Stormwater Management Plan

Town of Rutland, Vermont

General Permit 3-9014 (2018), NPDES Number VTR040000

Welcome to
The Town of Rutland, Vermont

Submitted to the Vermont Department of
Environmental Conservation
Watershed Management Division

VERMONT

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Town of Rutland
181 Business Route 4
Center Rutland, VT 05736

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1. INTRODUCTION

The following represents the Town of Rutland's Stormwater Management Program (SWMP) as required by the State of Vermont, Agency of Natural Resources (ANR), Department of Environmental Conservation (VT DEC), National Pollutant Discharge Elimination System (NPDES), General Permit 3-9014 (2018) for Stormwater discharges from Small Municipal Separate Storm Sewer Systems (MS4s).

a. WATERSHED DESCRIPTION

The Moon Brook watershed, within the Town of Rutland, is the regulated area under this SWMP. The Moon Brook watershed encompasses 2.44 square miles of the Town. Within this regulated area are 21 known stormwater outfall locations. These outfalls were previously mapped by the VT DEC. See Figure 1 for a map of the regulated area.

b. WATER QUALITY BASED REQUIREMENTS

Pursuant to the Clean Water Act 402(p)(3)(B)(iii), the permit includes provisions which require the permittee to reduce the discharge of pollutants to the maximum extent practicable, protect water quality, and to satisfy the Clean Water Act.

c. REQUIREMENTS TO MEET WATER QUALITY STANDARDS

Discharges shall not cause or contribute to an exceedance of applicable water quality standards for the receiving waters. Applicable water quality standards are the Vermont Water Quality Standards that are in place upon the effective date of the permit. If at any time the Town becomes aware that a discharge causes or contributes to an exceedance of applicable water quality standards, the Town shall, within 60 days of becoming aware of the situation, eliminate the conditions causing or contributing to the exceedance of water quality standards.

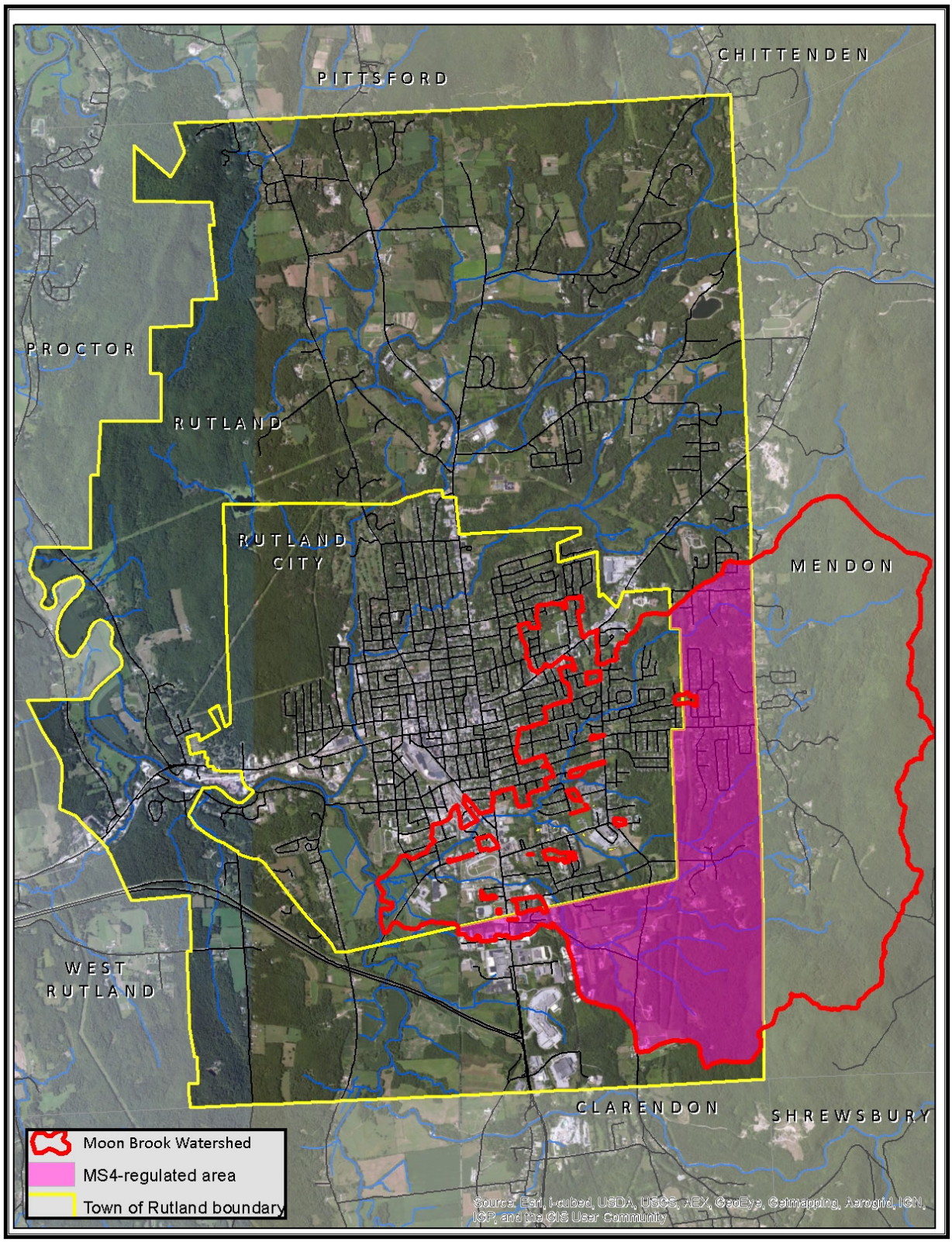

Figure 1. Map of the Moon Brook watershed (red) including the Town of Rutland (yellow) and associated MS4-regulated area (pink).

If elimination within 60 days is infeasible the Town shall document in its SWMP measures and anticipated timeframes to eliminate the conditions causing or contributing to the exceedance. Within 30 days of eliminating the condition, the Town shall document the measures used to correct the condition in the SWMP.

The Town will include in its annual report a description of any such discharges identified during the reporting period; a description of measures taken to eliminate conditions during the reporting period or the basis of a finding that elimination is infeasible; and a timeframe for completion of all steps necessary to eliminate such discharges. The Town shall comply with any additional requirements or schedules established by the Secretary, including any requirements to submit additional information concerning the potential cause of the exceedance.

2. DISCHARGE CONTEXT

a. Part 4.2 DISCHARGES TO IMPAIRED WATERS

The VT DEC has identified the Moon Brook watershed as being impaired by stormwater. The Town of Rutland intends to achieve compliance through the implementation of the SWMP contained on the following pages, to include specific actions outlined within the six minimum control measures.

The Town's SWMP contains several strategies aimed at controlling stormwater runoff pollution. These strategies include controlling sediment through the implementation of Construction Site Stormwater Runoff Controls, and Post-Construction Stormwater Management in New Development and Redevelopment. The Plan also works toward the control of illicit discharges through the implementation of the Town's Illicit Discharge Detection and Elimination Program. The Town will also work with the Rutland Natural Resources Conservation District (RNRCD) to support and publicize its cleanup activities with a focus on the Moon Brook and its tributaries, as well as the development and implementation of planting programs to increase vegetated buffers in riparian areas. The Town will also undertake a storm drain stenciling program to identify catchbasins that drain to waterways and will complete an assessment of municipal operations to improve maintenance of the stormwater system and to limit pollutant discharge. The public works garage is now covered under an operational stormwater permit (7283-9015). These activities will be focused within the Moon Brook watershed primarily, because it is the MS4-regulated area of the Town subject to the requirements of General Permit 3-9014 (2018). However, regulatory implementation including illicit discharge and construction/post-construction runoff control will likely be applied Town-wide. The most significant effort in the short term, planned for adoption in 2019, is the Town's stormwater ordinance.

b. Part 4.2.A DISCHARGES TO IMPAIRED WATERS WITH AN APPROVED TMDL

i. Part 8.1 Flow Restoration Plan

The Town has completed a study to identify and prioritize potential stormwater retrofit opportunities in Moon Brook to make progress toward Flow Restoration Plan (FRP) requirements under the Moon Brook Total Maximum Daily Load (TMDL). The Town has prepared a complete FRP containing the following information:

- ✓ An identification of the suite of necessary stormwater Best Management Practices (BMPs) that will be used to achieve the flow restoration targets.
- ✓ A design and construction schedule for the stormwater BMPs that has been identified as necessary to achieve the flow restoration targets.
- ✓ A financing plan that estimates the cost of implementing the FRP.
- ✓ A regulatory analysis that identifies and describes what, if any, additional regulatory authorities will be needed to implement the FRP.
- ✓ An identification of regulatory assistance that will be needed to implement the FRP.
- ✓ An identification of any third party that is responsible for implementation of the FRP.

Schedule of Compliance – There are two expired permits within the flow impaired area that the Town has incorporated into its MS4. These two permits are detailed in Table 1 below:

Table 1. List of expired permits within the flow impaired area.

Site Name	Permit Number	Permit Expiration Date	Stormwater System
Wynnmere Senior Housing Project	4375-INDS	1-22-2012	Swales and catchbasin collection to detention pond
LaVictoire Residential Subdivision	1-1031	6-30-1996	Vegetated swales to culverts
Table prepared by Emily Schelley (VT DEC, January 2014). Revised by Watershed Consulting (2015).			

The Town will implement all measures necessary to achieve the flow restoration targets in the stormwater TMDL no later than December 5, 2032, and will report on progress annually no later than April 1st of each year. To date, the Town has successfully implemented the first project identified in the FRP, the Hitzel Terrace Retrofit. The second project, the Wynnmere Pond Retrofit, is presently in the planning and design phase and is set for a 2019 implementation.

Flow and Precipitation Monitoring Program – Flow and precipitation monitoring has not been initiated because the City of Rutland, the other MS4 contributing runoff to Moon Brook, has not yet implemented a flow reduction program. It is anticipated that a joint monitoring effort could be put into place when the City implements it flow reduction program.

Protection and Regulation of Development in Stream Corridors – The Town has developed a stormwater ordinance that provides enhanced protection for stream corridors within the Moon Brook watershed. The ordinance is presently in draft form and is intended to be reviewed and approved by the Town Selectboard in 2019.

ii. Part 8.2 Lake Champlain Phosphorus Control Plan

A phosphorus TMDL was developed for Lake Champlain to reduce export of this nutrient that is harmful in excess to the lake. As part of compliance with this TMDL, and under the MS4 permit, MS4 communities within the Lake Champlain Basin are required to complete a Phosphorus Control Plan (PCP) for developed lands within their municipality. The Town is committed to completing a PCP within the timeline specified under the general permit as provided in Table 2.

Table 2. Timeline for completing the PCP as specified under the general permit.

April 1, 2019	- Submit the first Annual PCP Report
April 1, 2020	- Submit the Annual PCP Report and the Implementation Table with results of the Road Erosion Inventory (REI)
April 1, 2021	- Complete the Phosphorus Control Plan (PCP) and submit it to the Secretary - Submit the Annual PCP Report
April 1, 2022 and every year thereafter	- Submit Annual PCP Report
No later than June 17, 2036	- Complete full implementation of the approved PCP

The proposed general approach to the development of the PCP will include:

- ✓ Review PCP requirements and the target assigned to the Town of Rutland.
- ✓ Complete a baseline conditions analysis to assess progress toward meeting the PCP goals including a review of the municipal roads projects, street sweeping and catchbasin cleaning, retrofits to existing town properties, and implementation of treatment practices after July 1, 2010, on non-permitted sites.

- ✓ Complete a future conditions analysis to determine additional BMPs that will be required to be designed and implemented to meet the PCP reduction target.

3. Part 6.2 MINIMUM CONTROL MEASURES

Six Minimum Control Measures – The Town has developed a SWMP which contains the required six minimum control measures (MCMs) to reduce pollutants to the Maximum Extent Practical.

a. MCM1 Public Education and Outreach on Stormwater Impacts

In order to comply with MCM1, Public Education and Outreach, the Town will continue with a public education program that distributes educational materials to the community. In order to meet this requirement, the Town will take the following steps:

i. BMP 1a, 1b, 1c: Participate in RSEP

The Town will work with the Rutland Regional Planning Commission (RRPC) to develop the framework for a Regional Stormwater Education Program (RSEP) that meets the minimum requirements of MCM1. A memorandum of understanding (MOU) between the Town and the RRPC is currently being renewed for the new MS4 permit term. This MOU will describe the tasks proposed to be completed to fulfill MCM1 as part of this new regional education and outreach strategy. A copy of the MOU associated with this regional initiative will be forwarded to the VT DEC when complete. As is the goal of the permit requirement, the Town will seek to reach residents with information about stormwater, its impacts, and methods to reduce negative consequences to waterbodies. As such, the Town (in partnership with the RRPC) will track how many people are reached and through what approach in order to refine and improve education and outreach methods in subsequent years to result in programming that appropriately targets Rutland citizens. Examples of tasks to be completed include the following:

- ✓ Maintenance and tracking of social media accounts focused on stormwater efforts in the Town;
- ✓ Coordination with local news media to run at least two stormwater-related stories per year targeting increased baseline knowledge of Rutland residents;
- ✓ Developing (or rebranding existing) messaging to be used in ad campaigns or on the website;
- ✓ Incorporation of relevant information referenced via the following weblinks into outreach materials:
    - https://www3.epa.gov/npdes/pubs/fact2-3.pdf

- https://www.epa.gov/npdes/national-menu-best-management-practices-bmps-stormwater%23edu#edu
- https://www3.epa.gov/npdes/pubs/measurablegoals.pdf

ii. BMP 1-1: Maintain Stormwater Website

The Town of Rutland has prepared a stormwater webpage (https://www.rutlandtown.com/storm-water/). This webpage provides stormwater-related information and activities within the Moon Brook watershed that involve the Town. The Town will continue to maintain this website and add new education and outreach materials as they are developed.

Rationale

Partnership between the Town and the RRPC provides additional tools and expertise for material generation and sharing as well as a mechanism for collaboration and resource sharing with other Towns in the region or across regions. Using Chittenden County as a model, Rutland seeks to leverage similar resources and partners that have resulted in success and efficiency for Chittenden County MS4 Towns through their connection with the CCRPC. The Town is a signatory on the RSEP Memorandum of Understanding (MOU) that runs from 2013 to 2018. The updated MOU will be provided to DEC once finalized.

Measurable Goal

The Town will participate on the RSEP steering committee and make payments in accordance with the terms of the MOU. The RRPC will provide a summary of activities to the Town to be included in reporting metrics to meet the permit while the Town will track cash contributions to RSEP and visits to the Town-controlled website pages specific to stormwater. The Town will also track the number of media stories that are run and any associated web traffic or activities that result from it.

b. MCM2 Public Involvement and Participation

i. BMP 2a, b, c, d: Participate in RCST

The Town intends to work with the RRPC and the RNRCD to develop the framework for a Rutland County Stream Team (RCST). This program will be modeled after the Chittenden County Stream Team program and will meet minimum requirements of engaging the public in activities related to stormwater management by offering opportunities such as:

- ✓ Catchbasin stenciling;
- ✓ Rain barrel building workshops and giveaways;
- ✓ Event tabling;
- ✓ GSI bike tour events;
- ✓ Educational training programs;

- ✓ Development of stormwater educational materials for integration in local school curriculum and annual teacher trainings on the materials (potential for a partnership with the Watershed Alliance from the University of Vermont's UVM Extension).

Rationale

The Town seeks to leverage existing events to reach community members directly as well as to integrate fun and creative approaches that have been successful in other areas (including Chittenden County). Therefore, the focus on the MCM2 efforts will be on tabling farmers markets with information on rain barrels or rain gardens, leading tours of the Town's green infrastructure sites with the assistance of the Rutland green infrastructure bike tour map developed in 2017, teaching residents how to build, install, and maintain a rain barrel, and coordinating with youth groups to do storm drain stenciling. The selected activities provide an easy entry point for residents to begin to learn about stormwater while benefiting personally from the activity.

Measurable Goal

Payments made to the RRPC to support these activities will be documented. The number of volunteers at events, the number of catchbasins stenciled, and the number of people who attend workshops or tours will also be tracked. As the program develops, and the most attractive activity options for Rutland residents are identified, the Town also aims to measure learning and behavior change from these efforts.

c. MCM3 Illicit Discharge Detection and Elimination

i. BMP 3a: Develop and enforce a program to detect and eliminate illicit discharges

An Illicit Discharge Detection and Elimination (IDDE) study has been completed for the Moon Brook watershed by an independent consultant. The Town will consider any follow up recommendations made in the report and also plan for retesting outfalls under a future follow up study. The Town's draft ordinance prohibits illegal dumping into the stormwater system.

ii. BMP 3a-1: Develop and maintain a storm sewer GIS or AutoCAD map

The VT DEC has mapped catchbasins, manholes, stormwater pipes, open swales, and stormwater outfalls in a GIS format. The Town presently has GIS software and can utilize this data. As stormwater retrofit projects are evaluated for the Town, additional data will likely be collected and there will be a need to update the data layer. The Town will request all new/corrected infrastructure data be submitted as part of ongoing stormwater planning efforts. In addition, the Town will require developers to submit

digital as-built drainage information associated with new developments regulated under the Town ordinance.

iii. BMP 3a-2: Develop and implement an Illicit Discharge Ordinance

The Town has developed an illicit discharge ordinance. The ordinance will regulate the contribution of pollutants to the MS4 from stormwater discharges by any user, prohibits illicit connections and discharges to the MS4, and establishes legal authority to carry out the IDDE Plan, including conducting inspections, monitoring, and enforcement procedures to ensure compliance with the ordinance.

iv. BMP 3a-3: Develop and implement an illicit discharge detection plan, focus on impaired waters and random dumping

The Town will develop an IDDE plan which will outline the technical process for locating potential illicit discharges and then completing the necessary follow up work to pinpoint source areas and eliminate the discharge. The plan will contain a listing of the discharges previously discovered through the baseline study currently underway, along with a schedule for addressing known discharges within the Town.

v. BMP 3a-4: Inform public of illicit discharge and disposal hazards

The Town will post the illicit discharge ordinance on the Town website and will also provide links to fact sheets on the website related to illegal dumping of hazardous materials into the storm drain system. As part of MCM2, the Town will also be partnering with the RNRCD on a storm drain stenciling project to identify inlets draining to Moon Brook to the public.

vi. BMP 3a-5: Address specific categories of Illicit Discharges, if necessary

The Town will investigate water line flushing, landscape irrigation, diverted stream flows, rising ground waters, uncontaminated groundwater infiltration (as defined at 40 CFR § 35.2005(20)), uncontaminated pumped groundwater, discharges from potable water sources, foundation drains, air conditioning condensation, irrigation water, springs, water from crawl space pumps, footing drains, lawn watering, flows from riparian habitats and wetlands, and discharges from firefighting activities. The Town will determine if these activities are significant contributors of pollutants to the Moon Brook watershed. A plan for mitigation will be prepared for any of these activities that are determined to contribute to negative water quality impacts.

vii. BMP 3a-6: Prepare annual report of monitoring and corrective actions taken

The Town will establish files to maintain all documents relating to the management of illicit discharges. A complaint system will also be established to receive citizen complaints through a stormwater hotline. The hotline will be posted on the Town's website. The

IDDE plan will be submitted with this first annual report or six months following the completion of the baseline IDDE investigation report currently in process.

viii. BMP 3a- 7: Notify the Secretary after discovery of an illicit discharge

The VT DEC IDDE notification procedure will be followed. This procedure is provided in Appendix B – IDDE Notification Procedure.

Rationale

The BMPs identified under this minimum control measure are aimed at reducing the inputs of toxics and pathogens in Moon Brook through a calculated process of identifying and addressing illicit discharges currently originating from the stormwater system, and also educating local residents and businesses on illegal dumping activities. Illicit discharge reduction has been shown to be a very cost-effective strategy for reducing pollution and therefore the Town considers this BMP to be the highest priority.

d. Construction Site Stormwater Runoff Control

i. BMP 4a-1: Develop, implement, and enforce a program for sites that disturb greater than or equal to 1 acre

The draft stormwater ordinance regulates construction activities that disturb greater than or equal to 1 acre of land.

ii. BMP 4-1: Develop and implement procedures to ensure MS4 construction activities are properly permitted

In the Town ordinance, there is a framework to evaluate construction projects to determine if they are subject to General Permit 3-9020 (2008) or an individual NPDES permit through the VT DEC. Earth disturbance activities that are determined to require coverage will be reported to the VT DEC.

iii. BMP 4-2: Review existing MS4 regulations for effectiveness in managing construction related E & S and consistency with state construction permits

The Town does not currently have zoning but has developed a stormwater ordinance for adoption to regulate construction site stormwater management. As such, the framework for this BMP will need to be built from the ground up.

iv. BMP 4-2a: Adopt E & S requirements that are at least as stringent as State requirements

The Town draft ordinance contains a section on construction erosion control requirements that are at least as stringent as State requirements.

v. BMP 4-3: Develop and implement an erosion control ordinance that regulates development not subject to State permitting

The Town ordinance includes requirements for projects that fall below the minimum regulatory threshold as set by the VT DEC. At a minimum, sub jurisdictional projects will be required to comply with the *Low Risk Site Handbook for Erosion Prevention and Sediment Control (2006).*

Rationale

The BMPs identified under this minimum control measure are aimed primarily at limiting the input of sediment and other construction materials to receiving waters, thereby impacting aquatic habitat and releasing nutrients to the aquatic environment. Requiring the implementation of erosion and sediment control BMPs will help keep sediment out of receiving waters and also reduce the burden on downstream stormwater infrastructure such as culverts and catchbasins.

e. Post-Construction Stormwater Management in New Development and Redevelopment

i. BMP 5d-1, 5d-2: Review existing MS4 regulations for effectiveness in managing stormwater runoff and consistency with State operational permits

The Town does not currently have zoning but has developed a draft ordinance with post-construction site stormwater management requirements. The regulation developed will be consistent with State post-construction permitting standards.

ii. BMP 5d-3: Assess changes to regulations to support LID

Low Impact Development (LID) measures such as bioretentions, porous asphalt/pavers/concrete, and rooftop disconnection are included in the post-construction regulations developed by the Town, as referenced by the 2017 Vermont Stormwater Management Manual. The Town website will provide links to information on LID for residential construction. In addition, the Town will work with the RNRCD to determine what LID practices have been implemented, and which types or practices are working well and have been well-received by the community.

iii. BMP 5d-4: Assess changes to regulations to minimize impervious surfaces through street & parking design

The minimization of impervious surfaces through street and parking design is considered in the post-construction ordinance that the Town will be preparing.

iv. BMP 5e: Develop and implement procedures to identify development

The Town has developed and will implement procedures to identify new development and redevelopment projects that disturb greater than or equal to 1 acre, including projects less than 1 acre that are part of a larger common plan of development or sale. The Town will report these projects to the VT DEC for coverage under the State post-construction stormwater permitting program. This information will be reported to the State each year as a part of the MS4 Annual Report.

v. BMP 5f: Develop and implement an ordinance that regulates development

The Town has developed a stormwater ordinance that regulates post-construction runoff controls for new development or redevelopment projects that disturb greater than or equal to 1 acre that are part of a larger common plan of development or sale and may not be subject to regulation under the VT DEC post-construction stormwater management permit program.

vi. BMP 5g-1: Develop and implement inspection procedures for development

There will be opportunities for inspections by Public Works personnel who routinely travel the community to complete their work. In addition, during outfall surveys as part of MCM3 or cleanup/stenciling efforts as part of MCM1 and MCM2, there will be additional opportunities for observation of ongoing development projects. The Town will further consider how inspection procedures can be implemented under the new ordinance.

vii. BMP 5g-2: Develop and implement procedures to ensure MS4 development activities are properly permitted

The Town will develop the capacity to at a minimum become informed of proposed construction projects including the total land disturbance and impervious surface to be created. Projects that exceed the minimum thresholds for permitting under the VT DEC will be referred to the State. Projects that do not exceed the minimum post-construction impervious cover standard set by the State but do exceed 1 acre of total disturbance will be subject to the Town regulatory standard to be developed.

Rationale

The BMPs identified under this minimum control measure are aimed at ensuring projects, which are proposed in the Town, are covered under a post-construction stormwater permit if the minimum regulatory threshold is exceeded. Coverage under a State permit will require that new/redeveloped impervious surface is treated and controlled prior to discharge within Town receiving waters. In addition, projects that exceed 1 acre of disturbance but do not exceed the minimum threshold for a State post-construction permit will be subject to regulatory requirement through the Town. The framework for identifying projects, reviewing and assessing

jurisdiction, and inspecting the development has been developed as part of the Town's draft ordinance.

f. Pollution Prevention/ Good Housekeeping for Municipal Operations

i. BMP 6a, b: Describe operation and maintenance program for reducing pollutant runoff from MS4 operations

The Town has completed a road erosion inventory during the summer of 2018 which identified erosion areas which are hydrologically connected to Moon Brook. The road network, including the drainage network of ditches, culverts and catchbasins in the MS4 are consistently monitored by the Public Works team. Any disturbances along those roads, due to road maintenance, such as ditching, cutting shoulders, etc. are protected by stone lining where appropriate or seeding and mulching where appropriate. These protection measures are generally completed the same day as the disturbances are completed or by the next day at the latest. Any excavated spoil from ditching or unsuitable soil from culvert changes is stored at the Town's sand pit where it is allowed to dry and compost then it is screened and used as topsoil for construction projects. Training is completed by attending appropriate workshops put on by Vermont local roads, other state agencies, or even private non-profit groups. A Town-wide REI will be completed by April 1, 2020.

A Winter Highway Maintenance Policy has been drafted and will be finalized for adoption in 2019. The focus of this plan will be within the Moon Brook watershed, but it is the intent to implement this plan throughout the Town.

ii. BMP 6c: For municipal facilities where fertilizers are applied, prohibit the use of fertilizers containing phosphorus unless warranted by a soil test

The Town does not have municipal facilities within the Moon Brook watershed. The fertilizer policy for the municipal facilities outside of the Moon Brook watershed will nonetheless be complied with under this MS4 authorization.

iii. BMP 6d: For municipal garages, an MS4 may participate in ANR's Municipal Compliance Assistance Program

The Town does not have municipal facilities within the Moon Brook watershed but will consider participating in ANR's Municipal Compliance Assistance Program for the municipal area.

iv. BMP 6e: Provide a list of all industrial facilities that the MS4 owns or operates that are subject to the MSGP

Currently there are none.

v. BMP 6f: Provide a copy of the operation and maintenance program as part of the SWMP
The Town program for Operation and Maintenance is provided in Section f(i) above.

Rationale

The BMPs identified under this minimum control measure are aimed at minimizing pollutant discharge from municipal operations as well as improving maintenance of the public stormwater system. The Town intends to implement a Winter Highway Maintenance policy to complement the program described in this section.

Appendix A – Regional Stormwater Education Program MOU

Appendix B – IDDE Notification Procedure

2016 VT DEPARTMENT OF ENVIRONMENTAL CONSERVATION PROCEDURE FOR DETECTING AND ELLIMINATING ILLICIT DISCHARGES

Background

Researchers in the science of stormwater management have found that dry-weather flows discharging from storm drainage systems can be a public health threat and contribute significant pollutant loadings causing or contributing to environmental degradation. If these loadings are ignored (by only considering wet-weather stormwater runoff, for example), little improvement in receiving water conditions may occur. Illicit dry-weather flows originate from many sources. The term "illicit discharge" is defined in EPA's Phase 1 & Phase II/MS4 storm water regulations as "any discharge to a municipal separate storm sewer that is not composed entirely of storm water, except discharges pursuant to an NPDES permit and discharges resulting from fire-fighting activities." Illicit discharges can be categorized as either direct or indirect.

➤ Examples of direct illicit discharges:

- sanitary wastewater piping that is directly connected from a home to the storm sewer
- materials (e.g., used motor oil) that have been dumped illegally into a storm drain catch basin
- a shop floor drain that is connected to the storm sewer
- across-connection between the municipal sewer and storm sewer systems

➤ Examples of indirect illicit discharges:

- an old and damaged sanitary sewer line that is leaking fluids into a cracked storm sewer line
- a failing septic system that is leaking into a cracked storm sewer line or causing surface discharge into the storm sewer (NEIWPCC, 2003)

The Federal Clean Water Act amendments (1987) require National Pollutant Discharge Elimination System (NPDES) permits for municipal storm water discharges. Section 402 (p)(3)(B)(ii) requires that permits for designated municipal separate storm sewers (MS4) shall include a requirement to effectively prohibit problematic non-storm water discharges into storm sewers. Emphasis is placed on the elimination of inappropriate connections to urban storm drains. This requires affected municipalities to identify and locate sources of non-storm water discharges into storm drains and institute appropriate actions for their elimination (Pitt et.al 2004).

In 2000 the Vermont State Legislature required the Department of Environmental Conservation (VTDEC) to implement a statewide program to: "Encourage municipal governments to utilize existing regulatory and planning authority to implement improved stormwater management by providing technical assistance, training, research and coordination with respect to stormwater management technology including illicit discharge detection and elimination (Sec. 3. 10 V.S.A. § 1264 (b)(9)).

Since 2001 VTDEC has supported the mapping and testing of all urbanized stormwater outfall pipes in order to locate illicit or illegal discharges of wastewater. About one-hundred communities have had Geographic Information System (GIS) drainage maps completed. and contractors have or are currently conducting IDDE surveys in sixty-five non-designated MS4 communities. An additional approximately 35 communities will have surveys completed by 2019.

The Imperfect Science of the Detection of Illicit Discharges

The process to locate and eliminate a discharge can be time consuming, convoluted and difficult. Discharges are often in older unmapped plumbing, are often masked or diluted by other discharges and may be intermittent in nature. Typically, a suite of indicators such as ammonia, E. coli, pH, methylene blue active substance or optical brighteners are chosen when trying to survey for and isolate a suspected illicit discharge. The monitoring strategy is focused primarily on continuous direct or indirect discharges. Typically, dilution and soil attenuation of indirect illicit discharges (such as a leaking sewer through the ground and into a storm pipe) confuses the monitoring results as one or more pollutants may not be present. Scientists detecting illicit discharges use a preponderance of evidence approach for locating all illicit discharges. No single monitoring indicator confirms a discharge. It takes time and skill to isolate and confirm an illicit discharge and many initially suspect discharges are not proven following extensive and repetitive testing.

In general, different indicators and monitoring methods are used depending on whether flow is present at an outfall to a receiving water or not. Because of the small volume of a single illicit discharge, and the large extent of a storm sewer system, outfalls may not discharge continuously. Non-flowing outfalls are more challenging to diagnose. Intermittent flows can be diagnosed using specialized monitoring techniques such as: off hours monitoring, sub-drainage bracketing, or week long optical brightener monitoring traps. Transitory discharges such as dumping of RV waste, cleaning fluids or paint are extremely difficult to detect with routine indicator monitoring, and are frequently identified only from hotline reports.

For all of the above reasons the Department is careful and cautious in declaring the existence of an illicit discharge.

Illicit Discharge Detection Procedure

The below procedure is followed for IDDE detection and confirmation. This procedure is to be followed when contractors operating under funding from the Vermont Department of Environmental Conservation Clean Water Initiative Program's Illicit Discharge Detection and Elimination (CWIP-IDDE) Program confirm an illicit discharge into a municipal separate storm sewer system or directly to a surface water or groundwater of the state.

The standard illicit discharge detection and elimination operating procedure followed by an CWIP-funded contractor is to complete an initial survey of municipal stormwater outfalls and then perform follow-up investigations within stormwater systems suspected of passing illicit discharges. Municipalities locating illicit discharges on their own shall follow a similar procedure. Stormwater systems are flagged for follow-up investigation if a suite of water quality tests indicates that an illicit discharge may be present. For discharges that the contractor finds

exceeds the following indicator standards the contractor must notify, upon discovery, the Department:

(1) E. coli >= 235 colonies/100 ml **and at least two of the following:**
(2) Ammonia >= .25 mg/l
(3) Methylene Blue Active Substance (MBAS) >= .2 mg/l
(4) Optical Brightener Presence
(5) Any other parameter that the contractor measures and in the best professional judgement of the contractor exceeds a normally expected range.

The Department will review the reported data and make a determination that the suspected discharge is or is not a threat to the public and the environment. If the suspected discharge is considered a threat the Department will formally public notice the discharge on the ANR on-line event reporting system. Untreated discharges of sewage that do not reach a separate storm sewer system or that do not reach surface waters do not need to be posted through this system. The notification shall be posted on the ANR on-line event reporting system no later than 4 hours from the discovery of the unpermitted discharges, except that if the unpermitted discharge is discovered between the hours of 9:00 p.m. and 5:00 a.m., the Department shall post the notification no later than 10:00 a.m. of that morning. The CWIP Illicit Discharge and Detection Elimination Program will also log the incident into the ANR BEAR enforcement database and designate itself as the principal investigator.

For all formally public noticed discharges municipalities are responsible for posting temporary signs at public access areas downstream of the outfall. These signs shall warn of the potential threat to public health that may be posed by recreating in the waters. The signs shall remain in place for 48 hours until after the untreated or unpermitted discharge has stopped. Signs shall be posted at public access area(s) located within one mile from the discharge. Municipalities are expected to cooperate in posting signage if the discharge crosses a municipal boundary. The Department shall specify a different sized geographic area for posting if necessary to protect the public health or environment.

Often it is not possible to isolate the discharge to a particular property or discharge pipe until additional investigations are completed. A suspected illicit discharge may not be confirmed as an actual illicit discharge until after repeated monitoring, dye or smoke tests, have confirmed the source's connection to the outfall. There are cases, however, when the discharge is immediately confirmed as illicit at the time of the initial observation. There are also cases when the evidence cannot confirm with a high level of certainty that an illicit discharge is occurring but there is sufficient evidence to keep the stormwater system on a watch list or further study list.

Termination of Public Notice

A suspected or confirmed discharge will remain on the ANR on-line event reporting system until the discharge has been eliminated or proven to be not a threat to the public health or the environment. The Department contractor or the municipality that the discharge is located in is responsible for notifying the CWP Illicit Discharge and Detection Elimination Program when a discharge has been eliminated. If the elimination occurs after the contract has ended the Town shall notify the Department.

Department Contractor Procedure Subsection

Contractor Procedure for Confirmed Non-Municipal (Private) Discharges

Once a discharge is confirmed as an actual illicit discharge the contractor will immediately notify the municipality in which the discharge is taking place. If the confirmed illicit discharge located by the contractor is under private ownership (e.g. a leaking or misconnected sewer lateral) within one month, the contractor will provide written documentation to the municipality confirming the illicit discharge. The municipality shall be the first point of contact with the owner(s) of the property from which the discharge is occurring. The Department will request the municipality utilize its existing sewer ordinance and pursue enforcement of the ordinance within one month of notification by the contractor. The municipality will notify or attempt to notify the owner of the property and provide the information to the owner documenting the discharge. The municipality, in consultation with the contractor, may arrange for additional testing. If the municipality does not have a sewer ordinance and is therefore unable to enforce on the owner, or if the municipality is unwilling to enforce through its zoning code, then the Clean Water Initiative Program will file an enforcement referral with the ANR Enforcement Division, and change the status of the incident in BEAR to request an Enforcement Officer follow-up.

Contractor Procedure for Confirmed Municipal (Public) Discharges

Once a discharge is confirmed as an actual illicit discharge the contractor will immediately notify the municipality in which the discharge is taking place. If the confirmed illicit discharge located by the contractor is under municipal ownership (e.g. a leaking or broken sewer main or discharge from a municipal facility) the municipality will assess whether an immediate repair is possible given the cost in resources and funds available. The municipality will inform DEC CWIP within four weeks of notification by the contractor of what action will be taken and will provide an expected timeline for repair completion. If the repair cost exceeds available resources then the municipality, in consultation with their consultant, the DEC CWIP Program, and the respective DEC Wastewater Operations and Management Program Specialist, will provide a formal written plan and time frame for the repair and removal of the illicit discharge. If the municipality does not provide a written plan and time frame for the repair and removal of the illicit discharge the Clean Water Initiative Program will file an enforcement referral with the ANR Enforcement Division and change the status of the incident in BEAR to request an Enforcement Officer follow-up.

References

NEIWPCC. 2003. Illicit Discharge and Detection Elimination Manual: A Handbook for Municipalities, Lowell MA.

Center for Watershed Protection and Robert Pitt. 2004. Illicit Discharge and Detection Elimination: A Guidance Manual for Program Development and Technical Assessments, EPA Cooperative Agreement X-82907801-0. U.S. Environmental Protection Agency Washington, D.C.

Appendix C – Moon Brook Flow Restoration Plan

Moon Brook Flow Restoration Plan (FRP)

Town of Rutland, VT

June 1, 2017

Prepared for:
Town of Rutland

Prepared by:
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WATERSHED
CONSULTING ASSOCIATES, LLC

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I. Disclaimer

The intent of this plan is to present the data collected, evaluations, analysis, designs, and cost estimates for the Moon Brook Flow Restoration Plan (FRP) Project, completed under a contract between the Town of Rutland and the hired consultant team, Watershed Consulting Associates, LLC. The Moon Brook FRP was prepared to meet the compliance requirements for the National Pollutant Discharge Elimination System General Permit 3-9014 (Vermont Department of Environmental Conservation, 2012) for stormwater discharges to impaired waters for Moon Brook impervious surface owners. This plan is intended as a regulatory document for the Town of Rutland only, and is not meant to serve as a watershed-wide plan.

II. Executive Summary

This Flow Restoration Plan (FRP) for the section of the Moon Brook Watershed (MBW) that falls within the Town of Rutland was developed in accordance with requirements for Municipal Separate Storm Sewer System (MS4) entities. Once approved by the Vermont Department of Environmental Conservation (VT DEC) this FRP will become part of the Moon Brook Stormwater Management Plan (SWMP) prepared by the Town of Rutland. The MS4 permitees in this watershed are the Town of Rutland, the City of Rutland, and the Vermont Department of Transportation (VTrans). This FRP will serve as a long-term planning tool for the Town of Rutland to implement stormwater best management practices (BMPs) throughout their section of the watershed in the effort to return Moon Brook to its attainment condition. Although three MS4 entities own impervious cover within the MBW, the Town of Rutland has elected to prepare its own FRP document.

The Vermont Best Management Practice Decision Support System (BMPDSS) model, a Geographic Information Systems (GIS)-based hydrologic model maintained by the VT DEC, was used to assess the impact of various stormwater BMP scenarios proposed as part of this FRP process. The VT DEC provided a Pre-2002 model run for the watershed, which included any BMPs that existed prior to 2002 in the watershed and provided an estimated stream flow during the 1-year storm event. The goal of the FRP is to reduce stream flow by 11.9% during this target storm event as outlined in the Total Maximum Daily Load (TMDL) document described below.

A second BMPDSS model was run by the VT DEC for the Post-2002 condition, including all BMPs that were constructed in the watershed after 2002 and thus designed to meet the Vermont 2002 Stormwater Management Manual (VT SWMM) design standards. This model reflected the existing conditions in the watershed and it was used to determine to what extent current stormwater controls have reduced high flows (flows occurring less than 0.3% of the time).

Revisions were made to both the Pre-2002 and Post-2002 models based on field investigations of BMPs with expired stormwater permits, discussions with the MS4s, and information from the VT DEC. These revisions were made watershed-wide, not just within the Town of Rutland, as the BMPDSS is an aggregate model and thus takes into account the condition of the entire watershed. Both of these models (Pre-2002 and Post-2002) were rerun following revisions, and these revised model runs were used for all subsequent modeling. Following revisions, the Post-2002 BMPDSS model run showed a 0.71% reduction in high flows from the revised Pre-2002 condition, which accounts for 6% of the required flow reduction of 11.9%. Once allocated by impervious area for each MS4, this reduction accounted for 6.6% of the Town of Rutland's high flow allocation. As such, additional BMPs were required to meet 100% of the required high flow reduction target for the Town.

An initial list of potential BMP sites was identified remotely using GIS with a focus on managing impervious area within the Town of Rutland. A preliminary field assessment was completed at each site to document potential BMP practices, constructability issues, and review drainage

areas. These new BMPs were then incorporated into the BMPDSS Credit model, which simulates the high flow reduction from the future construction of the identified BMPs. This was an iterative process where new BMPs were added and the model rerun as new BMPs were identified. The final run of the model was aimed at achieving target high flow reduction for the Town of Rutland. Watershed-wide, a high flow reduction of 2.72% was achieved with the proposed scenario, which, allocated by impervious cover managed, resulted in a 1.9% high flow reduction for the Town of Rutland. This equates to 67% of the Town's allocated target. While the target was not achieved by the Town, the proposed BMP scenario does manage 35% of the Town's impervious surfaces. The majority of the remaining impervious cover is low density and widely distributed throughout the watershed. This makes large stormwater BMPs infeasible for this area. Additional reductions could be achieved through distributed green stormwater infrastructure (GSI).

The final BMPDSS Credit model run included a total of eight retrofits, all of which are located in the Town of Rutland. One project, a gravel wetland site known as Randbury Road, is a joint project with VTrans. Of the eight projects, three are gravel wetlands, three are detention swales, and two are outlet retrofits of existing detention ponds. The total cost for implementation of these BMPs for the Town of Rutland is estimated at approximately $1,027,000. This total is reduced to $948,000 when a cost-share for the Randbury Road project was estimated. All cost estimates utilize 2014 construction cost estimates.

While not an actionable target, increasing the stream's low flow (baseflow) is still a water quality goal. However, due to limited soil infiltration potential within the Town of Rutland, the proposed BMPs do not improve modeled watershed-wide stream low flow (reduction of -0.45%).

III. Background

Moon Brook, located in central Vermont in Rutland County, extends into the Town of Rutland, the City of Rutland, and the Town of Mendon. This watershed covers approximately 7.8 mi^2 (5,032 acres) and contains approximately 10% impervious cover (0.8 mi^2). The watershed is currently on the State of Vermont's impaired waters list, determined by the Environmental Protection Agency's (EPA) 303(d) list, as a result of stormwater runoff. Biological monitoring data has shown that Moon Brook fails to meet Vermont Water Quality Standards.

The final MS4 general permit, dated December 2012, requires that the Town of Rutland develop and submit a comprehensive FRP for their section of the Moon Brook watershed. The purpose of this Moon Brook FRP is to identify the necessary stormwater BMPs that will be used to achieve the flow restoration targets prescribed in the Moon Brook TMDL document.

III.1 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 Moon Brook using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows and increase in stream low or base flows.

The basis for the TMDL-required high flow reductions was the comparison of modeled Flow Duration Curves (FDCs) between the impaired Moon Brook and comparable attainment watersheds. An FDC graphs the percentage of time during a period that flow exceeds a certain value, with the low flow represented by the 95th percentile ($Q_{95\%}$) and the high flow represented by the 5th percentile ($Q_{0.3\%}$). 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 to develop FDCs from which an area of normalized high flow and low flow were extracted by drainage area. The percent change between impaired and attainment FDCs was used as a basis for the TMDL requirements. The high flow ($Q_{0.3\%}$) was determined to be relatively equivalent to the 1-year design storm flow. Therefore, all proposed BMPs are designed to the Channel Protection volume (CP_v) storage standard to address the high flow reduction target.

Included in the 2012 MS4 permit issuance were requirements for municipalities to develop FRPs to comply with the stormwater TMDLs. The FRPs must be developed for each impaired watershed by October 1, 2016, and must include the following elements:

1) An identification of required controls,
2) A design and construction schedule,
3) A financial plan,
4) A regulatory analysis,
5) The identification of regulatory assistance, and
6) Identification of any third-party implementation.

The schedule shall provide for implementation of the required BMPs no later than 20 years from the effective date of the permit, before December 5, 2032.

III.1.1 Future Growth

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within the 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 and future unmanaged impervious area. The 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 1.

Table 1. Moon Brook TMDL flow restoration targets

Target High Flow $Q_{0.3}$ (± %) Reduction	Target Low Flow Q_{95} (± %) Increase
-11.9%	**23.9%**

While the low flow goal is important to ensure flow during the dry summer months, it is not an actionable requirement in the EPA approved TMDL, and therefore was not the primary focus of the BMP identification for this study.

III.2 MS4 Allocation of Flow Targets

Allocation of the flow targets by MS4 was approximated for Moon Brook based on relative impervious cover. However, there are limitations to this method as the BMPDSS model is an aggregate model in which upstream BMPs affect downstream flow and runoff does not necessarily follow political boundaries.

Approximately 76% of the impervious cover within the Moon Brook Watershed is within the City of Rutland, 24% within the Town of Rutland, and 0.5% is owned by VTrans (Table 2). Although a section of Moon Brook is located in the Town of Mendon, this town is not considered a small MS4 community and therefore was not included in the allocation. Based on impervious surface ownership, the Town of Rutland is responsible for a high flow reduction of 2.82% and a low flow increase of 5.66% of the overall TMDL targets.

Table 2. Moon 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 [1]	Target Low Flow Q_{95} (± %) Increase
Mendon	2041.8	42.1	----	----	----
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 [2]	**2990.4**	**466.7**		**-11.90%**	**23.90%**

[1] The high flow target is negative (-), indicating a reduction in high flow from the baseline condition is required. The low flow target is positive (+), indicating a need for an increase in low flow from the baseline condition.

[2] Watershed totals do not include watershed area or impervious area within the Town of Mendon as this community is not designated as a small MS4 community.

IV. Best Management Practice Decision Support System Model Assessment

The VT DEC worked with an external consultant (TetraTech) to develop a Vermont specific hydrologic model, the VT BMPDSS, to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios. This modeling was adapted for use in Vermont with funding from the Vermont Agency of Natural Resources. 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.

IV.1.1 Permit Review

In order to confirm the information included in the Pre-2002 and Post-2002 BMPDSS models, all expired stormwater permits in the Town of Rutland, in the Moon Brook Watershed were acquired and reviewed. Two expired permits were identified. The first was Permit #4375-INDS - Wynnmere Senior Housing, and the second was Permit #1-1031 - La Victoire Subdivision (Table 3). The permitted detention pond under #4375-INDS was assessed for compliance with Vermont 2002 Stormwater Standards and for a retrofit opportunity. Based upon this review, a change to the outlet structure would bring the pond into compliance with these standards and increase detention. The stormwater system permitted under #1-1031 consists of a system of vegetated swales and culverts. A portion of the permitted runoff area drains to another proposed BMP, the Hitzel Terrace detention pond (further details regarding this proposed BMP can be found in Appendix B). Only a portion of the site permitted under #1-1031 drains to the proposed Hitzel Terrace detention pond because it was determined to be most feasible. A portion of the permitted site will remain uncollected. The entire permitted site however is planned to be incorporated into the Town of Rutland MS4.

Table 3. Expired stormwater permits in Moon Brook

Site Name	Permit #	Permit Expiration Date	Stormwater System
Wynnmere Senior Housing Project	4375-INDS	1/22/2012	Swales and catchbasin collection to detention pond
LaVictoire residential subdivision	1-1031	6/30/1996	Vegetated swales to culverts
Table prepared by Emily Schelley (VT DEC, Jan. 2014). Revised by WCA (2015).			

IV.1.2 Review of Existing Models

Both the Pre-2002 and Post-2002 models were assessed and revised as needed. New BMPs, either developed since the models were last updated or BMPs that were unknown at the time of the last model updates, were added. Additionally, other revisions such as watershed boundary changes, subwatershed boundary changes, and combined sewershed boundary changes were

incorporated. Updated input files for the Pre-2002 and Post-2002 models were submitted to VT DEC so that updated model scenarios could be run. Input files included revised HydroCAD® models of each BMP as necessary, and GIS data for BMP drainage areas, subwatersheds, and BMP locations. A full list of the existing BMPs in the Pre-2002 and Post-2002 models is included in Appendix D and a map is included in Appendix E.

IV.1.2.1 Pre-2002 Condition Revisions

Several revisions were made to the Pre-2002 BMPDSS model based on information provided by the MS4 entities and the VT DEC, as well as field investigations. The model was revised as follows:

- Replaced previous combined sewershed delineation with revised version provided by Rutland City (currency: February 2013).
- Revised subwatershed delineations to reflect updated sewershed boundaries. These revisions reduced the watershed area from 5070 acres to 5032 acres.
- Revised subwatershed boundaries to account for updated utility infrastructure mapping and field verification of drainage paths in areas where there was either an existing BMP installed or a permitted discharge.
- Based on field observations and discussion with the City of Rutland staff, a section of the mapped MBW near the VTrans-owned rail yard was determined to be out of the watershed as it was concluded that the property drains to the combined sewer rather than to Moon Brook.
- Added five existing but previous unmodeled BMPs to the Pre-2002 model:
    1. Allen Pond Development - detention pond,
    2. Family Dental Associates - detention pond,
    3. Natural Detention area near Rutland Plywood,
    4. Northeast School (Thrall Avenue) – detention pond (without new outlet structure, which was added after 2002 and included in the Post-2002 model revisions), and
    5. Roadside Church Roof - dripline infiltration trench

IV.1.2.2 Post-2002 Model Revisions

Upon field and remote review, and in light of information provided by the MS4 entities, several revisions were necessary for the Post-2002 BMPDSS model. The model was revised as follows:

- Mapped impervious cover was adjusted in areas where an existing BMP was located.
- Revised Pre-2002 model subwatershed boundaries to account for additional BMPs.
- Added five rain gardens (Rutland Natural Resources Conservation District projects).
- Added five existing BMPs implemented after 2002 to the model including:
    1. Vermont Eye Care Center - detention pond,
    2. Rutland Eye Physicians building - detention swale,
    3. Rutland Heart Center, Common Street – detention pond,
    4. Gravel Wetland - Rutland Natural Resources Conservation District project, and

5. Northeast School (Thrall Avenue) - detention pond with new outlet structure added after 2002.

IV.1.2.3 Post-2002 Model Results

Following the revisions to the Pre-2002 and Post-2002 BMPDSS models described above, the model scenarios were rerun by the VT DEC. A watershed-wide high flow reduction of 0.89% was observed as a result of Post-2002 BMPs in place in the watershed. This accounts for 7.5% of the total required, watershed-wide, high flow reduction of 11.9%. The Post-2002 model results show that the Town of Rutland has addressed approximately 8.3% of their high flow target reduction. Model results are summarized in Table 4.

Based on the model results, additional CPv stormwater controls will be required to meet the Town of Rutland's allocated portion of the high flow reduction target. Biomonitoring of Moon Brook will ultimately determine when the stream has reached attainment conditions, but the minimal modeled high flow reduction with existing BMPs suggests that additional stormwater controls will be needed.

Table 4. Post-2002 BMPDSS model assessment results

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%	-0.66%	-8.36%	7.3%
Rutland Town	-2.82%	-0.23%	-2.59%	8.3%
VTrans	-0.06%	0.00%	-0.06%	0.0%
Watershed Total	**-11.90%**	**-0.89%**	**-11.19%**	**7.5%**

V. Required Controls Identification

Initial analyses utilizing GIS and remotely sensed data provided a basis for targeted field investigation. This process identified large, contiguous, unmanaged areas of impervious cover, existing stormwater infrastructure, town-owned parcels, and existing stormwater management features. Soils data provided by the Natural Resource Conservation Service and topographic data were also reviewed. A list of potential BMP locations was identified, and sites were investigated in the field to determine BMP feasibility.

Field investigations also involved documenting potential constructability issues, assessing site conditions, assessing natural resource concerns, determining utility conflicts, assessing ease of operation and maintenance, and reviewing drainage areas. An in-depth engineering assessment

will still be required at each site to confirm the presence or absence of utilities, natural resource constraints, and potential transportation impacts as part of the final design process. The BMPs were designed using the HydroCAD® model to meet the CPv storage criteria for cold waters (12-hour detention standard).

Ultimately, it was determined that eight of the assessed locations were appropriate for BMP implementation (Table 6). These BMPs included three gravel wetlands, three detention swales, and two outlet retrofits of existing detention systems. Though all projects are located in the Town of Rutland, the Randbury Road gravel wetland project is a joint project with VTrans. Project details, photos, and maps for all BMPs are included in Appendix A and Appendix B, and a brief summary of each BMP is located in Table 6. Concept level designs of the Randbury Road project can be found in Appendix G.

V.1 BMPDSS Model Assessment Results

Selection of the final proposed BMP list was an iterative process and a total of three BMPDSS Credit model runs were completed. The initial BMPDSS Credit model run (Credit 1) included one BMP, the Randbury Road project. The Credit 1 scenario did not achieve the Town of Rutland's allocated flow reductions required by the TMDL, only addressing 20.5% of the Town of Rutland's allocated high flow reduction target. As such, three additional BMPs were identified and added in a subsequent iteration of the model. These projects included the 4375-INDS Wynnmere pond retrofit, the VELCO / Carmel Place project, and the Hitzel Terrace project. Following this Credit 2 model run, a high flow reduction of 1.59% of the Town of Rutland's allocation target reduction of 2.82%, was modeled. This equates to 56% of the Town's target high flow reduction. As high flow reduction targets were still not met, a Credit 3 model run was completed. This model run included the remaining four projects: Cannon Drive, Industrial Park, North End Drive, and Nancy Lane. Following this model run, a high flow reduction of 2.72% was modeled, 1.89% of which was allocated to the Town of Rutland (Table 5). This reduction equates to 67% of the Town's high flow reduction target. All model runs are summarized in Appendix F.

As these BMPs were targeted within the Town of Rutland and excluded BMP placement in the City of Rutland, the total watershed-wide high flow reduction was only 2.72%, which is 22.9% of the watershed-wide high flow target.

Table 5. BMPDSS final BMPDSS Credit model summary for the proposed FRP scenario

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	**11.9%**	**-3.08%**	**-8.82%**	**25.88%**

V.2 Proposed FRP Model Scenario

The final recommended BMP list includes seventeen proposed BMPs (Table 6), and the proposed FRP scenario addresses 25.9**%** of the watershed-wide high flow target. As BMPs were not proposed for the City of Rutland at this time, it was not expected that this Credit scenario would achieve 100% of the Moon Brook TMDL high flow reduction targets. However, the BMPs proposed for the Town of Rutland manage 43.5 acres or 39% of the Town's impervious cover and address 78.7% of their allocated high flow reduction target.

The remaining unmanaged impervious area in the Town of Rutland is low density and widely distributed. Any additional stormwater management would likely need to be addressed through distributed GSI. The amount of impervious cover that would need to be managed by the Town in order to achieve the required -2.82% high flow reduction if the City were to take no further action was estimated using results from previous Moon Brook BMPDSS model runs. A linear regression was performed utilizing the impervious cover managed by the Town with the BMPs proposed for each of the previous model runs (R^2=0.998; see Appendix I for full regression). Assuming that this relationship holds true through the identification of smaller distributed projects, it is predicted that the Town would need to manage an additional 10.8 acres from the latest BMPDSS model run. This scenario would manage 54.3 acres of the Town's 110.6 acres of impervious cover (49%).

Individual projects will not be developed to manage this additional 10.8 acres of impervious surface within the Town at this time as most of the contiguous and concentrated impervious cover has already been managed with BMPs. The remaining 21.4% of the high flow target is proposed to be met in two ways. The first phase of this plan will be to manage a portion of the remaining acreage using distributed GSI throughout the Town. These locations will be identified in the latter half of the third quarter of the design and construction schedule. Projects would be designed and constructed in the final quarter of the design and construction schedule. The second phase of this approach would involve a cost share between the Town and the City. This cost share can be negotiated in the fourth quarter of the design and construction schedule. The

Town would commit to contributing an agreed upon amount to meet any allocated portion of the high flow target that they are not already achieving.

The Credit 4 scenario described above and this dual phase approach to managing the remainder of the required high flow target was considered the most feasible implementation plan for the Town. It is expected that 100% of the watershed-wide high flow target will be met if the City of Rutland chose to implement BMPs throughout their section of the watershed. The ultimate determination of when Moon Brook returns to its attainment condition will be made by the State, based on monitoring data or other relevant information (MS4 General Permit Sec. IV.J.3).

VI. Proposed Implementation Plan

The final list of proposed BMPs for the Town of Rutland are summarized in Table 6, including 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. Further details about each project can be found in Appendix B. The high flow target managed by BMP (%) based on managed impervious cover is also included in Table 6.

Table 6. Final proposed BMPs for the Moon Brook FRP

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Permit #	Drainage Area (acres)	Impervious Cover Managed (acres)	% Impervious	% of Total Managed Impervious Cover in the Town of Rutland MS4	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	Town of Rutland High Flow Target Managed by BMP (%)
Hitzel Terrace	Town of Rutland	Private	Outlet Retrofit	No Permit	67.2	9.4	14.0%	100%	1.03	22.3%
Randbury Rd	VTrans/ Town of Rutland	VTrans/ Town of Rutland/ Private	Gravel Wetland	New Road Project (Construction Permit)	23.1	11	47.6%	80%	0.86	21.0%
Nancy Ln	Town of Rutland	VELCO	Detention Swale	No Permit	34.1	5.9	17.4%	100%	1.27	14.1%
Industrial Park	Town of Rutland	Private	Gravel Wetland	No Permit	8.5	4.1	48.3%	100%	0.79	9.7%
4375-INDS - Wynnmere Pond Retrofit	Town of Rutland	Private	Outlet Retrofit	4375-INDS	17.3	3.7	21.1%	100%	0.55	8.7%
N End Dr	Town of Rutland	VELCO	Detention Swale	No Permit	16.4	2.5	15.0%	100%	0.5	5.9%
VELCO / Carmel Place	Town of Rutland	VELCO	Detention Swale	No Permit	21.3	2.3	10.6%	100%	0.62	5.4%

Ann Clark Cookie Cutters	Town of Rutland	Private	Gravel Wetland	No Permit	2	1.3	63.1%	100%	0.2	3.0%
Gleason Rd Swale	Town of Rutland	Private	Bioretention	No Permit	6.4	1	15.3%	100%	0.17	2.4%
Cannon Dr	Town of Rutland	Town of Rutland	Gravel Wetland	No Permit	3.7	0.7	18.1%	100%	0.15	1.6%
Connor Dr	Town of Rutland	Private	Gravel Wetland	No Permit	1.4	0.5	33.8%	100%	0.09	1.1%
Cold River Rd Bioretention West	Town of Rutland	Private	Bioretention	No Permit	6.2	0.4	7.0%	100%	0.14	1.0%
Roadside Chapel Parking Lot	Town of Rutland	Private	Gravel Wetland	No Permit	1.6	0.4	25.8%	100%	0.03	1.0%
Quality Ln and Cold River Bioretention	Town of Rutland	Town of Rutland / Private	Bioretention	No Permit	1.1	0.4	33.8%	100%	0.04	0.9%
Gleason Rd Bioretention	Town of Rutland	Private	Bioretention	No Permit	0.7	0.3	47.7%	100%	0.02	0.8%
Sid Harvey's	Town of Rutland	Private	Detention Basin	No Permit	1.7	0.3	19.9%	100%	0.1	0.8%
Cold River Rd Bioretention East	Town of Rutland	Town of Rutland / Private	Bioretention	No Permit	2.3	0.2	7.3%	100%	0.06	0.4%

VII. Design and Construction Schedule

A design and construction (D&C) schedule was developed to provide a long-term plan for the implementation of the FRP. The seventeen projects were spaced out over the timeframe with one project being completed per year in most cases. Three years (2025, 2027, and 2028) have two projects scheduled for completion. The timeline provides for design, acquisition of necessary permits, regulatory approvals, acquisition of necessary land, and actual construction.

In 2030, the Town will pursue the two strategies for fully meeting their high flow reduction target as discussed in section V.2 Proposed FRP Model Scenario (distributed GSI and cost sharing with the City). It is expected that once the City completes their portion of the FRP, the Town will have met their allocated high flow reduction target. If this is not the case, the Town will pursue these two strategies to the extent necessary to fully manage their allocated portion of the TMDL high flow reduction requirement.

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.

The projects were scheduled based on the ease of construction as well as the benefit of the individual BMP based on the relative impervious cover managed by that BMP. The two retrofits of existing BMPs were scheduled first as it was assumed that these projects would provide a significant benefit to the watershed while costs and construction complexity remain low. This allows time for the Town of Rutland to plan for the construction of the remaining BMPs where the Town is the sole impervious cover owner. These projects, which are more expensive to construct and will require more extensive engineering and design, were generally ranked by high flow target managed (%), but changes were made to this ranking to more evenly distribute the cost burden for the Town throughout the implementation period. The final project, Randbury Road, is not scheduled until 2032 as this is the timeframe that VTrans has agreed to for this project and cooperation from VTrans is required for the construction of this BMP. The proposed implementation schedule and cost per implementation phase can be found in Table 7.

Table 7. Implementation schedule for proposed BMPs

Site Name	MS4 Impervious Owner	Ownership of Land where BMP is Located	BMP Type	Drainage Area (acres)	Impervious Cover Managed (acres)	Impervious Cover Managed (% of Drainage Area)	Runoff Channel Protection Volume (CPv) Storage (ac-ft)	Town of Rutland High-Flow Target Managed (%)	Estimated Cost (Rounded to Nearest $1,000)	Estimated Cost for Town of Rutland with Cost Share	Schedule
Hitzel Terrace	Town of Rutland	Town of Rutland	Outlet Retrofit	67.2	9.4	14.0%	1.03	22.3%	$14,000	$14,000	2018
4375-INDS - Wynnmere Pond Retrofit	Town of Rutland	Private	Outlet Retrofit	17.3	3.7	21.1%	0.55	8.7%	$10,000	$10,000	2019
Nancy Ln	Town of Rutland	VELCO	Detention Swale	34.1	5.9	17.4%	1.27	14.1%	$133,000	$133,000	2020
Industrial Park	Town of Rutland	Private	Gravel Wetland	8.5	4.1	48.3%	0.79	9.7%	$307,000	$307,000	2021
N End Dr	Town of Rutland	VELCO	Detention Swale	16.4	2.5	15.0%	0.50	5.9%	$52,000	$52,000	2022
VELCO / Carmel Place	Town of Rutland	VELCO	Detention Swale	21.3	2.3	10.6%	0.62	5.4%	$65,000	$65,000	2023
Cannon Dr	Town of Rutland	Town of Rutland	Gravel Wetland	3.7	0.7	18.1%	0.15	1.6%	$130,000	$130,000	2024
Gleason Rd Swale	Town of Rutland	Private	Bioretention	6.4	1.0	15.3%	0.17	2.4%	$61,000	$61,000	2025

Connor Dr	Town of Rutland	Private	Gravel Wetland	1.4	0.5	33.8%	0.09	1.1%	$34,000	$34,000	2025
Ann Clark Cookie Cutters	Town of Rutland	Private	Gravel Wetland	2.0	1.3	63.1%	0.20	3.0%	$75,000	$75,000	2026
Roadside Chapel Parking Lot	Town of Rutland	Private	Gravel Wetland	1.6	0.4	25.8%	0.03	1.0%	$18,000	$18,000	2027
Gleason Rd Bioretention	Town of Rutland	Private	Bioretention	0.7	0.3	47.7%	0.02	0.8%	$26,000	$26,000	2027
Cold River Rd Bioretention West	Town of Rutland	Private	Bioretention	6.2	0.4	7.0%	0.14	1.0%	$55,000	$55,000	2028
Cold River Rd Bioretention East	Town of Rutland	Town of Rutland / Private	Bioretention	2.3	0.2	7.3%	0.06	0.4%	$23,000	$23,000	2028
Quality Ln and Cold River Bioretention	Town of Rutland	Town of Rutland / Private	Bioretention	1.1	0.4	33.8%	0.04	0.9%	$36,000	$36,000	2029
Distributed GSI / Cost Share with City of Rutland											2030-2032
Sid Harvey's	Town of Rutland	Private	Detention Basin	1.7	0.3	19.9%	0.10	0.8%	$25,000	$25,000	2031
Randbury Rd	VTrans/ Town of Rutland	Private	Gravel Wetland	23.1	11.0	47.6%	0.86	21.0%	$316,000	$237,000	2032
Watershed Total					**44.3**				**$1,380,00**	**$1,301,000**	

VIII. Financial Plan

Planning level costs were estimated for each project using a consistent spreadsheet-based method. A cost-share allocation was calculated for the Randbury Road project due to joint MS4 contributions. As of now, the Town of Rutland does not have a separate funding source for stormwater related costs. The stormwater program is funded from the general tax, which is pooled for the Town's Public Works Department. The Town plans to appropriate at least $20,000 per year from the general fund for FRP implementation. As projects become more developed, the Town will budget accordingly. The Town is in the process of developing their stormwater program and regulations in the upcoming year, which will also influence how projects are funded. Several additional funding sources that may be available for larger projects, which may need to be phased over several years, include the Clean Water State Revolving Fund program and municipal bond bank funds. The Town intends to pursue any available grants from State and Federal sources.

VIII.1 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 for each BMP within the watershed (see HW Memo in Appendix H). 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.

VIII.1.1 Cost-Share Allocation

A cost-share was calculated for the Randbury Road project, which manages impervious cover owned by both the Town of Rutland and VTrans. A concept plan was developed for this project (Appendix G). This cost-share was determined using a combination of the percent runoff contribution and percent impervious surface ownership managed within the BMP drainage area. The runoff managed was determined by site-specific HydroCAD models. The percent impervious was determined through GIS using 2011 impervious cover mapping published by the Lake Champlain Basin Program. An average of the percent runoff volume generated and the impervious cover managed by MS4 was taken. The average was rounded to the nearest quarter, and the cost was allocated based on this percent. The cost-share allocation applied provides one example for how these two MS4s can share the financial responsibility for this project. The cost breakdown is summarized in Table 8.

Table 8. A potential cost-share for the Randbury Rd project by MS4

Total Cost: $356,000		
	VTrans	**Town of Rutland**
Runoff Volume 1-Year (ac-ft)	0.4	0.5
Percent Runoff Volume	45%	55%
Impervious Acres	2.2	8.8
Percent Impervious	20%	80%
Percent Cost Allocation	32%	68%
Cost Allocation Rounded to Nearest 25%	**25%**	**75%**
Cost Share	**$ 89,000**	**$ 267,000**

VIII.1.2 Cost Estimate Calculations

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 9 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 9 lower).

Table 9. 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 applied 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: 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.
- Cost per Impervious Acre: Calculated as the construction costs, plus the permitting and engineering costs, divided by the impervious acres managed by the BMP.
- Operation and Maintenance (O&M): The annual O&M was calculated as 3% of the base construction costs. A maximum of $10,000 was used.
- 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 project such as an outlet retrofit, and a minimum cost of $25,000 was applied for more complex projects.

VIII.1.3 BMP Cost Estimates

The total cost for implementation of the FRP projects for the Town of Rutland was determined to be $1,301,000. This total assumes a cost-share for the joint-MS4 project (Randbury Road, Table 8). This is an approximate estimate and is subject to change based on more refined design and cost-sharing agreements. Table 10, below, includes a summary of the project cost estimates. The worksheet used to develop cost estimates for each proposed BMP is included in Appendix C.

Table 10. Cost estimates for proposed BMPs

Project Name	Retrofit Description	Impervious Area (acres)	Design Control Volume (ac-ft)	Base Unit Cost ($/cft)	Site Adjustment Factor	Minimum Project Cost ($10k for simple retrofits; $25k otherwise)	Final Project Cost Rounded to Nearest $1,000	% of Impervious within the Town of Rutland MS4	Town of Rutland Cost Share	Cost per Impervious Acre	O&M
4375-INDS - Wynnmere Pond Retrofit	Outlet Retrofit	17.3	0.11	$2	0.25	$10,000	$10,000	100%	$10,000	$166	$72
Hitzel Terrace	Outlet Retrofit	67.2	0.55	$2	0.25	$10,000	$14,000	100%	$14,000	$212	$356
VELCO / Carmel Place	Detention Swale	21.3	0.62	$2	1	$25,000	$65,000	100%	$65,000	$3,047	$1,626
N End Dr	Detention Swale	16.4	0.50	$2	1	$25,000	$52,000	100%	$52,000	$3,185	$1,309
Nancy Ln	Detention Swale	34.1	1.27	$2	1	$25,000	$133,000	100%	$133,000	$3,888	$3,314
Randbury Rd	Gravel Wetland	23.1	0.86	$10	0.5	$25,000	$316,000	75%	$237,000	$9,671	$5,587
Industrial Park	Gravel Wetland	8.5	0.79	$10	0.5	$25,000	$307,000	100%	$307,000	$27,389	$5,162
Cannon Dr	Gravel Wetland	3.7	0.15	$10	1.5	$25,000	$130,000	100%	$130,000	$34,931	$2,881
Roadside Chapel Parking Lot	Gravel Wetland	0.4	0.03	$10	0.5	$10,000	$18,000	100%	$18,000	$20,520	$209

Gleason Rd Bioretention	Bioretention	0.3	0.02	$10	1.5	$10,000	$26,000	100%	$26,000	$60,786	$451
Gleason Rd Swale	Bioretention	1.0	0.17	$10	0.5	$25,000	$61,000	100%	$61,000	$43,574	$1,078
Connor Dr	Gravel Wetland	0.5	0.09	$10	0.5	$25,000	$34,000	100%	$34,000	$49,251	$595
Sid Harvey's	Detention Basin	0.3	0.10	$2	1.5	$25,000	$25,000	100%	$25,000	$50,109	$384
Ann Clark Cookie Cutters	Gravel Wetland	1.3	0.20	$10	0.5	$25,000	$75,000	100%	$75,000	$45,112	$1,274
Cold River Rd Bioretention West	Bioretention	0.4	0.14	$10	0.5	$10,000	$55,000	100%	$55,000	$85,891	$934
Quality Ln and Cold River Bioretention	Bioretention	0.4	0.04	$10	1	$10,000	$36,000	100%	$36,000	$70,485	$575
Cold River Rd Bioretention East	Bioretention	0.2	0.06	$10	0.5	$10,000	$23,000	100%	$23,000	$99,863	$372
Total:							**$1,379,000**		**$1,301,000**		

IX. Regulatory Analysis

The Town of Rutland intends to incorporate the two expired permits in the MBW into the Town's MS4 permit. The Town has not yet worked out details of this transfer with homeowners covered under these two permits, so the possibility does exist that the Town may ask the State to issue a Residual Designation Authority permit in the future if this incorporation process fails. A description of both expired permits in the Town of Rutland with discharges to Moon Brook is included in Table 3.

X. 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 95th percentile ($Q_{95\%}$) of the curve, and the high flow represented by the 5th 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.

XI. Appendices