pond retrofit does not address groundwater recharge, though recharge is currently provided on site via grass swales and vegetated disconnections.

The remaining 6.5 acres of managed VTrans impervious cover is managed by 9 additional BMPs. While these BMPs manage small amounts of VTrans impervious area, they are not determined to be the responsibility of VTrans to implement.

The percent of the high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 84% of the VTrans high flow target was met by these proposed BMPs. The single largest contributor to this target attainment was the Williston Rest Area pond retrofit, which met 23.8% of the VTrans high flow target. The median filters contribute additional progress towards the high flow target. All 13 BMPS are summarized in Table D5. This table includes the impervious cover managed, drainage area, and CPv storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B. Preliminary design concept plans for the Town Office and the WCA-1, -2, -3, and -4 projects can be found in Appendix H-1.

Table D 5 VTrans final proposed BMPs for the Allen Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Rest Area Pond Retrofit	VTrans / Town	VTrans	Detention Basin	NP	26.8	4.4	16.5%	4.4	100%	0.670	23.8%	$158,000
Town Office	VTrans	VTrans	Median Filter	NP	2.2	0.4	16.6%	0.4	100%	0.061	2.0%	$32,000
WCA_1	VTrans	VTrans	Median Filter	NP	4.2	0.7	16.1%	0.7	100%	0.175	3.7%	$92,000
WCA_2	VTrans	VTrans	Median Filter	NP	2.5	0.4	17.3%	0.4	100%	0.043	2.3%	$25,000
WCA_3	VTrans	VTrans	Median Filter	NP	2.3	0.6	23.9%	0.6	100%	0.030	3.0%	$25,000
WCA_4	VTrans	VTrans	Median Filter	NP	3.3	0.7	21.8%	0.7	100%	0.101	3.8%	$53,000
VTrans Median A	VTrans	VTrans	Median Filter	NP	1.3	0.3	23.6%	0.3	100%	0.116	1.6%	$60,000
VTrans Median B	VTrans	VTrans	Median Filter	NP	0.7	0.2	28.7%	0.2	100%	0.078	1.1%	$41,000
VTrans Median E	VTrans	VTrans	Median Filter	NP	1.2	0.3	25.6%	0.3	100%	0.084	1.6%	$44,000
VTrans Median F	VTrans	VTrans	Median Filter	NP	1.1	0.2	18.9%	0.2	100%	0.085	1.1%	$44,000
VTrans Median G	VTrans	VTrans	Median Filter	NP	1.5	0.3	20.6%	0.3	100%	0.117	1.7%	$61,000

VTrans Median H	VTrans	VTrans	Median Filter	NP	1.3	0.2	18.9%	0.2	100%	0.113	1.3%	$59,000
VTrans Median I	VTrans	VTrans	Median Filter	NP	1.7	0.4	22.2%	0.4	100%	0.134	2.0%	$70,000
Other non-VTrans dominated BMPs	*Town/ VTrans*	*Non-VTrans*	*Assorted*	--				*6.5*		--	*35.0%*	
Watershed Total:								**15.6**			**84.0%**	**$764,000**

E. Bartlett Brook

1. Bartlett Brook TMDL Flow Targets

In the effort to restore Bartlett Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table E1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table E 1 Bartlett Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-33.2%	**13.2%**

In Table E1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the Pre-2002 condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the Pre-2002 condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

The VT DEC added a future growth factor to the TMDL flow targets to account for future non-jurisdictional impervious growth. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, this type of growth is important to account for within the 20 year stormwater management plan.

The original TMDL assumed a non-jurisdictional impervious growth of 50 acres, whereas a study completed by the Chittenden County Regional Planning Commission (CCPRC) estimated that a more realistic future growth estimate was 5.7 acres based on the actual non-jurisdictional growth rate from 2003 to 2010. The future growth rate was calculated as follows:

$$\text{Growth Rate} = \left(\left(\frac{Non-Jurisdictional\ Impervious,2010)}{Non-Jurisdictional\ Impervious,2003}\right)^{\left(\frac{1}{years}\right)}\right) - 1\ ) * 100$$

The revised future growth reduced the high-flow target (Q 0.3%) reduction from 33.0% to 11.6%, which was calculated as shown in the following equation.

Modified Flow Target = $(Target\ \%\ with\ no\ FG) + (\ Target\ \%\ from\ FG) * (\frac{Revised\ FG\ acres}{Original\ FG\ acres})$

The modified TMDL flow targets with a revised future growth for Bartlett Brook are shown in Table E2.

Table E 2 Bartlett Brook TMDL flow restoration targets with a modified future growth target of 5.7 acres

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-11.6%	**9.3%**

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads. Additionally, the University of Vermont (UVM) owns land within the Bartlett Brook Watershed, used for the operation of the UVM Horticulture Farm. However, agricultural impervious area is not subject to FRPs. As such, UVM was determined to not be an eligible MS4 for Bartlett Brook.

Approximately 1.9% of the impervious cover in the Bartlett Brook Watershed is within the Town of Shelburne, 3.8% is owned by VTrans, and the remaining 94.2% within the City of South Burlington (Table E3). The TMDL flow targets were allocated to each MS4 based on their relative impervious ownership in the watershed where the Town of Shelburne is responsible for a 0.22% high flow reduction, VTrans is responsible for a 0.44% high flow reduction, and the City of South Burlington is responsible for the remaining 10.93% high flow reduction.

Table E 3 Bartlett Brook flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
University of Vermont	----	----	----	NA	NA
Town of Shelburne	60.6	2.7	1.9%	-0.22%	0.18%
VTrans	9.5	5.2	3.8%	-0.44%	0.35%
South Burlington	680.5	129.7	94.2%	-10.93%	8.76%
Watershed Total	**750.7**	**137.6**		**-11.60%**	**9.30%**

2. Bartlett Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. Both the Post-2002 and Credit models are compared to the Pre-2002 model on a percent change basis to determine changes in high and low flows.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Bartlett Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Bartlett Brook Post-2002 (existing condition) model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 11.6% in the watershed, current BMPs reduced high flows by 2.54%, which equates to 21.9% of the total required flow reduction (Table E4). Of that reduction, 54.7% of the VTrans allocation was addressed, reducing high flows by 0.24% of the 0.44% required reduction. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table E 4 Bartlett Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
Town of Shelburne	-0.22%	0.00%	-0.22%	0.0%
VTrans	-0.44%	-0.24%	-0.20%	54.7%
South Burlington	-10.93%	-2.30%	-8.63%	21.0%
Watershed Total	**-11.60%**	**-2.54%**	**-9.06%**	**21.9%**

3. Bartlett Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

The final watershed-wide BMP scenario includes the implementation of 18 stormwater BMPs including five retrofits to existing BMPs with expired permits, four new detention systems, three new infiltration systems, and six green stormwater infrastructure (GSI) systems. Credit toward the flow target is also provided by nine existing (Post-2002) stormwater structures. The VTrans proposed BMPs are summarized in Table E6, including the impervious cover treated, drainage area, and CPv volume storage estimated by the HydroCAD design model. A map of the proposed BMP locations is included in Appendix A.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 2 proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 194.5% of the modified high-flow target, providing a robust factor of safety. The Credit model showed a high flow reduction of 1.18% for the VTrans allocation of the Bartlett Brook Watershed, which equates to 267.2% of the total VTrans required high flow reduction and a 167.2% factor of safety (Table E5). The factor of safety is included in the recommended BMP list to provide the MS4s with additional options in the event the list has to be modified or as conditions in the watershed change from present day. In the event a proposed project becomes infeasible after further design and construction planning or must be downscaled, VTrans will still be able to meet their allocated target for that watershed without seeking out additional projects. Of the suggested 9.3% increase in low flow, 47% of the target was achieved (4.35% low flow increase).

The ultimate determination for implementation of projects within the watershed providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table E5.

Table E5 Bartlett Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
Town of Shelburne	-0.22%	0.00%	-0.22%	0.0%
VTrans	-0.44%	-1.18%	0.74%	267.2%
South Burlington	-10.93%	-21.38%	10.44%	195.5%
Watershed Total	**-11.60%**	**-22.56%**	**10.96%**	**194.5%**

As discussed in section E1.1. Future Growth Target, the modified future growth estimate of 5.7 acres was utilized for this analysis. However, in the event that the original future growth estimate of 50 acres was proven to be accurate, the original TMDL high flow reduction target of 33.2% would be required. This equates to a high flow reduction of -1.27% for VTrans as opposed to the -0.44% required with the modified future growth assessment.

In order to predict the amount of additional impervious cover that would need to be managed by VTrans, the results from iterative Bartlett Brook BMPDSS model runs were used to perform a linear regression. The impervious cover managed by VTrans for the proposed BMPs by model scenario were regressed with the unmodified high flow target met (%) by that model run. With this original TMDL high flow reduction target, VTrans will meet 93.4% of the target with the currently proposed BMPs. To meet the full target, management of a total of 5.52 acres of impervious cover is required, which necessitates management of an additional 0.51 acres of impervious cover (R^2=0.83; Figure E1).

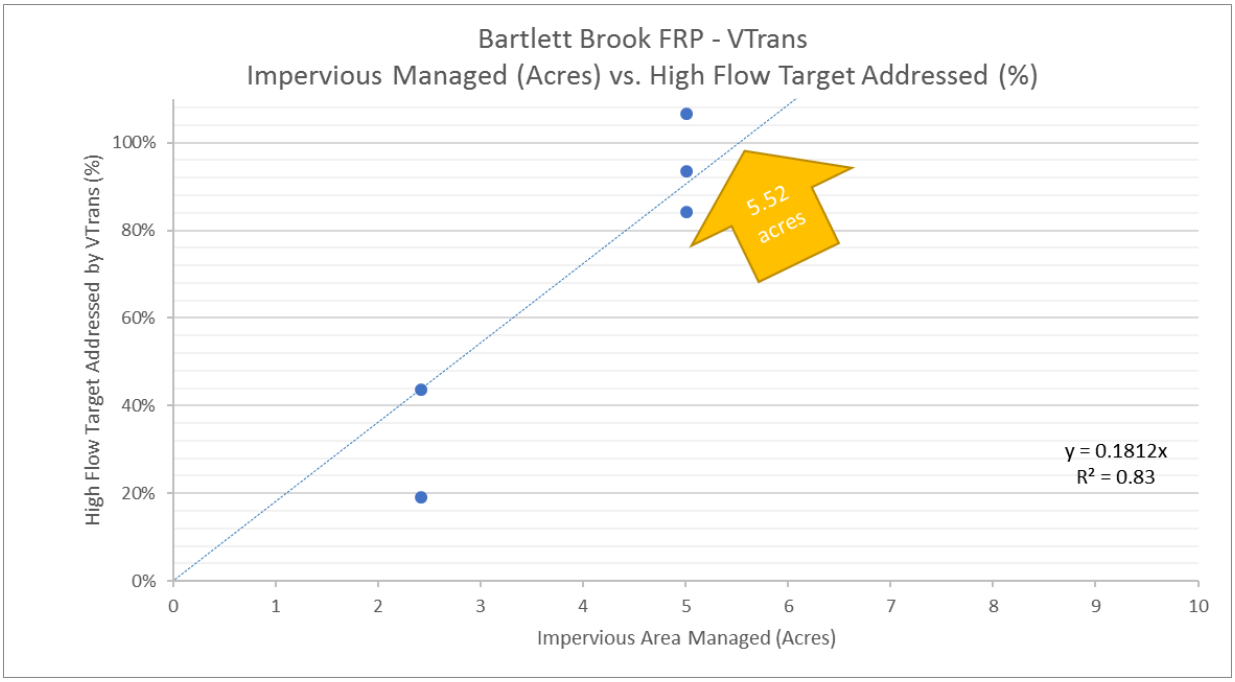

Figure E 1 Regression for predicting required impervious cover managed by VTrans to meet original TMDL high flow reduction targets for Bartlett Brook.

Currently, a project or projects will not be developed to manage this additional 0.51 acres of impervious surface as current controls do meet nearly 200% of the required high flow reduction with the modified future growth assessment. If this assumption of the modified future growth estimate is proven to be false moving forward, VTrans will identify and construct additional control(s). If this is the case, the control(s) will be identified near the end of the design and construction schedule (Phase 5). Projects would be designed and constructed in the final two phases of the design and construction schedule.

3.2. VTrans Proposed BMPs

There are two proposed VTrans BMPs in the Bartlett Brook Watershed, which are summarized in Table E6. Both of these BMPs were designed as underground detention structures within the VTrans right-of-way (ROW). The Bartlett Bay Treatment System (BBTS) Expansion manages 9.2 acres of impervious cover, 20.4% (1.9 acres) of which is owned by VTrans. The underground detention proposed for 1690 Shelburne Rd. manages 0.4 acres of impervious area, 100% of which is owned by VTrans. The remaining 2.7 acres of treated VTrans impervious cover is managed by an existing Post-2002 BMP that currently detains the CPv.

The existing BBTS was designed in 2002 to provide water quality treatment for runoff from a portion of Route 7 and several buildings along Green Mountain Dr. A 15" pipe was installed with the original system to plan for future connections from Route 7. The BBTS expansion would route an additional 15.86 acres to the BBTS system via a new stormline connection on Route 7 from a portion of Route 7 and Harborview Dr. The expansion would involve

implementing a new forebay for the additional connection in front of the Oil N Go property and expanding the southeast portion of the wetland. The existing access road would also need to be repositioned.

An underground detention chamber is proposed to detain just the 1-year storm volume (CPv) from the existing Route 7 stormline, via a flow splitter. There is an existing outfall from Shelburne Rd, parallel to the Oil N Go property, that would need to be reset to make room for the chamber. Further analysis needs to be completed to determine if the detention chamber will encroach on the flood plain for the Bartlett Brook culvert or if any other utility conflicts exist.

The percent of the VTrans high-flow target mitigated by these three BMPs was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 267.2% of the VTrans high flow target was met by these three BMPs. The single largest contributor to this target attainment was the existing Post-2002 BBTS BMP, which meets 145% of the VTrans high flow target. This differs from the earlier Post-2002 model summary as the BMPDSS is an aggregate watershed-wide model and proposed BMPs in other sections of the watershed impact flow reductions. The BBTS Expansion and the 1690 Shelburne Rd. projects meet an additional 122.2% of the VTrans high-flow target (100% and 22.2% respectively; Table E6).

The proposed BMPs are summarized in Table E6. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B. Preliminary design concept plans for the 1690 Shelburne Rd project and a section of the BBTS Expansion project can be found in Appendix H-2.

Table E 6 VTrans final proposed BMPs for the Bartlett Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Bartlett Bay Treatment System (BBTS) Expansion	VTrans/ South Burlington	South Burlington	Underground Detention Chamber in ROW	5625-9010, 2-0180, 2-0153	16.1	9.2	57.2%	1.9	20.4%	0.55	100.0%	$378,000
1690 Shelburne Rd	VTrans/ South Burlington	VTrans/ Developer-Pizzagalli	Underground Detention Chamber in ROW	5625-9010	0.8	0.4	51.3%	0.4	100%	0.04	22.2%	$199,000
Existing BBTS (Post-2002) BMP	*Town / City/ VTrans*	*Non-VTrans*	*Detention*	--	--	--		*2.7*		--	145.0%	
Watershed Total:								**5.0**			**267.2%**	**$577,000**

F. Centennial Brook

1. Centennial Brook TMDL Flow Targets

In the effort to restore Centennial Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table F1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table F 1 Centennial Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-63.0%	23.0%

In Table F1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the Pre-2002 condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the Pre-2002 condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the BMP identification for this study.

1.1. Future Growth Target

The VT DEC added a future growth factor to the TMDL flow targets to account for future non-jurisdictional impervious growth. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, this type of growth is important to account for within the 20 year stormwater management plan.

The original TMDL assumed a non-jurisdictional impervious growth of 50 acres, whereas a 2013 study completed by the Chittenden County Regional Planning Commission (CCPRC) estimated that a more realistic future growth estimate of 5 acres based on the actual non-jurisdictional growth rate. The future growth rate was calculated as follows:

$$\text{Growth Rate} = \left(\left(\frac{Non-Jurisdictional\ Impervious,later\ date}{Non-Jurisdictional\ Impervious,earlier\ date}\right)^{\left(\frac{1}{years}\right)}\right) - 1\ ) * 100$$

The revised future growth reduced the high-flow target (Q 0.3%) reduction from 63.0% to 51.1%, which was calculated as shown in the following equation.

Modified Flow Target = $(Target\ \%\ with\ no\ FG) + (\ Target\ \%\ from\ FG) * (\frac{Revised\ FG\ acres}{Original\ FG\ acres})$

The modified flow targets for Centennial Brook were used for this FRP and are shown in Table F2.

Table F 2 Centennial Brook TMDL flow restoration targets with modified future growth

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-51.6%	**23.2%**

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

The majority of the impervious cover in Centennial Brook Watershed is owned by the City of South Burlington (45.7%), though the University of Vermont and the City of Burlington own significant impervious areas (34.1% and 14.3% respectively). The remaining impervious cover is owned by VTrans (4.7%) and the Burlington International Airport (BTV; 1.1%). The TMDL flow targets were allocated to each MS4 based on their impervious ownership where VTrans is responsible for a 2.43% reduction in high flows and the remaining four MS4s are responsible for a 49.07% flow reduction (Table F3).

Table F 3 Centennial Brook flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
BTV	23.4	3.1	1.1%	-0.59%	0.26%
VTrans	56.9	12.7	4.7%	-2.43%	1.08%
Burlington	94.9	38.6	14.3%	-7.37%	3.29%
UVM	298.4	92.1	34.1%	-17.58%	7.85%
South Burlington	405.6	123.2	45.7%	-23.53%	10.51%
Watershed Total	**879.2**	**269.7**		**-51.50%**	**23.00%**

2. Centennial Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis to determine changes in high and low flows.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Centennial Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Centennial Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 51.5% in the watershed, current BMPs reduced high flows by 16.1%, which equates to 35.4% of the total required flow reduction (Table F4). Of that reduction, 0% of the VTrans allocation was addressed and a required 2.43% high flow reduction remains. As such, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table F 4 Centennial Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
BTV	-0.59%	0.00%	-0.59%	0.0%
VTrans	-2.43%	0.00%	-2.43%	0.0%
Burlington	-7.37%	-3.91%	-3.46%	53.1%
UVM	-17.58%	-10.5%	-7.08%	59.7%
South Burlington	-23.53%	-1.69%	-21.84%	7.2%
Watershed Total	**-51.50%**	**-16.1%**	**-35.40%**	**31.3%**

3. Centennial Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 2 proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 100.6% of the modified high-flow target. The Credit condition presented below reflects management of 67% of the impervious cover in the watershed including all potential retrofits identified and evaluated by the MS4s. A low flow increase of 1.8% was modeled, which equates to 8% of the suggested low flow increase target.

The Credit model showed a high flow reduction of -2.30% for the VTrans allocation for the Centennial Brook Watershed, which equates to 94.5% of the VTrans required high flow reduction (Table F5). The high flow reduction for the watershed was 100.6% of the modified high flow reduction target.

Table F 5 Centennial Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
BTV	-0.59%	-0.46%	-0.13%	77.5%
VTrans	-2.43%	-2.30%	-0.13%	94.5%
Burlington	-7.37%	-8.91%	1.54%	120.9%
UVM	-17.58%	-11.95%	-5.63%	68.0%
South Burlington	-23.53%	-28.18%	4.66%	119.8%
Watershed Total	**-51.50%**	-51.80%	0.30%	100.6%

As discussed in section F1.1. Future Growth Target, the modified future growth estimate of 5 acres was utilized for this analysis. However, in the event that the original future growth estimate of 40 acres was proven to be accurate, the original TMDL high flow reduction target of 63.0% would be required. This equates to a high flow reduction of -2.97% for VTrans as opposed to the -2.43% required with the modified future growth assessment.

In order to predict the amount of additional impervious cover that would need to be managed by VTrans, the results from previous Centennial Brook BMPDSS model runs were used to perform a linear regression. The impervious cover managed by VTrans for the proposed BMPs by model scenario were regressed with the unmodified high flow target met (%) by that model run. With this original TMDL high flow reduction target, VTrans will meet 77.28% of the target with the currently proposed BMPs. To meet the full target, management of an additional 5.2 acres of impervious will be needed for a total of 13.2 acres of managed impervious cover (R^2=0.76; Figure F1).

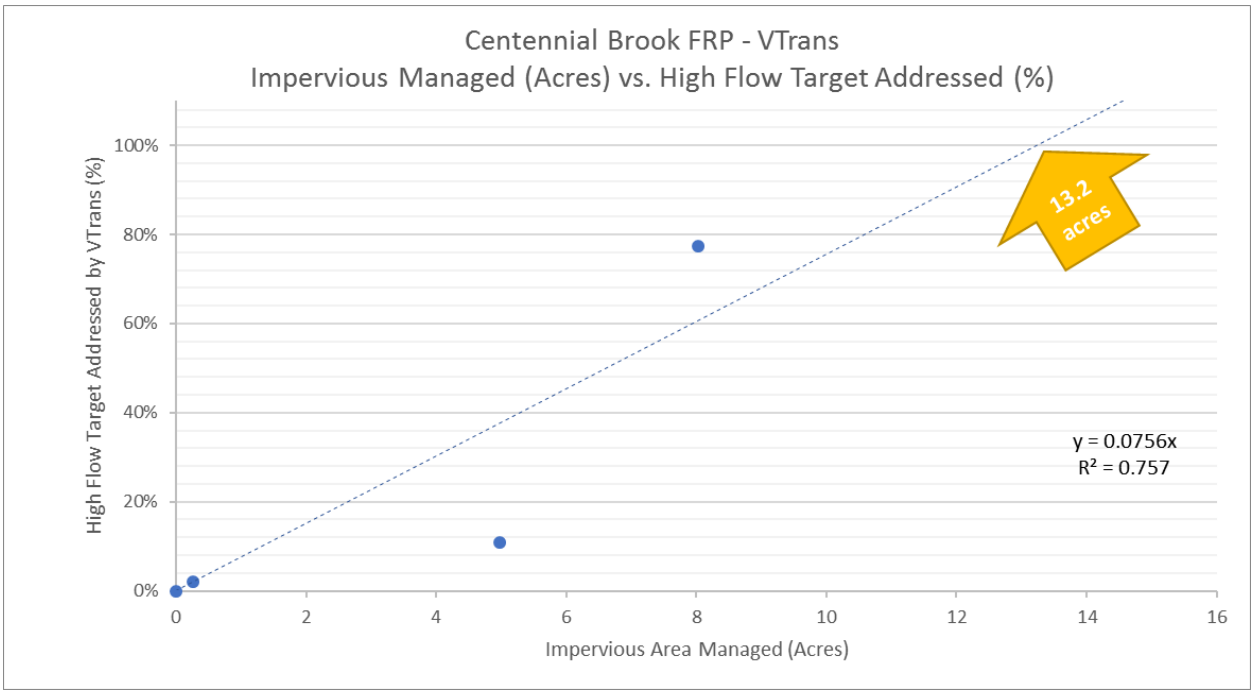

Figure F 2. Regression for predicting required impervious cover managed by VTrans to meet original TMDL high flow reduction targets for Centennial Brook.

Currently, projects will not be developed to manage this additional 5.2 acres of impervious surface as current controls do meet 100.6% of the required high flow reduction with the modified future growth assessment. If this assumption of the modified future growth estimate is proven to be false moving forward, VTrans will identify and construct additional controls. If this is the case, the controls will be identified near the end of the design and construction schedule (Phase 5). Projects would be designed and constructed in the final two phases of the design and construction schedule.

3.2. VTrans Proposed BMPs

There are two proposed VTrans BMPs in the Centennial Brook Watershed, which are summarized in Table F6. These BMPs include one underground detention chamber and one detention basin. The underground detention, I-89 cloverleaf (NE), manages 5 acres of VTrans impervious cover, 36.1% of the total impervious cover managed by the BMP. The detention basin, I-89 Outfall, manages 2.8 acres of VTrans impervious cover, 98.2% of the total impervious cover managed by this BMP.

The proposed I-89 Cloverleaf (NE) underground detention chambers would be located between the I-89 northbound lane and off-ramp. The proposed BMP would require a new control structure to meet CPv storage standards. An existing 48" culvert outlet pipe is easily accessible for construction and maintenance. Additional feasibility analysis is needed to ensure that this project would not impact nearby wetlands.

The I-89 Outfall detention basin location is flexible depending on constraints found during further evaluation. Most downstream locations would be across from the drainage outlet and below the water main, which would be the best location to maximize storage. Some feasibility issues in these locations include impacts to the water main ROW and acquisition of a section of private property. Keeping all of the work within VTrans jurisdiction is an alternative by moving the embankment up gradient to limit the I-89 ROW and reduce available storage.

In addition, one BMP, Patchen Rd. depression, also manages a small amount of VTrans impervious area (0.3 acres). VTrans impervious makes up 4.8% of the impervious area managed by this BMP. The remainder is located in the City of South Burlington. This BMP was determined not to be the responsibility of VTrans to implement.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

$$\% \text{ of high-flow target managed} = (A \div B) \times C$$

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 94.5% of the VTrans high flow target was met by these BMPs, the majority of which are a result of the I-89 Cloverleaf (NE) and I-89 Outfall BMPs (91.4% cumulatively; Table F6). Although the VTrans high flow reduction target was not met in this watershed, the BMPs proposed were determined to be the most feasible for the watershed-wide scenario. The two proposed VTrans BMPs are summarized in Table F6. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B.

Table F 6 VTrans final proposed BMPs for the Centennial Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
I-89 Cloverleaf (NE)	VTrans	VTrans	Underground Detention Chamber	NP	39.2	13.8	35.2%	5.0	36.1%	2.36	58.7%	$432,000
I-89 Outfall	VTrans	VTrans	Detention Basin	NP	13.1	2.8	21.6%	2.8	98.2%	2.87	32.7%	$1,419,000
Other non-VTrans dominated BMPs	*Town / City/ VTrans*	*Non-VTrans*	*Assorted*	--	--	--		*0.3*		--	*3.1%*	
Watershed Total:								**8.0**			**94.5%**	**$1,851,000**

G. Indian Brook

1. Indian Brook TMDL Flow Targets

In the effort to restore Indian Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table G1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table G 1 Indian Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-1.3%	1.1%

In Table G1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 18 acres in the watershed based on local development and projected growth for Indian Brook. The approved TMDL flow targets for Indian Brook are shown in Table G1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

Three MS4s own impervious cover within Indian Brook Watershed: the Village of Essex Junction (53.3%), the Town of Essex (39.1%), and VTrans (7.6%). The TMDL flow targets were allocated

to each MS4 based on their impervious ownership where the Village of Essex Junction is responsible for a 0.7% flow reduction, the Town of Essex is responsible for a 0.5% flow reduction, and VTrans is responsible for the remaining 0.1% flow reduction (Table G2).

Table G 2 Indian Brook TMDL flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
Village of Essex Junction	952.6	218.3	53.3%	-0.69%	0.59%
Town of Essex	3492.7	160.1	39.1%	-0.51%	0.43%
VTrans	141.9	31.3	7.6%	-0.10%	0.08%
Watershed Total	**4587.3**	409.7		**-1.30%**	**1.10%**

2. Indian Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis to determine changes in high and low flows.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Indian Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Indian Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 1.3% in the watershed, current BMPs reduced high flows by 0.54%, which equates to 41.5% of the total required flow reduction (Table G3). Of that reduction, 1.9% of the VTrans allocation was addressed, reducing high flows by 0.002% of the required 0.10% reduction. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table G 3 Indian Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
Village of Essex Junction	-0.69%	-0.27%	-0.42%	39.5%
Town of Essex	-0.51%	-0.26%	-0.24%	52.1%
VTrans	-0.10%	-0.002%	-0.10%	1.9%
Watershed Total	**-1.30%**	**-0.54%**	**-0.76%**	**41.5%**

3. Indian Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 3 proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 211.5% of the modified high-flow target, providing a 111.5% factor of safety (Table G4). The factor of safety is included in the recommended BMP list to provide the MS4s with additional options in the event the list has to be modified or as conditions in the watershed change from present day. A low flow increase of 0.64% was modeled, which equates to 58% of the suggested low flow increase target.

The Credit model showed a high flow reduction of 0.06% for the VTrans allocation for the Indian Brook Watershed, which equates to 56.6% of the total VTrans required high flow reduction (Table G4). Although this plan does not address 100% of the VTrans high flow allocation, the proposed scenario was determined to be the most feasible watershed-wide plan.

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table G4.

Table G 4 Indian Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
Village of Essex Junction	-0.69%	-1.55%	0.86%	223.5%
Town of Essex	-0.51%	-1.15%	0.64%	225.6%
VTrans	-0.10%	-0.06%	-0.04%	56.6%
Watershed Total	**-1.30%**	**-2.75%**	**1.45%**	**211.5%**

3.2. VTrans Proposed BMPs

There are three proposed VTrans BMPs in the Indian Brook Watershed, which are summarized in Table G5. These BMPs include one retrofit of an existing natural detention area into a terraced detention basin and two sand filter systems. The terraced detention basin, Fairview Dr, manages 0.7 acres of VTrans impervious cover, 17.4% of the total impervious cover managed. The two sand filter systems proposed in the median on the North and South side of the Route 15, manage 0.9 and 0.8 acres of VTrans impervious cover respectively. This impervious cover is entirely owned by VTrans.

The Fairview Dr retrofit proposes to convert a natural depression to a gravel wetland with water quality treatment bays. This retrofit will benefit the high flow target and provide water quality treatment. Runoff from the northwest side of Route 15 (Main St.) would be intercepted and directed into the system through a new culvert, represented as the "Fairview Dr Add-on" drainage. This would eliminate most runoff to the highly eroded outfall. Runoff would exit the system back under Route 15 via an upgraded pipe (12" to 30").

The I-289/Route 15 Exit Ramp was identified as a potential opportunity to manage runoff from primarily VTrans owned impervious. Two sand filter systems were proposed in the median on the North and South side of the Route 15 overpass. The proposed practice is an approximately 4' deep sand filter, with a 4" underdrain, and 1.5' surface ponding depth before passing over a weir. The system is designed to provide CPv storage. The low-flow orifice and sand filter provide extended filtration and thus water quality benefit.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

The proposed BMPs are summarized in Table G5. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B. Preliminary design concept plans for the three proposed projects can be found in Appendix H-3.

Table G 5 VTrans final proposed BMPs for the Indian Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Fairview Dr/Fairview Dr Add-on	Village/ VTrans/ Town	Village	Gravel Wetland	1-1074 SN002	29.4	4.1	14.0%	0.7	17.4%	0.67	17.4%	$290,000
I-289/Route 15 North	VTrans	VTrans ROW	Median Filter	NP	2.8	0.9	30.6%	0.9	100%	0.12	20.7%	$34,000
I-289/Route 15 South	VTrans	VTrans ROW	Median Filter	NP	2.2	0.8	35.3%	0.8	100%	0.10	18.5%	$29,000
Watershed Total:								**2.3**			**56.6%**	**$353,000**

H. Moon Brook

1. Moon Brook TMDL Flow Targets

In the effort to restore Moon Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table H1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table H 1 Moon Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-11.9%	23.9%

In Table H1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 25 acres in the watershed based on local development and projected growth for Moon Brook. The approved TMDL flow targets for Moon Brook are shown in Table H1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas. Additionally, the Town of Mendon owns land within the Moon Brook Watershed, but this town is not designated as an MS4 and is thus not included in the allocation.

Rutland City owns the majority of impervious cover within Moon Brook Watershed (76.8%) while Rutland Town owns 23.7% and VTrans owns the remaining 0.5%. The TMDL flow targets

were allocated to each MS4 based on their impervious ownership where Rutland City is responsible for a 9.02% flow reduction, Rutland Town is responsible for a 2.82% flow reduction, and VTrans is responsible for the remaining 0.06% flow reduction (Table H2).

Table H 2 Moon Brook TMDL flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
Mendon	2041.8	35.8	----	----	----
Rutland City	1415.3	353.8	75.8%	-9.02%	18.12%
Rutland Town	1556.4	110.6	23.7%	-2.82%	5.66%
VTrans	18.7	2.3	0.5%	-0.06%	0.12%
Watershed Total	**2990.4**	**466.7**		**-11.90%**	**23.90%**

2. Moon Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Moon Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Moon Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 11.9% in the watershed, current BMPs reduced high flows by 0.71%, which equates to 6% of the total required flow reduction (Table H3). Of that reduction, 0% of the VTrans allocation was addressed and a required 0.06% flow

reduction remains. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table H 3 Moon Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
Rutland City	-9.02%	-0.52%	-8.50%	5.8%
Rutland Town	-2.82%	-0.19%	-2.63%	6.6%
VTrans	-0.06%	0.00%	-0.06%	0.0%
Watershed Total	**-11.90%**	-0.71%	-11.19%	6.0%

3. Moon Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 1 proposed VTrans BMP. The watershed-wide proposed FRP scenario addresses 25.88% of the modified high-flow target. The minimal high flow reduction is due to the non-participation of the City of Rutland in the FRP process at this time. The Credit model showed a high flow reduction of 0.12% for the VTrans allocation for the Moon Brook Watershed, which equates to 196.87% of the total VTrans required high flow reduction (Table H4). No progress was made towards the suggested increase in low flow.

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets

with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table H4.

Table H 4 Moon Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
Rutland City	-9.02%	-0.74%	-8.28%	8.26%
Rutland Town	-2.82%	-2.22%	-0.60%	78.69%
VTrans	-0.06%	-0.12%	0.06%	196.87%
Watershed Total	**-11.90%**	-3.08%	-8.82%	25.88%

3.2. VTrans Proposed BMPs

The one proposed VTrans BMP in the Moon Brook Watershed, which is summarized in Table H5. This BMP is a gravel wetland collecting runoff from a drainage ditch. The gravel wetland manages 2.3 acres of VTrans impervious cover, 20.9% of the total impervious cover managed by this BMP.

The proposed BMP, located behind the new ALDI Store along Route 7 and Cold River Rd., could potentially be an ideal solution to reduce peak-flows and sediment loading to Moon Brook from a 23-acre drainage area, 47.4% of which is impervious. The proposed gravel wetland will provide flow detention as well as water quality benefits. The Randbury Road site is located on private property, which would need to be acquired by the Town of Rutland in order for this site to be a feasible retrofit location. The site currently consists of a wooded undeveloped area with a highly eroded drainage ditch. The retrofit BMP could collect runoff from this drainage ditch, which has been formed from the high volume of runoff originating from the Route 7 outfall. Based on field observation, the site is underlain by sandy soils so infiltration of runoff may be possible. Additionally, the existing drainage ditch was assessed by the State Fisheries Biologist, and determined to be void of fisheries resources. As such, alterations to the existing ditch would be feasible. This BMP location is of particular interest as the project could align with the Town's re-development goals for the area, which will include a new access road to ease traffic on Route 7. This project would require a new stormwater management system regardless of this FRP (see Appendix H-4 for a design concept plan).

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

$$\% \text{ of high-flow target managed} = (A \div B) \times C$$

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 196.87% of the VTrans high flow target was met by this BMP at the Randbury Rd site. The proposed BMPs are summarized in Table H5. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP location is included in Appendix A and details about the proposed BMP is located in Appendix B. A preliminary design has been created for this project and is included in Appendix H-4.

Table H 5 VTrans final proposed BMPs for the Moon Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Randbury Rd	VTrans/ Town of Rutland	VTrans/ Town of Rutland/ Private	Gravel Wetland	NP/ New Road Project (Construction Permit)	23.1	11.0	47.4%	2.3	20.9%	0.83	196.87%	$279,000
Watershed Total:								**2.3**			**196.87%**	**$279,000**

I. Munroe Brook

1. Munroe Brook TMDL Flow Targets

In the effort to restore Munroe Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table I1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table I 1 Munroe Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-5.2%	**7.4%**

In Table I1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 20 acres in the watershed based on local development and projected growth for Munroe Brook. The approved TMDL flow targets for Munroe Brook are shown in Table I1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

Shelburne owns the majority of impervious cover within the Munroe Brook Watershed (87.9%) while the City of South Burlington owns 7.1% and VTrans owns the remaining 5.0%. The TMDL flow targets were allocated to each MS4 based on their impervious ownership where Shelburne

is responsible for a 4.57% flow reduction, the City of South Burlington is responsible for a 0.37% flow reduction, and VTrans is responsible for the remaining 0.26% flow reduction (Table I2).

Table I 2 Munroe Brook TMDL flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
Shelburne	3152.3	237.1	87.9%	-4.57%	6.51%
South Burlington	292.4	19.1	7.1%	-0.37%	0.52%
VTrans	23.1	13.5	5.0%	-0.26%	0.37%
Watershed Total	**3467.7**	**268.7**		**-5.20%**	**7.40%**

2. Munroe Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Munroe Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Munroe Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 5.2% in the watershed, current BMPs reduced high flows by 2.6%, which equates to 50% of the total required flow reduction (Table I3). Of that reduction, 0.04% of the VTrans allocation was addressed, which equates to 15.1% of the VTrans allocation. A 0.22% flow reduction for VTrans remains. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table I 3 Munroe Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
Shelburne	-4.57%	-1.93%	-2.64%	42.2%
South Burlington	-0.37%	-0.63%	0.26%	170.8%
VTrans	-0.26%	-0.04%	-0.22%	15.1%
Watershed Total	**-5.20%**	**-2.60%**	**-2.60%**	**50.0%**

3. Munroe Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included three proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 100% of the modified high-flow target. The Credit model showed a high flow reduction of 0.36% for the VTrans allocation for the Munroe Brook Watershed, which equates to 137.5% of the total VTrans required high flow reduction (Table I4). The factor of safety is included in the recommended VTrans BMP list to provide for additional options in the event the list has to be modified or as conditions in the watershed change from present day. In the event a proposed project becomes infeasible after further design and construction planning or must be downscaled, VTrans will still be able to meet their allocated target for Munroe Brook without seeking out additional projects. No progress was made towards the suggested low flow increase target.

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets

with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table I4.

Table I 4 Munroe Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
Shelburne	-4.57%	-4.15%	-0.42%	90.8%
South Burlington	-0.37%	-0.69%	0.32%	187.5%
VTrans	-0.26%	-0.36%	0.10%	137.5%
Watershed Total	**-5.20%**	**-5.20%**	**0.30%**	**100.0%**

3.2. VTrans Proposed BMPs

There are three proposed VTrans BMPs in the Munroe Brook Watershed, which are summarized in Table I5. These BMPs include an underground detention chamber, a retrofit of an existing detention pond, and a gravel wetland.

The proposed underground detention, by Danform Shoes, manages 2.1 acres of VTrans impervious cover, 74.9% of the total impervious cover managed. This detention area would collect drainage from the west side of Shelburne Rd (Route 7) from the Munroe Brook Watershed boundary to the area in front of Danform Shoes. The underground storage would be located primarily within the VTrans ROW.

A retrofit of an existing pond, the Executive Dr (M08) Detention Pond, would continue to manage 2.7 acres of VTrans impervious cover. However, the retrofit of the pond would increase detention and provide for pre-treatment within a forebay. This pond has a large drainage area (approximately 91 acres) and collects stormwater from over 21 acres of impervious cover, 12.7% of which is owned by VTrans.

The final VTrans BMP proposed for the watershed is across Shelburne Rd (Route 7) from the Tractor Supply building. This proposed gravel wetland would manage 2.8 acres of VTrans impervious cover, 75.6% of the total impervious cover managed, and would be located along Shelburne Rd primarily in the VTrans ROW. In total, this BMP would collect and treat stormwater from 6.8 acres, 3.8 acres of which is impervious cover. The design of this BMP would provide for detention of the CPv as well as significant water quality treatment.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 137.5% of the VTrans high flow target was met by these BMPs. The proposed BMPs are summarized in Table I5. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B.

Table I 5 VTrans final proposed BMPs for the Munroe Brook FRP Credit BMPDSS model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
M08 Executive Dr Pond	Town/ VTrans	Non-VTrans	Detention Pond	1-1291	91.1	21.3	23.4%	2.7	12.7%	0.54	49.0%	$25,000
By Danform Shoes	Town/ VTrans	VTrans	Underground Detention	NP	4.9	2.8	58.0%	2.1	74.9%	0.145	38.4%	$102,000
Across from Tractor Supply	Town/ VTrans	VTrans	Gravel Wetland	NP	6.8	3.8	55.5%	2.8	75.6%	0.544	51.5%	$480,000
Watershed Total:								**7.6**			**137.5%**	**$607,000**

J. Potash Brook

1. Potash Brook TMDL Flow Targets

In the effort to restore Potash Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table J1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table J 1 Potash Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-16.5%	11.2%

In Table J1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 30 acres in the watershed based on local development and projected growth for Potash Brook. The approved TMDL flow targets for Potash Brook are shown in Table J1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

The City of South Burlington owns the majority of impervious cover within the Potash Brook Watershed (84.7%) and thus is responsible for the majority of high flow reductions (13.98%). The remaining impervious area is owned by VTrans (8.3%), while BTV owns 3.5%, the City of

Burlington owns 3%, and UVM owns the remaining 0.5%. The TMDL flow targets were allocated to each MS4 based on their impervious ownership where VTrans is responsible for a 1.37% high flow reduction (Table J2). These summaries are representative of the watershed condition following updates to the watershed boundary completed in the Post-2002 and Credit model runs.

Table J 2 Potash Brook TMDL flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
South Burlington	3662.1	778.5	84.7%	-13.98%	9.49%
VTrans	317.0	76.3	8.3%	-1.37%	0.93%
BTV	72.1	32.0	3.5%	-0.57%	0.39%
Burlington	105.8	27.3	3.0%	-0.49%	0.33%
UVM	338.2	5.1	0.5%	-0.09%	0.06%
Watershed Total	**4495.2**	919.2		**-16.50%**	**11.20%**

2. Potash Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Potash Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Potash Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 16.5% in the watershed, current BMPs

reduced high flows by 4.5%, which equates to 27.3% of the total required high flow reduction (Table J3). Of that reduction, 8% of the VTrans allocation was addressed as a reduction of 0.11% was achieved. A 1.2% VTrans flow reduction remains. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table J 3 Potash Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
South Burlington	-13.98%	-4.35%	-9.64%	31.1%
VTRANS	-1.37%	-0.11%	-1.25%	8.0%
BTV	-0.57%	0.00%	-0.57%	0.0%
Burlington	-0.49%	-0.04%	-0.45%	8.1%
UVM	-0.09%	0.00%	-0.09%	0.0%
Watershed Total	**-16.50%**	**-4.50%**	**-12.00%**	**27.3%**

3. Potash Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 107 BMPs, 6 of which are the responsibility of VTrans. The watershed-wide proposed FRP scenario addresses 100% of the modified high-flow target. No progress was made towards the suggested low flow increase target.

The Credit model showed a high flow reduction of 0.6% for the VTrans allocation for the Potash Brook Watershed, which equates to 43.7% of the total VTrans required high flow reduction

(Table J4). Although this plan does not address 100% of the VTrans high flow allocation, the proposed scenario was determined to be the most feasible watershed-wide plan.

The ultimate determination for when the watershed has returned to its attainment condition will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table J4.

Table J4 Potash Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
South Burlington	-13.98%	-15.28%	1.31%	109.4%
VTRANS	-1.37%	-0.60%	-0.77%	43.7%
BTV	-0.57%	-0.02%	-0.56%	3.0%
Burlington	-0.49%	-0.56%	0.07%	114.2%
UVM	-0.09%	-0.04%	-0.05%	43.8%
Watershed Total	**-16.50%**	**-16.50%**	**0.00%**	**100.0%**

3.2. VTrans Proposed BMPs

There are six proposed VTrans BMPs in the Potash Brook Watershed, which are summarized in Table J5. These BMPs include one median filter, two gravel wetlands, and three detention basins.

The proposed I-89 Swale median filter would be located between I-89 North and South lanes west of Hinesburg Road in South Burlington. The proposed BMP would be a constructed median filter in the depressed area between the interstate lanes and would manage 1.8 acres of VTrans impervious cover, 100% of the total impervious cover managed. Several existing culverts could be rerouted to this median filter.

Gravel wetlands are proposed at sites Exit 13 and Exit 14 in South Burlington. These wetlands would be constructed in the depressed triangle greenspace between ramps and receive stormwater from several rerouted culverts. The gravel wetlands at Exit 13 and Exit 14, manage 4.8 and 1.8 acres retrospectively, 100% of the total impervious cover managed by these BMPs.

The proposed BMP at the 189 Cloverleaf is a detention pond that will manage 3.5 acres of VTrans impervious cover, 30% of the total impervious cover managed. An outlet structure

added to this already depressed area will detain stormwater once stormlines from Shelburne Road are rerouted. Wetlands are the only known feasibility concern for this proposed BMP.

A detention pond is proposed at the Dorset St/189 Ramps site that will detain stormwater from a large section of Dorset Street, managing 1.1 acres of VTrans impervious cover (19.6% of the total impervious cover managed). The stormline near Kennedy Drive can be intercepted to reroute discharge to the area between the 189 ramps. This BMP location will need significant earthwork as the area is currently elevated.

At Queen City Park Rd, a detention basin is proposed to add detention to an exciting depressed area where stormlines already outfall to manage 0.4 acres of VTrans impervious cover, 14.7% of the total impervious cover managed. The drainage from Shelburne Road is assumed to be rerouted to a larger depression to the north at site 189 Cloverleaf because of limiting space.

The remaining 8.2 acres of managed VTrans impervious cover is managed by 18 additional BMPs. While these BMPs manage small amounts of VTrans impervious area, they are not determined to be the responsibility of VTrans to implement.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 43.7% of the VTrans high flow target was met by these BMPs, the majority of which are a result of the six specific BMPs described in Table J5. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B.

Table J 5 VTrans final proposed BMPs for the Potash Brook FRP Credit BMPDSS model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Exit 13	VTrans	VTrans	Gravel Wetland	NP	16.7	4.8	28.6%	4.8	100%	0.567	9.7%	$219,000
189 Cloverleaf	VTrans / Town	VTrans	Detention Basin	NP	21.3	11.5	54.3%	3.5	30%	1.129	7.0%	$59,000
I-89 Swale	VTrans	VTrans	Median Filter	NP	6.3	1.8	28.6%	1.8	100%	0.531	3.6%	$129,000
Exit 14	VTrans	VTrans	Gravel Wetland	NP	4.9	1.8	36.9%	1.8	100%	0.294	3.7%	$131,000
Dorset St / 189 Ramps	VTrans / Town	VTrans	Detention Basin	NP	9.4	5.6	59.5%	1.1	19.6%	0.348	2.2%	$101,000
Queen City Pk Rd	VTrans / Town	VTrans	Detention Basin	NP	6.5	2.9	44.9%	0.4	14.7%	0.452	0.9%	$99,000
Other non-VTrans dominated BMPs	*Town/ VTrans*	*Non-VTrans*	*Assorted*	--				*8.2*		--	*16.6%*	
Watershed Total:								**21.5**			**43.7%**	**$738,000**

K. Rugg Brook

1. Rugg Brook TMDL Flow Targets

In the effort to restore Rugg Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table K1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table K 1 Rugg Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-16.0%	16.8%

In Table K1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

The VT DEC added a future growth factor to the TMDL flow targets to account for future non-jurisdictional impervious growth. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, this type of growth is important to account for within the 20 year stormwater management plan.

The original TMDL assumed a non-jurisdictional impervious growth of 15 acres, whereas a 2013 study completed by the Chittenden County Regional Planning Commission (CCPRC) estimated a more likely future growth estimate of 4.54 acres based on the actual non-jurisdictional growth rate from 2003 to 2014. The future growth rate was calculated as follows:

$$\text{Growth Rate} = \left(\left(\frac{Non-Jurisdictional\ Impervious,2014)}{Non-Jurisdictional\ Impervious,2003}\right)^{\left(\frac{1}{years}\right)}\right) - 1\ ) * 100$$

The revised future growth reduced the high-flow target (Q 0.3%) reduction from 16.0% to 15.3%, which was calculated as shown in the following equation.

Modified Flow Target = $(Target\ \%\ with\ no\ FG) + (\ Target\ \%\ from\ FG) * (\frac{Revised\ FG\ acres}{Original\ FG\ acres})$

The modified flow targets for Rugg Brook were used for this FRP and are shown in Table K2.

Table K 2 Rugg Brook TMDL flow restoration targets with modified future growth

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-15.3%	**16.8%**

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

St. Albans Town owns the majority of impervious cover within the Rugg Brook Watershed (73.9%). VTrans and St. Albans City on the remainder of the impervious cover in the watershed (15.7% and 10.4% respectively). The TMDL flow targets were allocated to each MS4 based on their impervious ownership where St. Albans Town is responsible for 11.3% of the flow reduction, VTrans is responsible for 2.4% of the flow reduction, and St. Albans City is responsible for the remaining 1.6% of the flow reduction (Table K3).

Table K 3 Rugg Brook TMDL flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
St. Albans Town	1556.4	151.4	73.9%	-11.30%	12.41%
VTrans	131.8	32.2	15.7%	-2.40%	2.64%
St. Albans City	70.5	21.4	10.4%	-1.60%	1.75%
Watershed Total	**1758.8**	**204.9**		**-15.30%**	**16.80%**

2. Rugg Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Rugg Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Rugg Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 15.3% in the watershed, current BMPs reduced high flows by 2.5%, which equates to 16.3% of the total required flow reduction (Table K4). Of that reduction, 12.1% of the VTrans allocation was addressed as a reduction of 0.29% was achieved. A 2.11% flow reduction from the VTrans MS4 remains. Based on the model results, additional CPv stormwater controls will be required to meet the TMDL high-flow target.

Table K 4 Rugg Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
St. Albans Town	-11.30%	-1.19%	-10.11%	10.5%
VTrans	-2.40%	-0.29%	-2.11%	12.1%
St. Albans City	-1.60%	-1.02%	-0.58%	63.9%
Watershed Total	**-15.30%**	**-2.50%**	**-12.80%**	**16.3%**

3. Rugg Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field

assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 13 proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 114.1% of the modified high-flow target, providing a 14.1% factor of safety. The Credit model showed a high flow reduction of 3.42% for the VTrans allocation for the Rugg Brook Watershed, which equates to 142.4% of the total VTrans required high flow reduction (Table K5). The factor of safety is included in the recommended BMP list to provide the MS4s with additional options in the event the list has to be modified or as conditions in the watershed change from present day. In the event a proposed project becomes infeasible after further design and construction planning or must be downscaled, VTrans will still be able to meet their allocated target for that watershed without seeking out additional projects. No progress was made towards the suggested low flow increase target.

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table K5.

Table K 5 Rugg Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
St. Albans Town	-11.30%	-12.41%	1.11%	109.8%
VTrans	-2.40%	-3.42%	1.02%	142.4%
St. Albans City	-1.60%	-1.63%	0.03%	101.9%
Watershed Total	**-15.30%**	**-17.46%**	**2.16%**	**114.1%**

3.2. VTrans Proposed BMPs

There are 13 proposed VTrans BMPs in the Rugg Brook Watershed, which are summarized in Table K6. These BMPs include an infiltration basin, four detention areas, and eight median filters.

The infiltration site, I-89 / Holyoke Farm, manages 0.2 acres of VTrans impervious cover, 49.9% of the total impervious cover managed. The proposed BMP would be located on land owned by an active farm, adjacent to I-89, located off Holyoke Farm Rd. The BMP would be a 15,000 sq-ft infiltration basin that has the potential to increase baseflow to the stream via infiltration, which addresses both the high-flow and low-flow TMDL targets.

The proposed detention basins will treat a total of 7.9 acres of VTrans impervious cover between the four sites. In three of the four locations the BMPs are located on both private and VTrans land. The Exit 19 site is the only detention basin located fully on VTrans land in the center median between the on ramp and the Interstate Access Rd.

Eight median sites were identified that would detain and treat runoff from I-89 in the existing highway median. The structures would be considered equivalent to dry swales as defined in the 2002 Vermont Stormwater Management Manual. The structures would be located in existing vegetated stormwater conveyances in the I-89 median. Key features of the structures include earthen check dams designed to create up to 1.5' of ponding depth behind each dam, amended soils consisting of a 50/50 blend of sand and native soil at the surface, and a pure sand filter below. A perforated underdrain wrapped in stone would be located below the sand filter, which would be connected to the outlet structure or day lighted.

The remaining 8.1 acres of managed VTrans impervious cover is managed by 12 additional BMPs. While these BMPs manage small amounts of VTrans impervious area, they are not determined to be the responsibility of VTrans to implement.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

$$\% \text{ of high-flow target managed} = (A \div B) \times C$$

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 142.4% of the VTrans high flow target was met by these BMPs, the majority of which are a result of thirteen specific BMPs (83.4% cumulatively). The proposed BMPs are summarized in Table K6. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B.

Preliminary design concept plans for the Access Rd East, Access Rd West, Exit 19, I-89 Holyoke Farm, and SDC 280 median filter projects can be found in Appendix H-5.

Table K 6 VTrans final proposed BMPs for the Rugg Brook FRP Credit BMPDSS model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Exit 19 South	VTrans	VTrans	Detention	NP	57.9	3.8	6.5%	3.7	97.2%	2.070	26.7%	$270,000
Access Rd. East	VTrans	VTrans/ Private	Detention	NP	85.1	2.8	3.2%	2.4	87.8%	1.820	17.6%	$410,000
Access Rd. West	VTrans	VTrans/ Private	Detention	Drains Portion of 1-1428	13.7	0.6	4.0%	0.6	100%	0.652	4.0%	$125,000
SASH / Federal St Connector	City/ VTrans	VTrans/ Private	Detention	NP	21.1	4.9	23.1%	1.2	24.5%	0.36	8.7%	$35,000
SDC87	VTrans	VTrans	Median Filter	NP	4.9	0.9	18.8%	0.9	100%	0.128	6.7%	$36,000
SDC83b	VTrans	VTrans	Median Filter	NP	1.8	0.4	20.1%	0.4	100%	0.077	2.6%	$22,000
SDC27	VTrans	VTrans	Median Filter	NP	1.6	0.4	26.4%	0.4	100%	0.063	3.1%	$18,000
SDC280	VTrans	VTrans	Median Filter	NP	2.1	0.4	17.4%	0.4	100%	0.063	2.7%	$18,000
SDC347	VTrans	VTrans	Median Filter	NP	1.4	0.3	21.7%	0.3	100%	0.060	2.2%	$17,000
SDC83a	VTrans	VTrans	Median Filter	NP	1.7	0.3	15.8%	0.3	100%	0.058	2.0%	$16,000
SDC342	VTrans	VTrans	Median Filter	NP	1.6	0.3	19.4%	0.3	100%	0.054	2.3%	$15,000

SDC29	VTrans	VTrans	Median Filter	NP	2.2	0.4	18.2%	0.4	100%	0.054	3.0%	$15,000
I-89 / Holyoke Farm	Town / VTrans	Private	Infiltration	NP	61.8	0.5	0.8%	0.2	49.9%	1.426	1.8%	$185,000
Other non-VTrans dominated BMPs	*Town / City/ VTrans*	*Non-VTrans*	*Assorted*	--	*124.1*	*29.9*	*24.1%*	*8.1*	*27.1%*	--	*59.0%*	
Watershed Total:								**19.6**			**142.4%**	**$1,182,000**

L. Stevens Brook

1. Stevens Brook TMDL Flow Targets

In the effort to restore Stevens Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table L1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table L 1 Stevens Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-24.4%	24.3%

In Table L1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 15 acres in the watershed based on local development and projected growth for Stevens Brook. The approved TMDL flow targets for Stevens Brook are shown in Table L1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas.

St. Albans City owns the majority of impervious cover within the Stevens Brook Watershed (70.6%) and thus is responsible for the majority of high flow reductions (17.23%). The remaining

impervious area is owned by St. Albans Town (22.7%) and VTrans (6.7%). The TMDL flow targets were allocated to each MS4 based on their impervious ownership where St. Albans Town is responsible for a 5.53% flow reduction and VTrans is responsible for the remaining 1.64% flow reduction (Table L2).

Table L 2 Stevens Brook flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
St. Albans City	585.4	218.0	70.6%	-17.23%	17.16%
St. Albans Town	1081.8	70.0	22.7%	-5.53%	5.51%
VTrans	67.7	20.7	6.7%	-1.64%	1.63%
Watershed Total	**1734.9**	**308.7**		**-24.40%**	**24.30%**

2. Stevens Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Stevens Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Condition Model

The Stevens Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 24.4% in the watershed, current BMPs reduced high flows by 0.92%, which equates to 3.8% of the total required flow reduction (Table L3). Of that reduction, 14.8% of the VTrans allocation of 1.52% was addressed and a

required 1.4% flow reduction remains. Based on the model results, additional CPv stormwater controls will be required to meet the required TMDL high-flow target.

Table L 3 Stevens Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
St. Albans City	-17.80%	-0.24%	-16.99%	1.4%
St. Albans Town	-5.09%	-0.44%	-5.09%	8.0%
VTrans	-1.52%	-0.24%	-1.40%	14.8%
Watershed Total	**-24.40%**	**-0.92%**	**-23.48%**	**3.8%**

3. Stevens Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 10 proposed VTrans BMPs. The watershed-wide proposed FRP scenario addresses 115.2% of the modified high-flow target, providing a 15.2% factor of safety. The Credit model showed a high flow reduction of 2.25% for the VTrans allocation for the Stevens Brook Watershed, which equates to 148.5% of the total VTrans required high flow reduction (Table L4). The factor of safety is included in the recommended BMP list to provide the MS4s with additional options in the event the list has to be modified or as conditions in the watershed change from present day. In the event a proposed project becomes infeasible after further design and construction planning or must be downscaled, VTrans will still be able to meet their allocated target for that watershed without seeking out additional projects. No progress was made towards the suggested low flow increase target.

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table L4.

Table L4 Stevens Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
St. Albans City	-17.80%	-16.52%	-1.28%	92.8%
St. Albans Town	-5.09%	-9.33%	4.25%	183.5%
VTrans	-1.52%	-2.25%	0.74%	148.5%
Watershed Total	**-24.40%**	**-28.10%**	**3.70%**	**115.2%**

3.2. VTrans Proposed BMPs

There are 10 proposed VTrans BMPs in the Stevens Brook Watershed, which are summarized in Table L5. These BMPs include two detention basins and eight median filters.

The proposed location for the Upper Fairfield Hill Rd. retrofit site is off Fairfield Hill Road (VT-36, VTrans-owned) on a private parcel within the Town. It captures approximately 34 acres of drainage from VT-36 as well as neighboring homes and driveways. A water quality treatment/flow control basin is proposed. Private land would need to be acquired in order to implement the BMP. The land, as of November 2013, is advertised for sale. The benefit of the proposed facility location is the ability to control flow at the top of the watershed before stormwater flows enter the main stream channel and gain velocity and erosive strength.

A water quality/flow detention retrofit is proposed at the Fairfield Rd./I-89 retrofit site, designed to capture runoff from a 28.9 acre-area including a portion of Fairfield Road (VT-36) and Town residences along the road. The structure will need to be designed according to Federal Highway Administration (FHWA) guidelines for safety. A new culvert under Fairfield Road would be required to route flow from the north side of VT-36 into the facility. The proposed BMP would treat runoff from VTrans and Town-impervious cover, and therefore a cost-share is recommended.

Eight sites within the VTrans I-89 ROW were identified as potential sites for water quality/flow detention BMPs to detain and treat runoff from I-89. The sites are all located in existing vegetated stormwater conveyances within the I-89 median. Key features of the structures

include earthen check dams designed to create up to 1.5 feet of ponding depth behind each dam, amended soils consisting of a 50/50 blend of sand and native soil at the surface, and a pure sand filter below. The structures are designed with a perforated underdrain to be located below the sand filter, connected to the nearest downstream, outlet structure or daylighted. The sites are all on VTrans land. Environmental permitting including primarily potential wetland impacts needs to be considered for each site. Designs are required to comply with FHWA safety standards for the interstate system.

The remaining 2 acres of managed VTrans impervious cover is managed by 4 additional BMPs. While these BMPs manage small amounts of VTrans impervious area, they are not determined to be the responsibility of VTrans to implement.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 148.5% of the VTrans high flow target was met by these BMPs (Table L5).

The proposed BMPs are summarized in Table L5. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMPs are located in Appendix B. Preliminary design concept plans for three of the proposed projects can be found in Appendix H-6 (Fairfield Rd I-89, SDC105b, and Upper Fairfield Hill Rd).

Table L 5 VTrans final proposed BMPs for the Stevens Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Upper Fairfield Hill Rd	VTrans	VTrans/ Private	Detention Basin	NP	34.3	3.4	9.8%	1.2	34.4%	1.28	22.7%	$164,000
Fairfield Rd. / I-89	VTrans	VTrans	Detention Basin	NP	28.9	2.1	7.2%	0.8	40.8%	0.68	16.6%	$109,000
SDC118	VTrans	VTrans	Median Filter	NP	1.1	0.5	50.9%	0.5	100%	0.06	10.7%	$28,000
Median A1	VTrans	VTrans	Median Filter	NP	0.9	0.4	46.4%	0.4	100%	0.06	8.2%	$27,000
SDC140b	VTrans	VTrans	Median Filter	NP	1.0	0.5	50.4%	0.5	100%	0.05	9.9%	$26,000
SDC408	VTrans	VTrans	Median Filter	NP	0.9	0.5	50.0%	0.5	100%	0.05	9.2%	$23,000
SDC98b	VTrans	VTrans	Median Filter	NP	0.9	0.4	49.0%	0.4	100%	0.05	8.2%	$22,000
Median A2	VTrans	VTrans	Median Filter	NP	0.7	0.3	45.5%	0.3	100%	0.04	5.8%	$21,000
SDC105b	VTrans	VTrans	Median Filter	NP	1.0	0.5	53.3%	0.5	100%	0.05	10.4%	$26,000

SDC105c	VTrans	VTrans	Median Filter	NP	0.8	0.4	52.1%	0.4	100%	0.04	8.6%	$20,000
Other non-VTrans dominated BMPs	*Town / City/ VTrans*	*Non-VTrans*	*Assorted*	--	--	--		*2.0*		--	*38.3%*	
Watershed Total:								**7.6**			**148.5%**	**$466,000**

M. Sunderland Brook

1. Sunderland Brook TMDL Flow Targets

In the effort to restore Sunderland Brook to its attainment condition and lift its impaired designation, a flow-based TMDL was developed for the watershed using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows (Q 0.3%) and increases in stream low or base flows (Q 95%). These flow targets (Table M1) serve as the basis for this section of the Flow Restoration Plan (FRP).

Table M 1 Sunderland Brook TMDL flow restoration targets

Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
-3.7%	3.6%

In Table M1, the high flow target is negative (-), indicating there needs to be a reduction in high flow from the baseline condition. Conversely, the low flow target is positive (+), indicating there needs to be an increase in low flow from the baseline condition to meet this goal. While the target low flow increase is an important water quality goal, it is not an actionable requirement in the EPA approved TMDL and thus was not the primary focus of the FRP BMP identification for this study.

1.1. Future Growth Target

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 8 acres in the watershed based on local development and projected growth for Sunderland Brook. The approved TMDL flow targets for Sunderland Brook are shown in Table M1.

1.2. MS4 Allocation of Flow Targets

Allocation of the high-flow target by MS4 was approximated based on relative impervious area ownership within the watershed. Impervious cover calculations excluded railroads and agricultural areas. The University of Vermont (UVM) owns land at the Fort Ethan Allen, but as a non-traditional MS4 the VT DEC did not consider UVM to be a jurisdictional MS4 within the Sunderland Brook Watershed. It is thus not included as a contributing MS4 to the Sunderland Brook TMDL.

The Town of Essex and the Town of Colchester own the majority of impervious cover in the Sunderland Brook Watershed (35.7% and 35.6% respectively). The remaining impervious cover is owned by the Village of Essex Junction and VTrans (25.5% and 3.2% respectively). The TMDL flow targets were allocated to each MS4 based on their impervious ownership where the Town of Essex and the Town of Colchester are both responsible for 1.32% flow reductions. The Village of Essex Junction is responsible for 0.94% of the flow reduction, and VTrans is responsible for the remaining 0.12% flow reduction (Table M2).

Table M 2 Sunderland Brook TMDL flow targets allocated by MS4

Owner	Total Watershed Area (acres)	Impervious Cover (acres)	% of Watershed Impervious Cover	Target High Flow Q 0.3 (± %) Reduction	Target Low Flow Q 95 (± %) Increase
University of Vermont	----	----	----	----	----
Town of Essex	318.3	111.8	35.7%	-1.32%	1.28%
Town of Colchester	916.6	111.6	35.6%	-1.32%	1.28%
Village of Essex Junction	173.6	80.1	25.5%	-0.94%	0.9%
VTrans	17.8	10.1	3.2%	-0.12%	0.12%
Watershed Total	**1426.3**	**313.6**		**-3.70%**	**3.60%**

2. Sunderland Brook BMPDSS Model Assessment

The Vermont DEC worked with an external consultant to develop a VT-specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. The BMPDSS model is used to predict peak flows at the watershed outlet for a Pre-2002 (baseline), Post-2002 (existing condition), and a Credit (BMP implementation) scenario. All models are compared to the Pre-2002 model on a percent change basis.

2.1. BMPDSS Pre-2002 Condition Model

The VT DEC developed a Pre-2002 condition model for Sunderland Brook. This model run includes all stormwater BMPs installed prior to the issuance of the 2002 VT Stormwater Standards. The subsequent Post-2002 and Credit model runs are compared to this Pre-2002 condition model. The unadjusted flow is used in the determination of progress towards the TMDL targets to eliminate the effect of watershed area in the percent change comparison.

2.2. BMPDSS Post-2002 Model

The Sunderland Brook Post-2002 model was revised with the most up to date information regarding the BMPs that are currently in place that manage the CPv or 1-year design storm. The Post-2002 model showed that of the target flow reduction of 3.7% in the watershed, current BMPs reduced high flows by 7.91%, which equates to 213.8% of the total required flow reduction (Table M3). Of that reduction, 377.4% of the VTrans allocation of 0.12% was addressed and a no required flow reduction remains. VTrans high flow reductions exceeded the target by 0.33%. Based on the model results, no additional CPv stormwater controls will be required to meet the TMDL high-flow target. However, as noted, even though modeled flow targets exceed TMDL flow targets, additional BMPs were identified in the event that future biomonitoring of the stream reveals non-compliance with Vermont water quality standards.

Table M 3 Sunderland Brook high flow target reduction progress with Post-2002 BMPDSS model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
Town of Essex	-1.32%	-3.99%	2.67%	302.0%
Town of Colchester	-1.32%	-3.37%	2.06%	256.2%
Village of Essex Junction	-0.94%	-0.10%	-0.84%	10.8%
VTrans	-0.12%	-0.45%	0.33%	377.4%
Watershed Total	**-3.70%**	**-7.91%**	**4.21%**	**213.8%**

3. Sunderland Brook Required Controls Identification

Potential BMP site selection focused on areas with a high-percentage of impervious coverage where stormwater flows were expected to be concentrated. A combination of field assessments and Geographic Information System (GIS) data was used to identify and screen potential BMP locations.

An initial list of retrofits was identified based on BMP feasibility as determined by available space, mapped NRCS soils, existing topographic data, and mapped stormwater and wastewater infrastructure provided by the VT DEC and MS4s. Natural resources were screened, though as part of the final design, an in-depth engineering assessment will still be required at each site to confirm the presence or absence of utilities and other potential impacts. The BMPs were then designed to meet the CPv storage criteria using HydroCAD® software.

3.1. BMPDSS Credit Model Assessment Results

The final recommended BMP list was modeled in the BMPDSS Credit run, which included 1 proposed VTrans BMP. The watershed-wide proposed FRP scenario addresses 482.4% of the modified high-flow target, providing retrofit options for the MS4s well above the required high flow reduction. The factor of safety is included in the recommended BMP list to provide the MS4s with options in the event that biomonitoring of Sunderland Brook reveals non-compliance with Vermont water quality standards. A low flow increase of 8.3% was modeled, which equates to 58% of the suggested target.

The Credit model showed a high flow reduction of 1.01% for the VTrans allocation for the Sunderland Brook Watershed, which equates to 847.3% of the total VTrans required high flow reduction (Table M4).

The ultimate determination for implementation of projects providing benefit beyond the high-flow target (> 100%) will be made by the State of Vermont based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3). Progress toward the TMDL flow targets with the proposed FRP scenario was allocated by MS4 based on impervious area coverage to determine the extent to which the proposed BMPs addressed each MS4's allocated responsibility of the flow targets, summarized in Table M4.

Table M 4 Sunderland Brook BMPDSS Credit model results

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
Town of Essex	-1.32%	-10.02%	8.71%	759.6%
Town of Colchester	-1.32%	-5.23%	3.91%	397.1%
Village of Essex Junction	-0.94%	-1.59%	0.64%	168.0%
VTrans	-0.12%	-1.01%	0.89%	847.3%
Watershed Total	**-3.70%**	**-17.85%**	**14.15%**	**482.4%**

3.2. VTrans Proposed BMPs

There is one proposed VTrans BMP in the Sunderland Brook Watershed, which is summarized in Table M5. This BMP includes one infiltration trench that manages 2.3 acres of VTrans impervious cover, 59.4% of the total impervious cover managed.

Tracy Rd. located in the Town of Colchester, was identified as a retrofit opportunity. The BMP retrofit would involve a retrofit of the existing grass swale on the VTrans site along Tracy Road. The existing grass swale and attached stormwater system collects drainage from the VTrans garage site and also from Barnes/Troy Ave. The existing swale would be expanded and a 2-foot-deep stone infiltration gallery would be added under the surface. The surface would remain as

grass and riser pipes would connect drainage into the deeper stone gallery for easier maintenance. The existing fence would need to be moved closer to the road. This project would benefit high and low flow targets as well as improve water quality discharge from the site. Since the contributing drainage comes from the Town of Colchester and VTrans impervious, a cost share could be set up to allocate resources. On a runoff volume basis, the Town of Colchester contributes 0.195 ac-ft versus 0.23 ac-ft from VTrans owned land. The split is about 46%/54%.

The Fort Ethan Allen Offset Project manages the remaining 4.5 acres of VTrans impervious cover, 14.2% of the total impervious cover managed in this drainage area. This BMP manages a small amount of VTrans impervious area through the construction of a micropool extended detention pond, it is not determined to be the responsibility of VTrans.

The percent of high-flow target mitigated by each BMP was calculated as a percentage of the total VTrans owned impervious cover managed as shown below.

% of high-flow target managed = (A÷B) x C

A = VTrans impervious managed by individual BMP (acres)
B = total VTrans impervious managed by all BMPs in watershed (acres)
C = VTrans high flow target addressed by all BMPs in watershed (% reduction)

A total of 847.3% of the VTrans high flow target was met by these BMPs, the majority of which are a result of the existing Fort Ethan Allen existing Post-2002 BMP. The proposed Tracy Rd BMP manages the remaining 288% of the high flow target (Table M5).

The proposed BMPs are summarized in Table M5. This table includes the impervious cover managed, drainage area, and CPv volume storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A and details about the proposed BMP is located in Appendix B. A preliminary design concept plans for the Tracy Rd project can be found in Appendix H-7.

Table M 5 VTrans final proposed BMPs for the Sunderland Brook FRP BMPDSS Credit model

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	VTrans Impervious Cover Managed (acres)	VTrans Impervious Cover Managed (% of Total Impervious Cover)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	VTrans High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)
Tracy Rd.	VTrans/ Colchester	VTrans/ Colchester	Infiltration Trench	6363-INDS	5.0	3.9	78.3%	2.3	59.4%	0.43	287.9%	$54,000
Existing Fort Ethan Allen (Post-2002) BMP	*Town / City/ VTrans*	*Non-VTrans*	*Assorted*	*5598-INDO*	*46.5*	*31.8*	*68.3%*	*4.5*	*14.2%*	--	*559.4%*	
Watershed Total:								**6.8**			**847.3%**	**$54,000**

N. Design and Construction Schedule

A design and construction (D&C) schedule was developed to provide a long term plan for the implementation of the VTrans FRP. The 54 projects were spaced out over a 16-year timeframe in seven separate phases. The timeline provides for design, acquisition of necessary permits, regulatory approvals, acquisition of necessary land, and construction. The flow restoration targets are subject to adjustment by the Secretary based on biological monitoring data or other confounding information concerning high flow reduction progress. Adjustments to the flow targets may impact the schedule and full implementation of the proposed projects. The D&C is a working document and will be revised based on new information regarding the projects and stream conditions. A complete implementation schedule summary can be found in Appendix E. A summary of the number of projects to be constructed and the total cost by implementation phase is included below (Table N1). A workbook has been developed to track these projects (Appendix F).

Table N 1 Summary of project implementation costs and the number of projects to be constructed in each implementation phase

	Phase 1 (2017-2019)	Phase 2 (2020-2022)	Phase 3 (2023-2025)	Phase 4 (2026-2027)	Phase 5 (2028-2029)	Phase 6 (2030-2031)	Phase 7 (2032)	Total
# of Projects	14	18	7	6	3	3	3	**54**
Total Cost (Rounded to Nearest $1,000)	$1,142,000	$729,000	$1,033,000	$1,020,000	$588,000	$607,000	$1,752,000	**$6,871,000**

O. Financial Plan

Planning level costs were estimated for each project using a consistent spreadsheet-based method for all projects. As such, some cost estimates may differ slightly from those presented in other FRP documents. The total estimated implementation cost for all 54 BMPs is $6,871,000. VTrans will request state and federal funding for the appropriate amount to implement the BMPs as outlined in the D&C (see Table N1). For those projects that will require a joint effort with another municipality, VTrans will request funding for their portion of the cost share. In watersheds where VTrans is either not meeting or exceeding their allocated target, there may be cost sharing between MS4s.

a. BMP Cost Estimates

A spreadsheet-based method, originally developed by the Horsley-Witten (HW) Group, was used to develop planning level costs for all proposed BMPs. The methodology was used in the development of the Centennial Brook FRP and provides consistent cost estimates across watersheds (see HW Memo in Appendix G). It is expected that these costs will change as further designs are completed and site conditions and constraints are better understood. Cost estimates are based on limited site investigation, but are useful for planning purposes. All estimates presented are based on 2014 dollars.

The BMP cost estimation is based on the design control volume as determined by HydroCAD models developed for each site, unit costs that take into account the type of BMP, a site adjustment factor that takes into account the difficulty of construction based on present development at a location, a factor for the design and permitting of the BMP, and a land acquisition cost.

Base unit costs were dependent on the type of BMP proposed, as well as the area of the BMP. For example, a detention basin's base cost would be \$2 per ft^3 (Table O1 upper). Depending on the type of site where the BMP will be constructed, a cost multiplier was used with more constricted and developed sites assumed to increase construction complexity and cost (Table O1 lower).

Table O 1 Unit costs and adjustment factors for each BMP type

BMP Type	Base Cost (\$/ft^3)
Detention Basin	\$2
Infiltration Basin	\$4
Underground Chamber (infiltration or detention)	\$12
Bioretention	\$10
Green Infrastructure/ Underground Chamber Combo	\$22
Site Type	**Cost Multiplier**
Existing BMP retrofit	0.25
New BMP in undeveloped area	1
New BMP in partially developed area	1.5
New BMP in developed area	2
Adjustment factor for large aboveground basin projects	0.5

Final costs were also influenced by a number of other factors. These include:

- Base Construction Cost: Calculated as the product of the design control volume, the unit cost, and the site adjustment factor.

- Permits and Engineering Costs: A cost multiplier of either 20% for large storage volume projects, or 35% for small or complex projects was applied.
- Land Acquisition Costs (modified from the HW method): For projects that require the acquisition of private land, a variation from the HW method was applied. An approximate land acquisition cost of $120,000 was used per acre required for the BMP. It should be noted that this value is based on a limited estimate and not necessarily an expected cost per acre.
- Total Project Cost: The total project cost was calculated as the sum of the base construction cost, permitting and engineering costs, and land acquisition costs. This cost was then rounded to the nearest $1,000.
- Minimum Cost Adjustment: This methodology tends to underestimate the cost of small retrofits, so a minimum project cost of $10,000 was applied for a simple, small projects such as an outlet retrofit, and a minimum cost of $25,000 was applied for more complex projects.

Cost estimates are summarized by watershed for VTrans BMPs below (Table O2). Cost estimates by BMP are located in Appendix C.

Table O 2 Cost estimate summary by watershed for all proposed VTrans BMPs

Watershed Name	# of VTrans BMPs	Estimated Cost
Allen Brook	13	$764,000
Bartlett Brook	2	$577,000
Centennial Brook	2	$1,851,000
Indian Brook	3	$353,000
Moon Brook	1	$279,000
Munroe Brook	3	$607,000
Potash Brook	6	$738,000
Rugg Brook	13	$1,182,000
Stevens Brook	10	$466,000
Sunderland Brook	1	$54,000
VTrans Total:	**54**	**$6,871,000**

P. Regulatory Analysis

BMPs presented in this FRP document will be implemented over the 16-year timeframe detailed in D&C. In several watersheds, the proposed BMP implementation scenario manages >100% of the VTrans high flow reduction target and thus includes a robust factor of safety (i.e., Sunderland Brook, Bartlett Brook; Appendix D). This factor of safety is included so that if one or more proposed projects become infeasible after further design and construction planning, VTrans will still be able to meet their allocated target for that watershed without seeking out

additional projects. The proposed BMP implementation plan will serve as a guide for VTrans, but is subject to change as more information becomes available. Each of the BMPs is either on land owned by VTrans, on land controlled by VTrans, or on land controlled by another municipality. For the BMPs that fall into the third category, VTrans is prepared to work with the appropriate municipality to implement the BMP.

VTrans currently has one expired permit, the US Route 7, Shelburne-South Burlington (Permit 1-1291), that will be incorporated into the VTrans MS4. VTrans has filed the paperwork to do so. VTrans does not own the Williston Welcome Center (Permit 1-1401) permit. This permit was issued to the Department of Buildings and General Services. VTrans does not intend to take over this permit, although the pond at this rest station will be retrofit as part of the FRP implementation. VTrans does not require any additional regulatory assistance from the DEC at this time.

Q. Glossary of Terms

A glossary of relevant terms is provided below.

Best Management Practice (BMP)- Generally, BMPs are defined as, "schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State and waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage" (MS4 Permit, 2012). In the context of the FRP, BMPs include prescribed stormwater flow control practices as defined in the computer-based BMPDSS model, in which various BMPs scenarios can be assessed.

Best Management Practice Decision Support System (BMPDSS)- A computer-based hydrologic model used to assess the impact of various stormwater BMP scenarios. This tool was developed by a private consultant for the VT DEC to use as the assessment tool for compliance with the Stormwater TMDLs.

Channel Protection Volume (CPv)- The stormwater volume generated from the 1-year, 24-hour rainfall event. The Vermont Stormwater CPv Design Standard requires 24 hours of extended detention storage of the CPv in warm water fish habitat and 12 hours for cold water fish habitat as a means to reduce channel erosion.

Detention BMP- A BMP (e.g. detention pond) which stores stormwater for a defined length of time before it eventually drains to the receiving water body. Stormwater is not retained in the practice long term. The objective with a detention BMP is to reduce the peak discharge (Q_p) from the basin in the effort to reduce channel erosion and settle out pollutants from the stormwater.

Flow Duration Curve (FDC)- An FDC is a curve displaying the percentage of time during a period that flow exceeds a certain value, with the low flow represented by the 95^{th} percentile (Q 95%) of the curve, and the high flow represented by the 5^{th} percentile (Q 0.3%).

Flow Restoration Plan (FRP)- The FRP is a required element of the MS4 General Permit #3-9014, under section IV. C. 1., for stormwater discharges to impaired waters. The FRP is a 20-year implementation plan of stormwater flow control BMPs to meet the TMDL high flow target and return the impaired water to its attainment condition. The FRP is required to include a list of stormwater BMP controls, as well as modeling results from the VT BMPDSS model demonstrating compliance of the approved TMDL flow target with the proposed BMP list.

Infiltration BMP- A BMP that allows for the infiltration of stormwater into the subsurface soil as groundwater, which returns to the stream as baseflow. Mapped soils of Hydrologic group A or B (sandy, well-drained soils) are an indicator of infiltration potential. Infiltration reduces the

amount of surface storage required. Typical BMP practices include infiltration basins, underground chamber systems, bioretention practices, and others.

Non-Jurisdictional Impervious- Non-jurisdictional impervious area is impervious cover that does not require a stormwater permit and is not managed by a stormwater BMP (impervious growth < 1 acre).

Residual Designation Authority (RDA)- The RDA permit is separate from the MS4 permit, held by the private landowner.

Stormwater Management Plan (SWMP)- A comprehensive program to manage stormwater discharges from the Municipal Separated Storm Sewer System as mandated by the MS4 General Permit #3-9014.

Stormwater TMDL- Vermont developed stormwater Total Maximum Daily Loads (TMDLs) for impaired watersheds using stormwater flow as a surrogate for pollutants. The basis for the flow-based TMDL is the understanding that stormwater is the source of pollutant loading. Therefore, minimizing stormwater flows will reduce pollutant loading to the streams and Lake Champlain. The approved TMDL requires a reduction in high flows, defined as greater than the 1-year storm event. The TMDL also includes a non-actionable (not enforced) low flow target, which is measured by an increase in stream baseflow (groundwater flow to streams).

Total Maximum Daily Load (TMDL)- A TMDL is a calculation of the maximum pollutant loading that a water body can accommodate and still meet Vermont Water Quality Standards. The term TMDL also refers to the regulated management plan, which defines how the water body will be regulated and returned to its acceptable condition, including the maximum loading, sources of pollution, and criteria for determining if the TMDL is met.

TMDL High Flow Target- The TMDL target defined as the percent change between the Pre-2002 (baseline) condition and the Post-2002 (existing) high flow. The high flow is the flow rate in the stream that is exceeded 0.3% of the time (Q 0.3%) over a 10-year simulation period. The Q 0.3% has been equated to the 1-year design storm runoff.

TMDL Low Flow Target- The non-actionable TMDL target defined as the percent change between the Pre-2002 (baseline) condition and the Post-2002 (existing) low flow. The low flow is the flow rate in the stream that is exceeded 95% of the time (Q 95%), over a 10-year simulation period. The Q 95% is considered baseflow, which is the flow in a stream fed by groundwater.

R. Appendices

Attachment E VTrans Phosphorus Control Plan (to be provided by April 2020)
December 5, 2017

ATTACHMENT E VTRANS PHOSPHORUS CONTROL PLAN (TO BE PROVIDED BY APRIL 2020)

ATTACHMENT F INCORPORATION OF PREVIOUSLY PERMITTED STORMWATER SYSTEMS

Attachment F Incorporation of Previously Permitted Stormwater Systems
December 5, 2017

Project Name	Location	Stormwater Permit	BMP Type(s)
Alburg-Swanton Missisquoi Bay Bridge	Alburg-Swanton	6070-9010	grass/stone swales, scuppers
Barre Town HES 026-1(38) (roundabout)	Barre Town	4969-9010	catch basins, culverts, dry swale, flow splitter
Berlin STPG SGNL(40)	Berlin	7066-INDS	grass/stone swales
Bennington D1 Garage (TRANSFERRED TO VTrans)	Bennington	3361-9010	culverts, detention basins, swales
Bennington-Hoosick DPI 0146(1) C/3 &C/4	Bennington-Hoosick	3156-9010.R	vegetated/stone swales, stone check dams, sedementation trap, culverts, detention basins,
Brandon D3 Maint Garage (Arnold Rd)	Brandon	3768-9010.R	vegetated swales, detention basin
Bristol STP BRF 021-1(15)	Bristol	5221-9010	grass treatment channels, disconnection
Burke RS 0269(3) Bridge Replacement	Burke	3906-9010.R	grass/stone swales, Dis, culverts
Cabot-Danville FEGC F028-3(26) C1	Cabot-Danville	4022-INDS.R	grass channels
Cambridge BRF 027-1(4) & STP 030-2(27)	Cambridge	4765-9010	grass channels, site balancing
Cambridge BRF 030-2(12)	Cambridge	3885-9010.R	DI, stone lined swale, sheet flow
Chester BRF-F 016-1(3)	Chester	3905-9010.R	catch basins, culverts
Colchester D5 ":Fort" Site Redevelopement	Colchester	6363-INDS.R	grass channels, micropool extended-detention pond, culverts
Colchester HES 0281(28)	Colchester	7427-INDS	sheet flow, grass channel
Colchester Park & Ride and Maintenance Facility	Colchester	3012-9010.R	wet detention basin, rain garden (not part of permit)
Cornwall BRS0172(6)	Cornwall	5606-9010	sheet flow, stone lined swales, pre-treatment chamber, grass treatment channels
Danville F 028-3(17) US2 Reconstruction/ Reloc	Danville	3743-9010.R	sheet flow, stone/grass lined swales
Danville FEGC 028-3(32) (downtown revitilization)	Danville	4144-9010	catchbasins, culverts, grass channels, wet pond
Derby Salt and Sand Shed (TRANSFERRED TO VTrans)	Derby	3076-9010	20% reduction in impervious
Dummerston Garage	Dummerston	7758-9015	sheet flow, grass channel, culverts
East Montpelier STPG 028-3(35)S US2/ VT14 inter	East Montpelier	5517-INDS.R	sheet flow, grass channel, culverts
Essex Town STP 5400(5) (VT117/ sand hill rd inter)	Essex Town	6300-INDS.R	sheet flow, grass channels, Dis, culverts
Ferrisburgh F 019-4(16) US7	Ferrisburgh	3764-9010.R	DIs, culverts, grass lined swale
Ferrisburgh Maint. Facility (TRANSFERRED TO VTrans)	Ferrisburgh	3399-9010.A	sheet flow, grass swales, sedement forebay, detention pond, catchbasins
Groton F 026-11(27) & BRF 026-11(27)S	Groton	3904-9010.R	DIs, culverts, grass lined swales, sheet flow, stone fill
Guilford Weigh Station	Guilford	6989-9015	sheet flow, wet swale, culverts
Hartland BRS 0113(21) US5	Hartland	3903-9010.R	Dis, culverts
Highgate D8 Highway Maintenance Facility	Highgate	4302-9010.R	grass swales, infiltration basin
Hyde Park HES 030-2(23) roundabout	Hyde Park	6263-9010	dry swales, catch basins, culverts, grass swales
Johnson STP 030-2(21)(25) Streetscape	Johnson	6531-9015	catch basins, culverts, swales, hydrodynamic separator
Middlesex D6 garage expansion	Middlesex	4578-9015	sheet flow, removal of impervious surface, revegetation(grass buffer strip), shallow grass infiltration area
Milton STP 5800 (2)	Milton	6019-9010	sheet flow, grass channels, disconnection, dry swales
Moretown-Middlesex BRS0284(14)	Moretown-Middlesex	4278-9010	sheet flow, vegetated disconnection, grass channel, culverts, curbing, Dis
Newfane STP F 015-1(16) Southern	Newfane	3953-9010.R	Dis, culverts, stone-lined swales, stone pad energy dissipater, grass-lined swale, sheet flow
Newfane STP-HES 015-1(15) Northern	Newfane	3767-9010.R	grass/stone lined swales
Pittsford-Brandon Seg 5	Pittsford-Brandon	3628-9010	grass channels, culverts, hydrodynamic/swirl concentrator device
Putney CMG PARK(26)	Putney	6923-9015.A	sheet flow, grass/stone swales, micropool extended detention basin
Randolph GMC Park (21) SC Park & Ride	Randolph	3850-9010	grass/stone lined swales, catch basins, pocket pond, outlet control structure
Richmond CMG Park (31) and STP 0284(17)	Richmond	6797-9010	swales, culverts, dry swales
Richmond STP RS 0284(11) Checkerhouse truss	Richmond	5526-9010	sheet flow, grass lined swale, culverts, channel flow
Searsburg-Wilmington F010-0(18) (VT Rte 9)	Searsburg	4301-9010.R	sheet flow, grass lined swale, culverts, disconnection
Shelburne - S. Burl US7 Shelburne Rd- unimpaired	Shelburne-South Burlington	5625-9010	Dis, vegetated/stone swales, culverts
Sheldon HES 034-1(17) Reconstruction	Sheldon	3661-9010.R	Dis, rock fill with vegetated cover, rip rapped outlet
Springfield CMG PARK(32)	Springfield	7034-9015	culverts, grass swales, grass treatment channel,
St. Albans US7 and VT207 intersections (Walmart)	St. Albans	6765-9010	grass swales
Stockbridge BRF 022-1(20)	Stockbridge	4233-INDS.R	sheet flow, grass swales, culverts, infiltration basin, site balancing, pretreatment plunge pool, stabilized emergency spillway, disconnection
Troy RS 0311(1)	Troy	3772-9010.R	Dis, culverts, stone pad, grass/stone swales,
Vergennes-Ferrisburgh F 017-1(5) 22A	Vergennes-Ferrisburgh	3765-9010.R	sheet flow, grass/stone lined swales, culverts, Dis
Waitsfield D6 Maintenance Garage	Waitsfield	5334-9010	sheet flow, vegetated swale, rock lateral spreader
Westminster-Rockingham BRS 0113(15)	Westminster-Rockingham	3763-9010.R	sheet flow, grass swales, culverts, Dis, disconnection
Wilmington F 010-1(19)	Wilmington	3766-9010.R	Dis, culverts, sheet flow, disconnection, stone swale
Windsor Garage Site Improvements	Windsor	5499-9015.A	disconnection, grass channel
Windsor IM 091-1(64) Bridges 33N & S	Windsor	6972-INDS	sheet flow, dry swale
Clarendon - Rutland Airport 2010 Permit Renewal includes: Taxiway "E" (3769-9010) and Parking Lot/GA Arpron (3770-9010) and NW Apron/Taxiway (4193-9010)	Clarendon	3769-9010.R	grass lined swale, sheet flow, Dis, sedimentation basins, culverts, vegetated detention pond, underdrain, controlled outlet structure
Clarendon - Rutland Airport MALSR (VTrans & FAA)	Clarendon	3473-9010	grass channels
Middlebury State Airport Safety Area Buyouts	Middlebury	4581-INDS	sheet flow, vegetated disconnection, infiltration basin, culverts, grass broadcrested weir
Berlin E.F. Knapp runway taxiway apron/etc	Berlin	4582-9010	sheet flow, grass channel, catch basins, culverts, wet pond, controlled outlet structure, level spreader
Coventry - Newport Air (amended for more hangars)	Coventry	3836-INDS.A1	sheet flow, culverts, gravel wetland with pre treatment forebay, controlled outlet structure, stabilized outfall, grass channels, surface sand filter with pre-treatment forebay, dry pond, disconnection
Lyndon - Caledonia Cnty Airport (hangers/taxiway)	Lyndon	4199-9010	sheet flow, vegetated disconnection
Lyndon - Caledonia Cnty Airport (new building & parking)	Lyndon	3896-9010	sheet flow, grass swales, culverts
Morristown - Morrisville/Stowe Air (2 hangars & txwy)	Morristown	4272-9010	grass lined swale