



# BARTLETT BROOK FLOW RESTORATION PLAN

City of South Burlington, Vermont

October 1, 2016  
Updated January 2019

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## **I. Disclaimer**

The Bartlett Brook FRP was prepared to meet the compliance requirement under the National Pollutant Discharge Elimination System (NPDES) General Permit 3-9014 (VTDEC 2012) for stormwater discharges to impaired waters for the Bartlett Brook impervious surface owners (the City of South Burlington, the Vermont Agency of Transportation (VTRANS) and the Town of Shelburne).

# 1. Executive Summary

This Flow Restoration Plan (FRP) for the Bartlett Brook watershed was developed in accordance with requirements in the Municipal Separate Storm Sewer System (MS4) General Permit #3-9014 (2018). On July 27, 2018 the Vermont Department of Environmental Conservation (VTDEC) approved an update to the MS4 General Permit (3-9014), at which time the Bartlett Brook FRP became part of the Stormwater Management Plans (SWMP) prepared by the MS4 permittees in the Bartlett Brook watershed. This includes the City of South Burlington, the Town of Shelburne, and the Vermont Agency of Transportation (VTrans). The Bartlett Brook FRP acts as a guidance document for the MS4 entities as they implement stormwater Best Management Practices (BMP's) over a twenty (20) year timeframe from 2012 to 2032, in the effort to return Bartlett Brook to its attainment condition.

Development of the Bartlett Brook FRP was an iterative process that utilized the Vermont Best Management Practice Decision Support System (BMPDSS) model maintained by VTDEC. This model was created by VTDEC and its partners as part of the initial Total Maximum Daily Load (TMDL) development. The BMPDSS model allows the user to add, remove, or modify information related to the existing and proposed stormwater BMPs in the watershed. The BMPDSS then predicts the impacts that these changes will have on stream flow. In 2002, the Vermont Department of Environmental Conservation (VTDEC) provided a "Baseline Condition" BMPDSS model for Bartlett Brook. This version of the BMPDSS model, also referred to as the Pre-2002 model, included all stormwater Best Management Practices (BMPs) that existed in the watershed prior to 2002 and provided an estimated stream flow during the 1-year storm event. The goal of the FRP, as established in the Bartlett Brook TMDL<sup>1</sup>, is to reduce stream flow by 33.0% during this target storm event.

In February 2014, at the request of the City of South Burlington, the Chittenden County Regional Planning Commission (CCRPC)<sup>2</sup> completed a study to estimate the expected non-jurisdictional impervious area growth<sup>3</sup> in the Bartlett Brook watershed over the next 20 years. The original TMDL assumed a non-jurisdictional impervious growth of 50 acres, whereas the CCRPC study estimated 5.7 acres based on the actual non-jurisdictional growth rate from 2003 to 2010. The revised future growth reduced the high-flow target (Q0.3%) from 33.0% to 11.6%.

The BMPDSS Baseline Condition model was provided to the City and updated to include all BMPs that were constructed in the watershed after 2002. This version of the model became known as the "Existing Condition", or Post-2002, model run. Finally, existing BMPs were evaluated to determine if they could be retrofit to provide improved treatment and detention

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<sup>1</sup> Vermont Department of Environmental Conservation (VT DEC). 2007. Total Maximum Daily Load to Address Biological Impairment in Bartlett Brook (VT05-11).

<sup>2</sup> Chittenden County Regional Planning Commission (CCRPC). 2014. Non Jurisdictional Impervious Surface Analysis for the Bartlett Brook Watershed.

<sup>3</sup> "Non-jurisdictional" refers to new imperious surfaces where the parcel's total impervious area is less than one acre and not required to obtain a State stormwater permit.

of stormwater runoff and new BMPs were added to the BMPDSS model until the required stream flow reduction target was achieved. This version of the model became known as the “Proposed Condition” model, or Credit Model run<sup>4</sup>.

The current Proposed Condition BMPDSS model run that exceeds the required reduction in stream flow during the 1-year storm event currently includes a total of 12 proposed sites, along with 13 Baseline Condition BMPs and 19 Existing Condition BMPs. The Proposed Condition model was assessed with the BMPDSS software, and determined to address 126% of the modified TMDL high-flow target (Q0.3%). The total cost for implementation of the proposed plan is estimated at \$2,426,000.

The final list of proposed BMPs were ranked based on best value and feasibility. The MS4 permit requires that the BMPs identified in the FRP be constructed within 20 years of the effective date of the 2012 MS4 permit, which results in a December 5, 2032 deadline. The MS4s involved in the Bartlett Brook FRP worked together to develop an implementation schedule for Bartlett Brook. BMPs that are currently covered by expired State of Vermont stormwater permits were included at the front of the schedule, so that the associated properties could complete the required stormwater improvements and achieve permit compliance. Other BMPs located on land owned or controlled by the MS4 entities were given priority over those that were located on private property. The remaining projects were scheduled based on their ability to contribute to stream flow reductions, cost effectiveness, and constructability.

A financial plan was also developed in conjunction with the implementation schedule. The City of South Burlington has been financing the required stormwater BMPs by utilizing funds raised by stormwater utility fees, State and Federal grants, as well as low interest loan programs.

## **2. Background**

Bartlett Brook is currently on the State of Vermont’s impaired waters list (EPA 303(d)) with the primary pollutant determined to be stormwater runoff. In the effort to restore Bartlett Brook and lift its impaired designation, a flow-based Total Maximum Daily Load (TMDL) was developed for Bartlett Brook. This TMDL requires reductions in stormwater flows during high flow conditions. Increases in stream baseflow were also recommended, but are not required under the TMDL. The flow targets are the basis for the FRP, developed in accordance with the Municipal Separate Storm Sewer System (MS4) General Permit Subpart IV.C.1 as a required part of the MS4s Stormwater Management Program (SWMP).

The purpose of this Flow Restoration Plan (FRP) is to outline a plan for the retrofit of existing impervious surfaces with stormwater management Best Management Practices (BMPs) (e.g. gravel wetlands, infiltration basins, etc.) to meet the TMDL flow targets. The TMDL required that watershed hydrology must be controlled in the Bartlett Brook Watershed to reduce high

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<sup>4</sup> Refer to original Bartlett Brook Flow Restoration Plan dated October 1, 2016 for additional detail on the iterative process to identify proposed projects.

flow discharges, in order to restore degraded water quality and achieve compliance with the Vermont Water Quality Standards (VWQS).

Three (3) MS4's including the City South Burlington, Town of Shelburne, and the Vermont Agency of Transportation (VTRANS) own impervious cover within the Bartlett Brook impaired watershed.

## **2.1 TMDL Flow Targets**

In response to Bartlett Brook not meeting the Vermont water quality standards, it was placed on the list of impaired waters in accordance with Section 303(d) of the Federal Clean Water Act. The VTDEC developed TMDLs for impaired watersheds using flow as a surrogate for pollutant loading.<sup>5</sup> 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 develop FDCs from which a normalized high flow and low flow per drainage area in square miles (cfs/sq.mi.) were extracted. FDCs were developed for both impaired and attainment streams and the relative difference between the two was used to establish the flows needed to restore the stream's hydrology.<sup>6</sup>

The high flow point on the FDC for Bartlett Brook was initially modeled at 11.35 cfs/mi<sup>2</sup> and the mean value of the high flow point on the FDCs for the selected attainment streams was established at 10.27 cfs/mi<sup>2</sup>. In order to meet the attainment target of 10.27 cfs/mi<sup>2</sup>, a 9.5% high-flow reduction was calculated for Bartlett Brook. This 9.5% reduction in high flow was allocated between Urban/Developed lands and Agriculture/Open lands, with an 8.8% high flow reduction assigned to Urban/Developed lands.

The TMDL also assumed a non-jurisdictional growth of 50 acres of impervious surfaces. After rerunning the P8 model, the high flow point on the Bartlett Brook FDC increased from 11.35 to 14.11 cfs/mi<sup>2</sup>. The resulting 2.76 cfs/mi<sup>2</sup> increase projected from the 50 acres of non-jurisdictional growth resulted in a secondary 24.4% reduction from the 11.35 high point on the Bartlett Brook FDC. The entire 24.4% reduction was allocated to Urban/Developed lands, resulting in a 33.2% total high flow reduction target for Urban/Developed lands in the Bartlett Brook TMDL.

As part of the FRP development, the Chittenden County Regional Planning Commission (CCPRC) completed a study that revised the non-jurisdictional growth estimate from 50 acres to 5.7 acres of non-jurisdictional growth, based on the actual non-jurisdictional

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<sup>5</sup> Vermont Department of Environmental Conservation (VT DEC). 2007. Total Maximum Daily Load to Address Biological Impairment in Bartlett Brook (VT05-11).

<sup>6</sup> "Stormwater Modeling for Flow Duration Curve Development in Vermont" (Tetra Tech, 2005).

growth rate from 2003 to 2010. The resulting revised future growth analysis reduced the high flow target from 33.20% to 11.6%.

**Table 1: TMDL flow targets and modified target with revised future growth**

Flow Target	Target High Flow Q 0.3 (± %) Reduction
TMDL Target (Stormwater allocation only)	-8.80
TMDL Target with <b>50 acres</b> of Non-Jurisdictional Future Growth	-33.20
TMDL Modified Target with <b>5.7 acres</b> of Non-Jurisdictional Future Growth*	-11.60
* Modified target was calculated as: $-(8.8\%) + (-24.4\%)(5.7 \text{ ac}/50 \text{ ac}) = -11.60\%$	

## 2.2 MS4 Permit Background and Requirements

On December 5, 2012, Vermont's revised MS4 Permit was issued. Included in the 2012 MS4 permit issuance were requirements for municipalities to develop FRPs to implement the stormwater TMDLs. The FRPs were required to be developed for each impaired watershed by October 1, 2016, and include the following elements:

- 1) An identification of the 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 required implementation of the BMPs as soon as possible, but no later than 20 years from the effective date of the 2012 permit; before December 5, 2032. In 2018 the State revised the MS4 Permit to include additional requirements to address the Lake Champlain Phosphorous TMDL. As part of the permit renewal, each MS4 was required to submit an updated Notice of Intent (NOI) and Stormwater Management Program (SWMP), including updated Flow Restoration Plans.

## 3. BMPDSS Model

In an effort to implement the Vermont Stormwater TMDLs, the VTDEC worked with an external consultant (TetraTech) to develop the computer-based VT Best Management Practice Decision Support System (BMPDSS), a VT-specific hydrologic BMP assessment model. This modeling tool was developed by TetraTech, Inc., with considerable investment from EPA Region 3 and Prince



George's County, Maryland, and was adapted for use in Vermont using funding from the Vermont Agency of Natural Resources (ANR). The purpose of the modeling tool was to predict progress toward the TMDL flow targets based on proposed BMP implementation scenarios to help MS4 communities identify different BMP options and associated costs.

The information for each BMP entered into the BMPDSS model includes: drainage area, storage volume, outlet control structures and geographic location. The remaining data needed to calculate flow simulations is built into the model and includes: topography, soil types, impervious cover, and rainfall data.

### 3.1 Baseline Condition Model (Pre-2002)

The Baseline Condition Model includes all stormwater treatment practices in the Bartlett Brook watershed that existed prior to 2002. The purpose of this model was to quantify the flows in the stream prior to beginning the Flow Restoration Planning process and establish a baseline from which to measure.

The Baseline Condition Model includes 16 BMPs. A summary table of the existing BMPs is included in (Table 2). The BMPDSS modeling run results show an unadjusted high flow of 18.46 cfs. The high flow reduction target is an 11.6% reduction in high flow from the Baseline Condition Model of 18.46 cfs.

**Table 2: BMPs Included in the Baseline Condition Model for the Bartlett Brook Watershed**

BMP ID	BMP Name	BMP Type	Permit #
BBZ056	Irish Farm Pond A	Pond	1-1404a
BBZ012	Irish Farm Pond B	Pond	1-1404b
BBZ057	Irish Farm Pond C	Pond	1-1404c
BBZ014	Pinnacle at Spear Pond A	Pond	1-1155a
BBZ015	Pinnacle at Spear Pond B	Pond	1-1155b
BBZ021	Champ Carwash	Pond	1-0523/ 6280-9030
BBZ019	Willie Racine Jeep West Pond	Pond	3121-9010
BBZ020	Willie Racine Jeep East Pond	Pond	3121-9010

BBZ022	Smart Suites Pond	Pond	1-1372/ 6296-9030
BBZ023	Smart Suites East	Infiltration Trench	1-1372/ 6296-9030
BBZ024	Smart Suites West	Infiltration Trench	1-1372/ 6296-9030
BBZ025	Oil n' Go	Swale	n/a
BBZ026	Overlook at Spear Pond 1	Pond	2-0261
BBZ027	Overlook at Spear Pond 2	Pond	2-0261
BBZ028	Overlook at Spear Pond 3	Pond	2-0261
BBZ029	Overlook at Spear Pond 4	Pond	2-0261

### 3.2 Existing Condition Model (Post-2002)

The Existing Condition Model includes all existing BMPs in the Baseline Condition Model, as well as the addition of any BMPs that have been constructed since 2002 in the Bartlett Brook watershed. The purpose of the model is to show current flows in Bartlett Brook. This allows the State and MS4 communities to track progress toward the high flow attainment target.

On a routine basis, the Existing Condition BMPDSS model is revised to include any recently constructed BMPs, including BMPs designed and constructed by the MS4s, as well as BMPs constructed as part of commercial development and redevelopment. Additionally, the Existing Conditions Model is updated to reflect any changes to existing BMPs, such as revised drainage areas, modification of outlet control structures, or changes in storage volumes. The results of the Existing Condition Model are compared to the Baseline Condition Model to determine if the 11.6% reduction in high flow has been achieved.

The current Existing Condition Model (model run date 1/7/2019) contains 36 BMPs, including 16 from the Baseline Model, along with an additional 20 BMPs that have been constructed since 2002. A summary table of the existing BMPs is included in (Table 3). The BMPDSS modeling run results show an Unadjusted High Flow of 16.97 cfs, which is an 8.07% reduction in high flow from the Baseline Condition Model of 18.46 cfs.

**Table 3: BMPs Included in the 1/7/2019 Existing Condition Model For the Bartlett Brook Watershed**

<b>BMP ID</b>	<b>BMP Name</b>	<b>BMP Type</b>	<b>Permit #</b>
Baseline BMPs (16)	Varies	Varies	Varies
BB003	Bartlett Brook Central	Gravel Wetland	1-0202 & 2-0120
BBZ030	Shearer Chevrolet	Pond	3003-INDS
BBZ031	Farm Stand Condominiums	Pond	4827-INDS
BBZ032	South Village Phase 1 Pond 1	Pond	4096-INDS
BBZ033	South Village Phase 1 Pond 2	Pond	4096-INDS
BBZ034	South Village Phase 1 Pond 3	Pond	4096-INDS
BBZ004	BBSTS	Pond	n/a
BBZ036	Harbor Heights Condominiums	Underground Storage	6294-9030
BBZ037	Bay Court Condominiums	Pond	6294-9030.1
BBZ038	South Pointe	Pond	3443-INDS
BBZ039	68 Nesti Drive	Swale/Pond	6281-9030
BBZ042	Bartlett Brook Apartments Dry Swale 1	Dry Swale	7365-INDS
BBZ043	Bartlett Brook Apartments Dry Swale 2	Dry Swale	7365-INDS

BBZ044	Bartlett Brook Apartments Dry Swale 3	Dry Swale	7365-INDS
BBZ045	Bartlett Brook Apartments Bioretention	Bioretention	7365-INDS
BBZ046	Bartlett Brook Apartments Infiltration Trench	Infiltration Trench	7365-INDS
BBZ047	Bartlett Brook Apartments Infiltration Basin	Infiltration Basin	7365-INDS
BBZ048	25 & 27 Green Mountain Drive Infiltration Basin 1	Infiltration Basin	3017-INDS.T
BBZ049	25 & 27 Green Mountain Drive Infiltration Basin 2	Infiltration Basin	3017-INDS.T
BBZ035	South Village Phase 2	Dry Detention Basin	4096-INDS.1A

### 3.3 Proposed Condition Model (Credit)

The Proposed Condition Model (model run date 1/7/2019) includes all BMPs in the Existing Condition Model, which in turn includes all BMPs from the Baseline Condition Model, as well as a collection of proposed BMPs that can achieve the high flow reduction target in the Bartlett Brook watershed. The iterative process of developing the list of proposed BMPs is detailed further in the original Bartlett Brook FRP, dated October 1, 2016.

The Proposed Condition Model includes 12 new BMPs including four (4) retrofits to existing BMPs with expired permits, eight (8) new stormwater treatment practices. Credit toward the flow target is also provided by all BMPs from the Existing Condition Model that were constructed after 2002.

The BMPDSS Proposed Condition Model results show an unadjusted high flow of 15.77 cfs, which is a 14.58% reduction in high flow from the Baseline Condition Model of 18.46 cfs. This exceeds the target reduction of 11.6% that was established in the Bartlett Brook TMDL. The Proposed Condition Model is estimated to manage 126% of the high flow target. A summary table of the proposed BMPs is included in (Table 4). A map of the proposed BMP locations is included in Appendix 3.

**Table 4: BMPs Included in the Proposed Condition Model for the Bartlett Brook Watershed**

<b>BMP ID</b>	<b>BMP Name</b>	<b>Owner-ship where BMP is located</b>	<b>BMP Type</b>	<b>Permit #</b>	<b>Runoff Area (ac)</b>	<b>Impervious Cover Managed (ac)</b>
Baseline BMPs (13)	Varies	Varies	Varies	Varies	--	--
Existing BMPs (19)	Varies	Varies	Varies	Varies	--	--
BB0010	Horticulture Farm Bioretention	UVM	Bioretention	N/A	20.08	2.72
BB0016	Underwood Stormwater Pond	City of. S. Burlington	Detention Basin	Drains to Expired #2- 2061	38.15	4.33
BB0004	Bartlett Bay Stormwater Treatment System (BBSTS) Expansion	Private Owner	Retrofit BBSTS Wetland	5625-9010, 2-0180, 2- 0153, 1- 0734	16.06	9.34
BBZ050	Harbor Freight	Private Development	Infiltration/ Detention Basin	7819-INDS	1.97	1.22
BBZ041	Bouyea Lane Dry Detention Channel	Private Redevelopment	Dry Detention Channel	6342-INDS	2.74	1.21
BBZ040	Bouyea Lane Wet Pond	Private Redevelopment	Wet Pond	6342-INDS	4.23	2.68
BB0009	Holiday Inn Parking Lot	Developer - Pizzagalli	Detention Basin	6297-9030	5.01	3.34
BB0001	1690 Shelburne Road	VTrans	Detention Chamber	N/A	0.81	.55
BB0012	Irish Farm Condos Pond B	HOA	Retrofit to Gravel Wetland	Expired # 1-1404	18.35	3.55
BB0015	Pinnacle at Spear Pond B	Private Owner	Retrofit to Sand Filter	Expired #1-1155	3.45	0.97
BB0011	Horticulture Farm Detention Pond	UVM	Detention	N/A	7.66	1.24
BB0014	Pinnacle at Spear Pond A	Private Owner	Retrofit to Gravel Wetland	Expired #1-1155	12.66	4.50

### 3.4 Watershed-Wide Project Ranking

All proposed stormwater BMPs in the Bartlett Brook watershed were subjected to a ranking process. The City of South Burlington contains a portion of five different stormwater impaired watersheds and is subject to five stormwater TMDLs (Potash, Bartlett, Englesby, Centennial, and Munroe Brook). As a result, the City has developed an FRP for each watershed and these FRPs contain a number of proposed stormwater BMPs. Proposed stormwater BMPs for all watersheds were ranked together and a City-wide project prioritization was created. Only proposed stormwater BMPs located in the Bartlett Brook watershed will be presented in the Bartlett Brook FRP.

Considerations that factored into the ranking of proposed BMP projects include the estimated benefit of a BMP towards the FRP's flow restoration targets, and the amount of impervious area treated. The project ranking matrix ranked the proposed stormwater BMPs based on the following criteria, which were grouped into four general categories as shown in Table 5.

**Table 5: Factors Included in the Proposed Stormwater BMP Project Ranking Matrix**

Category	ID	Criteria
Cost/Operations	A	Project Cost per Impervious Acre
Project Design Metrics	B	Impervious Acres Managed (ac)
	C	Channel Protection Volume (CPv) Mitigated, (ie. 1-year Storm)
	D	Volume Infiltrated (ac-ft)
Project Implementation	E	Permits
	F	Land Availability
Other Project Benefits/Constraints	G	Flood Mitigation (Is existing flooding issue mitigated by project?)
	H	TMDL Flow Target Addressed (Q03, Q95)
	I	Lake Champlain Phosphorus TMDL
	J	Other Project Benefits/Constraints

Values for each criteria were identified and assigned a relative score, so that proposed BMP projects could be ranked based on a total score. The final ranking of proposed projects is included in Table 6 below. The scoring key and full descriptions of the criteria are included in Appendix 4. It should be noted that three projects from the Proposed Condition BMPs list (Table 4) are not included in the project ranking list below, as they are redevelopment projects on private property that were not anticipated during FRP development. Since these projects are being constructed as a result of private development, they do not need to be ranked for the purpose of implementation by the MS4s.

**Table 6: Ranking Summary of Proposed Stormwater BMPs in the Bartlett Brook Watershed**

ID #	Site ID	BMP Type	Retrofit Description	Total Score
BB0010	Horticulture Farm Bioretention	Bioretention	Bioretention basin along walking path.	19.75
BB0016	Underwood Stormwater Pond	Detention Basin	Detention BMP in ROW and/or on City property. Would alleviate flooding downstream.	19.5
BB0009	Holiday Inn Parking Lot	Detention Basin	Detention BMP on private open land. Planned for design as part of 1690 Shelburne Rd. Project. Infiltration potential	18
BB0004	BBSTS Expansion	Wetland	Route CPv storm to BBSTS Wetland, and add forebay.	16.75
BB0014	Pinnacle at Spear Pond A	Gravel Wetland	Retrofit of existing dry detention basin into gravel wetland.	16.75
BB00012	Irish Farm Condos Pond B	Gravel Wetland	Upgrade existing pond to gravel wetland STP, with more storage. Route additional 5.47 acres to Pond B.	16
BB0015	Pinnacle at Spear Pond B	Sand Filter	Retrofit of existing dry detention basin into sand filter.	13.75
BB0011	Horticulture Farm Detention Pond	Detention	Provide irrigation pond for UVM farm	12
BB0001	1690 Shelburne Rd.	Detention Basin	Detain unmanaged portion of Route 7 in underground detention chamber.	12

## 4. Design and Construction Schedule

A Design and Construction (D&C) schedule is a required element of the final FRP. This schedule must show how the proposed BMPs included in the FRP can be implemented over a timeframe of less than 20 years from the date of MS4 permit issuance. This means that all BMPs associated with FRPs must be implemented prior to December 5, 2032. The City of South Burlington owns impervious surface in five stormwater impaired watersheds; Bartlett, Englesby, Centennial, Munroe, and Potash Brook. Therefore, proposed stormwater BMPs in all five watersheds were considered when developing a realistic D&C schedule for the City. However, only the projects located within the Bartlett Brook watershed are presented in the implementation schedule in Table 7.

**Table 7: Bartlett Brook Watershed BMP Project Implementation Schedule**

Project ID	Project Name	MS4	BMP Type	BMP Description	Implementation Year	Project Cost w/ Inflation
BB0003	Bartlett Brook Central	South Burlington	GW	Gravel Wetland constructed to treat runoff from a 70 acre drainage area. Previous outfalls had significant erosion issues.	2017	\$ 767,000
BBZ050	Harbor Freight	Private	IG/DB	Private redevelopment including an infiltration gallery and detention pond. Project constructed in 2018.	2018	N/A
BB0015	Pinnacle at Spear Pond B	South Burlington	SF	Retrofit of existing dry detention basin into sand filter and expansion of drainage area. Project constructed in 2018.	2018	\$ 85,000
BB0014	Pinnacle at Spear Pond A	South Burlington	GW	Retrofit of existing dry detention basin into gravel wetland. Project currently under contract for construction in 2019.	2019	\$ 141,000
BB0004	BBSTS Expansion	South Burlington	DP	Expansion of an existing system to treat an additional 9.34 acres of impervious from Route 7 and Harborview Dr. The project would involve pretreatment, as well as expanding the pond.	2020	\$ 498,000
BB0010	Horticulture Farm Bioretention	UVM	Bio	The proposed project would involve the retrofit of a swale into a bioretention basin. A berm in the center of the basin would provide an extended flow path.	2020	\$ 320,000



BB0011	Horticulture Farm Detention Pond	UVM	DP	The proposed pond on the UVM Horticulture Farm property to control flow from 7.6 acre drainage area. Pond would provide store of usable water on-site.	2020	\$ 221,000
BBZ042	Bouyea Lane Development Wet Pond	Private	DP	Private redevelopment in the Bartlett Brook watershed that will result in the construction of a detention pond.	2021	N/A
BBZ043	Bouyea Lane Development Dry Detention Channel	Private	DT	Private redevelopment in the Bartlett Brook watershed that will result in the construction of a dry detention channel.	2021	N/A
BB0012	Irish Farm Condos Pond B	South Burlington	GW	Upgrade existing pond to gravel wetland STP, with more storage. Route additional 5.47 acres to Pond B.	2021	\$ 304,000
BB0009	Holiday Inn Parking Lot	South Burlington	UD	Opportunity for an underground infiltration gallery in the open space to mitigate runoff from the Holiday Inn Parking lot and hotel.	2023	\$ 247,000
BB0016	Underwood Stormwater Pond	South Burlington	DP	The proposed project would retrofit the existing roadside swale along Spear St, just South of Nowland Farm Rd, into a detention basin with a 44.3 acre area.	2025	\$ 308,000
BB0001	1690 Shelburne Road	VTrans	UD	Detain unmanaged portion of Route 7 in underground detention chamber.	2028	\$ 302,000

In addition to a project's score within the BMP ranking matrix, development of a BMP implementation schedule required the consideration of additional factors, such as expired State of Vermont stormwater permits, properties containing more than 3 acres of impervious area, and land owned or controlled by the MS4 entities. Additionally, private property redevelopment and development of the City's Phosphorus Control Plan (PCP) may cause certain projects to gain or lose priority within the implementation schedule in the future.

## 5. Financial Plan

Subject to the requirements of the MS4 permit, a financial plan is required as part of the FRP. This plan must provide initial BMP cost estimates and demonstrate the means by which BMP implementation will be financed. The financial plan must also include the steps that each MS4 will take to implement the finance plan. Initial BMP cost estimates were calculated in 2014 using cost values that were current at that time. Once projects were scheduled over the 20 year implementation schedule, an annual 3% inflation rate (based on historic trends in the construction cost index<sup>7</sup>) was applied. Table 7 presents inflation adjusted project costs for each BMP project. Applying this inflation rate provides a more accurate annual cost for BMP construction in the later years of the schedule.

### 5.1 City of South Burlington Financial Plan

In 2005, the City of South Burlington created Vermont's first stormwater utility. Under the stormwater utility system, all developed properties in the City pay an impervious area-based stormwater fee using an Equivalent Residential Unit (ERU) system. These stormwater fees provide the City with a stable funding source that is used to comply with State and Federal stormwater regulations and maintain stormwater infrastructure throughout the City. The stormwater utility was created with the understanding that there would be future stormwater costs related to the five stormwater impaired watersheds located in South Burlington, as well as costs related to future implementation of projects required by the Lake Champlain Phosphorous TMDL. The City is currently utilizing funds generated from stormwater utility fees to fund FRP related costs.

Once the BMP cost and implementation schedule was developed, the City of South Burlington Stormwater Utility was able to incorporate this information into its existing stormwater rate model. The City evaluated two different scenarios for funding the BMPs included in the FRP. The first scenario assumed that there would be no grant funding available to assist with implementation. The second scenario assumed that grant funding of approximately \$250,000 per year would be available in 2018 through 2029, and that this amount would increase to \$500,000 in 2030, 2031, and 2032. The resulting annual cost to a single family residential property and commercial property owner containing 1 acre of impervious area is summarized in Table 8. Calculations for "Commercial Property Containing 1 Acre Impervious Area" in Table 8 assume an Equivalent Residential Unit (ERU) rate of 17 and do not take into account the City's relative tier factors based on percent impervious cover.

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<sup>7</sup> RSMean. "Historical Cost Indexes." <https://www.rsmeansonline.com/references/unit/refpdf/hci.pdf>

**Table 8: Annual Stormwater Fee Paid by Property Owners Under Different FRP Funding Scenarios**

Fiscal Year	Funding Scenario 1 - Receive No Grants		Funding Scenario 2 - Receive \$250,000 in Grants Annually	
	Single Family Residential Property	Commercial Property Containing 1 Acre Impervious Area	Single Family Residential Property	Commercial Property Containing 1 Acre Impervious Area
2018	\$80.28	\$1,364.76	\$80.28	\$1,364.76
2019	\$82.44	\$1,401.48	\$82.08	\$1,395.36
2020	\$84.60	\$1,438.20	\$83.88	\$1,425.96
2021	\$87.12	\$1,481.04	\$85.68	\$1,456.56
2022	\$90.00	\$1,530.00	\$87.48	\$1,487.16
2023	\$93.24	\$1,585.08	\$89.28	\$1,517.76
2024	\$96.84	\$1,646.28	\$91.08	\$1,548.36
2025	\$100.80	\$1,713.60	\$92.88	\$1,578.96
2026	\$105.12	\$1,787.04	\$94.68	\$1,609.56
2027	\$109.80	\$1,866.60	\$96.48	\$1,640.16
2028	\$114.84	\$1,952.28	\$98.28	\$1,670.76
2029	\$119.88	\$2,037.96	\$100.08	\$1,701.36
2030	\$124.92	\$2,123.64	\$101.88	\$1,731.96
2031	\$129.96	\$2,209.32	\$103.68	\$1,762.56
2032	\$135.00	\$2,295.00	\$105.48	\$1,793.16

It is the City's expectation that grant funding from the State of Vermont and other Federal sources will be available to help with the cost of stormwater TMDL implementation. In 2015 the Vermont legislature created the Clean Water Fund (CWF). The CWF was provided with \$2,005,000 in 2016, \$7,688,000 in 2017, \$5,325,477 in 2018, and \$4,000,000 in 2019 (along with \$25M allocated from the Capital Bill Budget). State investment in the CWF alone is not at the level necessary to provide significant funding to the MS4 communities subject to stormwater TMDLs. The City of South Burlington intends to work closely with our legislative representatives to ensure that the required long term, dedicated funding is made available for the stormwater improvements included in the FRPs. The City of South Burlington will also continue to pursue funding from existing and new grant sources from other organizations including, but not limited to, VTDEC, the Vermont Agency of Transportation, and the Lake Champlain Basin Program.

## **5.2 Vermont Agency of Transportation Financial Plan**

Planning level costs were independently estimated for VTrans projects. As such, some cost estimates may differ slightly from those presented in other FRP documents. VTrans will request state and federal funding for the appropriate amount to implement the BMPs as outlined in their design and construction schedule. If a project requires joint funding with a municipality, VTrans will request funding sufficient to cover their portion of the

project cost. In watersheds where VTrans is either not meeting or exceeding their allocated target there may be cost sharing between MS4s.

### 5.3 BMP Cost Estimates:

Cost estimates were developed based on a simple spreadsheet method that calculated base construction cost as a product of the design control volume, the unit cost, and the site adjustment factor, as outlined in Table 9 below<sup>8</sup>. Additionally, permitting, engineering, land acquisition, and O&M costs were factored into the total cost estimate.

**Table 9: Retrofit unit costs and adjustment factors**

BMP	Base Cost (\$/ft3)
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

## 6. Regulatory Analysis

In accordance with the MS4 permit, an FRP requires a regulatory analysis that identifies and describes what, if any additional regulatory authorities that the permittees will need in order to effectively implement the FRP.

Currently, stormwater runoff within the Bartlett Brook watershed is regulated primarily by the VTDEC, City of South Burlington, Town of Shelburne, and VTrans. VTDEC regulates new developments through issuance of Stormwater Discharge Permits with technical requirements as outlined in the 2017 Vermont Stormwater Management Manual. The City of South Burlington and Town of Shelburne require improved stormwater practices and low impact development for new developments through their stormwater ordinances and Land Development Regulations (LDRs). VTrans regulates stormwater discharges to the state Right of Way through 19 V.S.A. §1111 “Permitted use of the right-of-way”.

<sup>8</sup> Methodology based on Horsley Witten Group Memorandum (Page 11). Included in Appendix 8.

The City of South Burlington updated the stormwater requirements in its LDRs in June 2016.<sup>9</sup> The revised LDRs require that any project resulting in ½ acre or more of impervious area implement stormwater controls that prioritize infiltration. The revised LDRs also contain new requirements for properties that are being redeveloped. It is the City's expectation that these changes will result in gradual improvements in stormwater management over the course of the 20 year BMP implementation schedule.

The City of South Burlington also revised its "Ordinance Regulating the Use of Public and Private Sanitary Sewerage and Stormwater Systems" in October 2015.<sup>10</sup> The ordinance provides a policy regarding the handling of expired VTDEC stormwater permits located in South Burlington. The City will continue to take over responsibility for exclusively residential stormwater systems that complete upgrades. In addition, the revised ordinance allows commercial properties with expired permits to obtain coverage under the City's MS4 permit if upgrades to the stormwater system are completed. These properties will still be responsible for maintaining their systems, but the permit coverage required by the State of Vermont can now be provided through the City's MS4 permit instead of obtaining coverage under one of VTDEC's other permit programs.

A full list of the expired State of Vermont permits with discharges to Bartlett Brook indicating the retrofits proposed under this FRP is included in Appendix 6 (Table A-9).

## 7. Third Party Implementation

As required by the approved MS4 general permit, all expired stormwater permits in the watershed were reviewed for inclusion within the BMPDSS model. The process of BMP identification involved an initial assessment of the existing BMPs with expired permits that did not already meet the Channel Protections standards in the 2002 Vermont Stormwater Management Manual (VSMM) to determine if they could be retrofit to meet the VSMM design standards (Table 10).

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<sup>9</sup> Section 12.03 – Stormwater Management Standards, "South Burlington Land Development Regulations," dated 8/6/18, can be viewed at the following link:  
<http://www.southburlingtonvt.gov/Planning/LDR%20Amendments/2018-5/LDRs%20Complete%20Effective%208-6-2018%20reduced.pdf>

<sup>10</sup> South Burlington's "Ordinance Regulating the Use of Public and Private Sanitary Sewerage and Stormwater Systems," dated 10/5/15, can be viewed at the following link:  
[http://www.southburlingtonvt.gov/document\\_center/planning/Sewerage\\_Stormwater\\_Systems.pdf](http://www.southburlingtonvt.gov/document_center/planning/Sewerage_Stormwater_Systems.pdf)

**Table 10: Stormwater BMPs Required by Expired State of Vermont Stormwater Permits That Are Included in the Bartlett Brook BMPDSS Model**

Permit #	Project Name	BMP Type in Model	Permit Status	RDA	Permit Issued
1-1404.9912	Irish Farms Residential Subdivision	Ponds (3)	Issued	n/a	5/31/2000
1-0523.XXXX	Champ Carwash	Pond, Swale system	Issued	6280-9030	11/3/1987
1-1155.9806	Pinnacle at Spear	Ponds (2)	Issued	n/a	4/21/1999
3121-9010	Willie Racine Jeep Isuzu	Ponds (2)	Issued	n/a	11/24/2003
1-1372.9905	Staybridge Suites & Harbor Sunset Hotel	Infiltration Trenches (2)	Issued	6296-9030	9/1/1999
	Oil n' Go	Swale	n/a		4/1/1999
2-0261.XXXX	Overlook at Spear/Summit at Spear	Ponds in series (4)	Issued	n/a	4/17/1985

\*Table Prepared by Emily Schelley (VT DEC 2014). Revised by WCA (2014)

## 7.1 Expired Permit Proposed Retrofits

All expired permit holders in the Bartlett Brook watershed will be required to obtain valid State stormwater permit coverage. This can be accomplished through a process that the State has identified in their current draft Stormwater Permitting Rule, or through the City's Stormwater Upgrade Feasibility Analysis (SUFA) process. Refer to [sburlstormwater.com/download-material/](http://sburlstormwater.com/download-material/) for the latest available version of the City's Stormwater Upgrade Feasibility Analysis (SUFA) document.

As noted in the SUFA, "FRPs for the stormwater impaired watersheds located in the City contain a preliminary assessment of the stormwater treatment potential of some sites. If an FRP identifies an STP on a site, then the site must install either the specified STP or an STP that provides equivalent or greater treatment. In addition, final FRPs will contain a schedule indicating when various retrofits must occur. Properties that choose to construct STPs must do so before November 15, 2023, or the date specified in the FRP, whichever is sooner." The City may revise the date included in the ordinance depending upon the dates included in the final version of State of Vermont Stormwater Permitting Rule. The City expects that VTDEC will finalize the rule in 2019. This will provide the City with sufficient time to update its ordinance.

The City has identified a specific retrofit project for the Irish Farm Condominiums neighborhood (expired Permit #1-1404), which is currently included in the Proposed Condition Model run. All other expired permits in the Bartlett Brook Watershed will be required to complete upgrades as determined by the technical standards included in the City's SUFA.

## **8. Appendices**

Appendix 1: BMP Summary Sheets

Appendix 2: Table A-3-1: BMPDSS Modeling Run Summary

Appendix 3: Map of BMPs Included in the Bartlett Brook Flow Restoration Plan

Appendix 4: Table A-5-1: BMP Ranking Criteria Key, Table A-5-2: Scoring Key

Appendix 5: Bartlett Brook Watershed BMP Design and Construction Schedule

Appendix 6: Bartlett Brook Expired Permit List

**APPENDIX 1**

**BMP SUMMARY SHEETS**



# Bartlett Brook FRP BMP Summary Sheet

Site name:		1690 Shelburne Road		South Burlington ID:		BB0001					
Approximate address:		Shelburne Rd north of Harbor View Rd, South Burlington		MS4 where BMP is located:		VTrans		New or existing BMP?		New	
Proposed BMP type:		Underground Detention									



Estimated project cost	\$199,000	MS4s contributing drainage to BMP	VTrans
Drainage area (acres)	0.81	Primary land use in drainage	Transportation
Impervious acres managed	0.55	2 or more landowners?	No
% Impervious	68%	CPv managed (ac-ft)	0.12
Land owner of BMP location	MS4 Owned/ Private	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.05	Primary or secondary BMP?	Primary
BMP Depth (feet)	4.00	Expired permit(s)?	No Permit
Hydrologic soil group	B/D		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
Detain unmanaged portion of Route 7 in underground detention chamber.	

# Bartlett Brook FRP BMP Summary Sheet

Site name:		BBSTS Expansion		South Burlington ID:		BB0004					
Approximate address:		Shelburne Rd north of Harbor View Rd, South Burlington		MS4 where BMP is located:		South Burlington		New or existing BMP?		Existing	
Proposed BMP type:		Detention Pond									



Estimated project cost	\$470,000	MS4s contributing drainage to BMP	South Burlington, VTrans
Drainage area (acres)	16.06	Primary land use in drainage	Commercial
Impervious acres managed	9.34	2 or more landowners?	Yes
% Impervious	58%	CPv managed (ac-ft)	0.55
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.30	Primary or secondary BMP?	Primary
BMP Depth (feet)	5.00	Expired permit(s)?	2-0180; 2-0153; 1-0734
Hydrologic soil group	D		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
The proposed expansion of the BBSTS system would be to route additional area to system via a new stormline connection on Route 7 from a portion of Route 7 and Harborview Dr. The expansion would involve adding a new forebay for the additional connection in front of the Oil N Go property, as well as expanding the southeast portion of the wetland. The existing access road would also be	

# Bartlett Brook FRP BMP Summary Sheet

Site name:		Holiday Inn Parking Lot		South Burlington ID:		BB0009					
Approximate address:		Shelburne Rd north of Harbor View Rd, South Burlington		MS4 where BMP is located:		South Burlington		New or existing BMP?		New	
Proposed BMP type:		Underground Detention									



Estimated project cost	\$189,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	5.01	Primary land use in drainage	Commercial
Impervious acres managed	3.34	2 or more landowners?	No
% Impervious	67%	CPv managed (ac-ft)	0.31
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.30
BMP Footprint Size (acres)	0.22	Primary or secondary BMP?	Primary
BMP Depth (feet)	5.00	Expired permit(s)?	6297-9030
Hydrologic soil group	B		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
Opportunity for an underground infiltration gallery in the open space to mitigate runoff from the Holiday Inn Parking lot. Also potential to route drainage from Staybridge Hotel, which is currently routed to a detention pond not meeting the VT CPv standard. Option to provide an offset project for new development.	Further verification of the new connections for the system will need to be completed to prove out the project feasibility



# Bartlett Brook FRP BMP Summary Sheet

<b>Site name:</b>	Horticulture Farm Bioretention	<b>South Burlington ID:</b>	BB0010
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<b>Approximate address:</b>	Spear St north of Deerfield Dr, South Burlington	<b>MS4 where BMP is located:</b>	UVM	<b>New or existing BMP?</b>	New
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<b>Proposed BMP type:</b>	Bioretention
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Estimated project cost	\$268,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	20.08	Primary land use in drainage	Residential
Impervious acres managed	2.72	2 or more landowners?	Yes
% Impervious	14%	CPv managed (ac-ft)	1.52
Land owner of BMP location	MS4 Owned	Volume infiltrated (ac-ft)	1.52
BMP Footprint Size (acres)	0.44	Primary or secondary BMP?	Primary
BMP Depth (feet)	4.00	Expired permit(s)?	No Permit
Hydrologic soil group	B		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
The proposed site was identified as an excellent candidate to improve the overall aesthetics of the walking path, while also providing significant stormwater management. The project would involve a retrofit of the swale into a 0.81 ac-ft bioretention basin. A berm in the center of the basin would provide an extended flow path to improve water quality treatment.	

# Bartlett Brook FRP BMP Summary Sheet

<b>Site name:</b>	Horticulture Farm Detention Pond	<b>South Burlington ID:</b>	BB0011
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<b>Approximate address:</b>	Deerfield Dr and Spear St, South Burlington	<b>MS4 where BMP is located:</b>	UVM	<b>New or existing BMP?</b>	Existing
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<b>Proposed BMP type:</b>	Detention Pond
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Estimated project cost	\$185,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	7.66	Primary land use in drainage	Residential
Impervious acres managed	1.24	2 or more landowners?	Yes
% Impervious	16%	CPv managed (ac-ft)	0.09
Land owner of BMP location	MS4 Owned	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.22	Primary or secondary BMP?	Primary
BMP Depth (feet)	6.00	Expired permit(s)?	1-1155
Hydrologic soil group	A/B		

Proposed BMP description:	Feasibility concerns:
BMP is located on the UVM Horticulture Farm property, for which irrigation is an everpresent need. The 10-year storm (Qp10) overflow from the Horticulture Farm basin would be routed to the dug pond, providing a store of usable water on-site and Qp10 control for the basin.	

# Bartlett Brook FRP BMP Summary Sheet

Site name:		Irish Farm Condos Pond B		South Burlington ID:		BB0012	
Approximate address:		Irish Cove Rd, South Burlington		MS4 where BMP is located:	South Burlington	New or existing BMP?	Existing
Proposed BMP type:		Gravel Wetland					



Estimated project cost	\$247,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	18.35	Primary land use in drainage	Residential
Impervious acres managed	3.55	2 or more landowners?	Yes
% Impervious	19%	CPv managed (ac-ft)	0.27
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.26	Primary or secondary BMP?	Primary
BMP Depth (feet)	7.00	Expired permit(s)?	1-1404
Hydrologic soil group	A		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
Upgrade existing pond to gravel wetland STP, with more storage. Route additional 5.47 acres to Pond B.	The system is on private property, owned by the condo's HOA.



# Bartlett Brook FRP BMP Summary Sheet

Site name:		Pinnacle at Spear Pond A		South Burlington ID:		BB0014	
Approximate address:		Pinnacle Dr, South Burlington		MS4 where BMP is located:	South Burlington	New or existing BMP?	Existing
Proposed BMP type:		Gravel Wetland					



Estimated project cost	\$141,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	12.66	Primary land use in drainage	Residential
Impervious acres managed	4.50	2 or more landowners?	Yes
% Impervious	36%	CPv managed (ac-ft)	0.43
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.34	Primary or secondary BMP?	Secondary
BMP Depth (feet)	5.00	Expired permit(s)?	1-1155
Hydrologic soil group	D		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
The outlet structure on Pond a (North lot) is proposed for retrofit, including the removal of the existing 12" culvert, replaced with a 3" low-flow orifice.	

# Bartlett Brook FRP BMP Summary Sheet

Site name:		Pinnacle at Spear Pond B		South Burlington ID:		BB0015					
Approximate address:		Spear St and Olivia Dr, South Burlington		MS4 where BMP is located:		South Burlington		New or existing BMP?		Existing	
Proposed BMP type:		Sand Filter									



Estimated project cost	\$85,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	3.45	Primary land use in drainage	Residential
Impervious acres managed	0.97	2 or more landowners?	Yes
% Impervious	28%	CPv managed (ac-ft)	0.11
Land owner of BMP location	Private	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.33	Primary or secondary BMP?	Secondary
BMP Depth (feet)	6.00	Expired permit(s)?	1-1155
Hydrologic soil group	C/D		

<b>Proposed BMP description:</b>	<b>Feasibility concerns:</b>
The outlet structure on Pond b (along Spear St) is proposed for retrofit including the addition of two low-flow orifices, 1" at 371' and a 2" at 373.5'. The retrofits will provide 0.139 ac-ft of CPv storage.	



# Bartlett Brook FRP BMP Summary Sheet

<b>Site name:</b>	Underwood Stormwater Pond	<b>South Burlington ID:</b>	BB0016
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<b>Approximate address:</b>	Spear St south of Deerfield Dr, South Burlington	<b>MS4 where BMP is located:</b>	South Burlington	<b>New or existing BMP?</b>	New
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<b>Proposed BMP type:</b>	Detention Pond
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Estimated project cost	\$222,000	MS4s contributing drainage to BMP	South Burlington
Drainage area (acres)	38.15	Primary land use in drainage	Residential
Impervious acres managed	4.33	2 or more landowners?	Yes
% Impervious	11%	CPv managed (ac-ft)	0.84
Land owner of BMP location	MS4 Owned	Volume infiltrated (ac-ft)	0.00
BMP Footprint Size (acres)	0.36	Primary or secondary BMP?	Primary
BMP Depth (feet)	6.00	Expired permit(s)?	No Permit
Hydrologic soil group	D		

Proposed BMP description:	Feasibility concerns:
The confluence of the existing stormline along Spear St, just South of Nowland Farm Rd. has been the source of flooding during large storm events. The proposed project would involve a retrofit of the existing roadside swale into a detention basin, designed to provide CPv (1-year) for a 44.3 acre area in the upper Bartlett Brook watershed.	

## **APPENDIX 2**

### **TABLE A-3-1: BMPDSS MODELING RUN SUMMARY**

Table A-3-1: BMPDSS Modeling Run Summary

Input file	Description	Area	Normalized flow (cfs/ sq mi)		Unadjusted flow (cfs)	
			Q0.3	Q95	Q0.3	Q95
Bartlett_base_03-27-2018.inp	updated draiange area of 1-1404 to take in drainage from offsite swale	1.1888	15.528	0.1935	18.460	0.230
Bartlett_Post2002_03262018.inp	update of the post run with built BMPs: Keari Lane, Laurel Hill, 3017-INDS, 7365-INDS, and 4096-INDS.1A. Updated 1-1404 drainage area, same as base.	1.1762	14.360	0.1955	16.890	0.230
	% Change vs Base				-8.50%	0.00%
Bartlett_Post_12-21-2018_1.inp	Removed Laurel Hill	1.1762	14.428	0.1870	16.970	0.220
	% Change vs Base				8.07%	-4.38%
Bartlett_proposed_4-20-2018.inp	Added BBTS and Pinnacle at Spear upgrades, as well as Harbor Frieght, Bouyea Lane Development new projects	1.1766	13.828	0.1870	16.270	0.220
	% Change vs Base				11.86%	-4.35%
Bartlett_proposed_12-21-2018.inp	Took out Laurel Hill.	1.1766	13.922	0.1870	16.380	0.220
	% Change vs Base				11.27%	-4.35%
Bartlett_proposed_1_4_2019.inp	same as Bartlett_proposed_12-21-2018.inp but added Hort Farm Bioretention (BB0010), Hort Farm Detention Pond (BB0011), Irish Farm Condos Pond B (BB0012), Holiday Inn Parking Lot (BB0009), Underwood (BB0016), & 1690 Shelburne Road (BB0001)	1.1766	13.402	0.1870	15.768	0.220
					14.58%	-4.35%

## **APPENDIX 3**

### **MAP OF BEST MANAGEMENT PRACTICES INCLUDED IN THE BARTLETT BROOK FLOW RESTORATION PLAN**







## **APPENDIX 4**

TABLE A-5-1: BMP RANKING CRITERIA KEY

TABLE A-5-2: SCORING KEY

Table A-5-1: BMP Ranking Criteria Key

Category	ID	Criteria	Technical Description	Description
Cost/Operations	A	Project Cost	The project costs were grouped into categories from >\$50,000 to \$1,000,000 based on the range of projects proposed. Cost estimates were developed using the latest unit costs from VTrans as well as local experience. More expensive	Project Costs include additional engineering, permitting, and construction. Transportation and utility conflicts, as well as overall constructability is also reflected in the cost.
Project Design Metrics	B	Impervious Acres Managed (ac)	Natural groupings within the range of impervious managed for the proposed projects were identified. More impervious managed receives a higher score.	The more impervious managed by a project, the higher the potential pollutant reduction. Additionally, the goal of the FRP is to manage existing impervious surfaces.
	C	Channel Protection Volume (CPv) Mitigated, (i.e.. 1-year Storm)	Groupings within the range of CPv volume storage were identified. The largest grouping receives the highest score. The CPv was estimated in HydroCAD, using local rainfall data.	The Channel Protection Volume (CPv) is the volume of stormwater runoff generated from the 1-year design storm (1.98" in Burlington). A BMP which provides CPv storage was determined to reduce the High-flow (Q0.3%), which is the flow rate exceeded 0.3% of the time (output from the State's BMPDSS model). Mitigating the CPv reduces channel erosion and excessive
	D	Volume Infiltrated (ac-ft)	Natural groupings within the range of volumes infiltrated for the BMPs were identified to which relative points were be assigned. The largest volume infiltrated was assigned the highest score. Volumes were calculated in HydroCAD.	The Volume Infiltrated indicates the amount of stormwater runoff that is infiltrated into the groundwater, and provides baseflow for the stream. The TMDL flow targets include a low-flow target, which is addressed by an infiltration-based BMP.
Project Implementation	E	Permitability	Permitability is simplified into two categories to reflect the common scenarios in permitting, as 1) minimal permitting, versus 2) Complex permitting issues. An itemized list of permits was included to inform the ranking, but was not used in the scoring.	Permitability is a measure of the expected level of effort to permit the project, based on knowledge that each type of permit takes varying amounts of time. Some common permits include Stormwater Construction, Local Zoning, Act 250 amendments, VTRANS ROW, etc.
	F	Land Availability	Public land is preferred, followed by regulated private land, and private land where the owners are known to be open to participate. Private land, in which participation of the owner is unknown is lower priority.	Land availability is critical for BMPs requiring open space for detention and access for the City. Properties owned by the City are ranked the highest, followed by privately owned land that has an expired permit, which provides leverage for owner participation.
Other Project Benefits	G	Flood Mitigation	Flood mitigation is categorized by the scale of the impact.	Flood mitigation is categorized by the scale of the impact. A neighborhood flooding issue is weighed more heavily than a localized drainage issue.
	H	TMDL Flow Target Addressed (Q03, Q95)	More weight is on BMPs that address both TMDL targets- the high-flow (Q0.3%) and low-flow targets (Q95%). The high-flow target is addressed by detention BMPs which storage the CP volume.	The goal of the FRP is to implement projects which address the TMDL flow targets. The high-flow target is measured as a <b>reduction</b> in the stream flow rate exceeded 0.3% of the time, while the low-flow target is an <b>increase</b> in the stream flow rate exceeded 95% of the time (baseflow). Projects which address both targets through storage or infiltration of the 1-year design storm are weighted the highest, followed by projects which address just the high-flow. Projects which do not address the full 1-year storm volume are weighted the lowest.
	I	Lake Champlain Phosphorus TMDL	Yes or no whether the proposed practice will provide benefit toward the Lake Champlain Phosphorus TMDL. This will be determined once the TMDL compliance metrics are released.	The Lake Champlain Phosphorus TMDL has been developed in the effort to reduce nutrient loading and consequential toxic algal blooms in Lake Champlain. The TMDL will require stormwater BMPs to meet a certain level of Total Phosphorus reduction. Each BMP will be evaluated against the TMDL compliance metrics, and scored yes or no if the project meets the TMDL standards.
	J	Other Project Benefits/Constraints	This criteria is to account for indirect project benefits like infrastructure improvements (e.g. aging culvert replacement, wetlands enhancement, and if it addresses an expired permit), or potential constraints (e.g. utility issues encountered during construction).	This criteria is to account for indirect project benefits like infrastructure improvements, community benefits, habitat creation, etc., as well as things that might constrain the project such as the potential of encountering utilities during construction.

Table A-5-2: Scoring Key

Category	ID	Criteria	Quality	Score
Cost/Operations	A	Relative Project Cost	\$1.00 - \$24,999	4
			\$25,000 - \$49,999	3
			\$49,999 - \$99,999	2
			\$100,000 - \$199,999	1
			\$200,000 - \$499,999	0
			\$500,000 +	-1
Project Design Metrics	B	Impervious Acres Managed (ac)	>10 acres	6
			>5-10 acres	5
			>4-5 acres	4
			>2-4 acres	3
			>1-2 acres	2
			< 1 acre	1
			0 acres	0
	C	Channel Protection Volume (CPv) Mitigated, (ie. 1-year Storm)	0.6-1.0 ac-ft	5
			0.4-0.6 ac-ft	4
			0.2-0.4 ac-ft	3
			0.05-0.2 ac-ft	2
			>0-0.05 ac-ft	1
	D	Volume Infiltrated (ac-ft)	0 ac-ft	0
			>2 ac-ft	5
			1 - 2 ac-ft	4
			0.5-1 ac-ft	3
			0.1- 0.5 ac-ft	2
Project Implementation	E	Permitability	Minimal Issues/Concerns or no permits	2
			Complex issues/Potential permit denial	0
	F	Land Availability	MS4 owned	4
			Non MS4 owned regulated (expire permit)	3
			Non MS4 owned/Participatory Owner	2
			Unknown	0
Other Project Benefits	G	Flood Mitigation (Is existing flooding issue mitigated by project?)	Not MS4 owned/Non participatory owner	-2
			Neighborhood Wide Flooding Issue	3
			Infrastructure damage (e.g. Wet Basement)	2
			Nuisance Issue (ie. ponding, puddles, etc).	1
	H	TMDL Flow Target Addressed (Q03, Q95)	None	0
			High and Low Flow Targets	3
			High Flow Target	2
	I	Lake Champlain Phosphorus TMDL	No target addressed in BMPDSS (just WQ treatment)	1
			Addressed TMDL	1
			Does not address TMDL	0
	J	Other Project Benefits	Infrastructure Improvement (e.g. Culvert Replacement)	1
			Educational/Functional Benefit	1
			Recreational Benefit	1
			Natural Habitat Creation/Protection	1
			Outfall Erosion Control	1
			Utility Issues/Uncertainty	-1



## **APPENDIX 5**

### **BARTLETT BROOK WATERSHED BMP DESIGN AND CONSTRUCTION SCHEDULE**

**Bartlett Brook Flow Restoration Plan**  
**Bartlett Brook Watershed BMP Project Implementation Schedule**

Project ID	Project Name	Expired Permit	MS4	BMP Type	BMP Description	Implementation Year	Project Cost (Rounded to Nearest \$1,000)	Project Cost with Inflation (Rounded to Nearest \$1,000)
BB0003	Bartlett Brook Central	1-0202; 2-0120	South Burlington	GW	Gravel Wetland and collection system constructed to treat runoff from four outfalls, a 70 acre drainage area. Outfalls had significant erosion issues. Land acquisition was not required for the project.	2017	\$ 767,000	\$ 767,000
BBZ050	Harbor Freight	7819-INDS	Private Development	IG/DB	Private redevelopment that includes an infiltration gallery and detention pond. Project was constructed in 2018.	2018	-	-
BB0015	Pinnacle at Spear Pond B	1-1155	South Burlington	SF	Retrofit of existing dry detention basin into sand filter and expansion of drainage area. Project was constructed in the Fall of 2018.	2018	\$ 85,000	\$ 85,000
BB0014	Pinnacle at Spear Pond A	1-1155	South Burlington	GW	Retrofit of existing dry detention basin into gravel wetland. Project is currently under contract for construction in Spring/Summer of 2019.	2019	\$ 141,000	\$ 141,000
BB0004	BBSTS Expansion	2-0180; 2-0153; 1-0734	South Burlington	DP	The proposed expansion would route additional area to system via a new stormline connection from a portion of Route 7 and Harborview Dr. The project would involve pretreatment, as well as expanding the pond.	2020	\$ 470,000	\$ 498,000
BB0010	Horticulture Farm Bioretention	No Permit	UVM	Bio	The proposed project would involve a retrofit of the swale into a 0.81 ac-ft bioretention basin. A berm in the center of the basin would provide an extended flow path to improve water quality treatment.	2020	\$ 268,000	\$ 320,000
BB0011	Horticulture Farm Detention Pond	1-1155	UVM	DP	BMP is located on the UVM Horticulture Farm property. The 10-year storm (Qp10) overflow from the Horticulture Farm basin would be routed to the dug pond, providing a store of usable water on-site and Qp10 control for the basin.	2020	\$ 185,000	\$ 221,000
BBZ042	Bouyea Lane Development Wet Pond	6342-INDS	Private Development	DP	Private redevelopment in the Bartlett Brook watershed that will result in the construction of a detention pond.	2021	-	-
BBZ043	Bouyea Lane Development Dry Detention Channel	6342-INDS	Private Development	DT	Private redevelopment in the Bartlett Brook watershed that will result in the construction of a dry detention channel.	2021	-	-
BB0012	Irish Farm Condos Pond B	1-1404	South Burlington	GW	Upgrade existing pond to gravel wetland STP, with more storage. Route additional 5.47 acres to Pond B.	2021	\$ 247,000	\$ 304,000
BB0009	Holiday Inn Parking Lot	6297-9030	South Burlington	UD	Opportunity for an underground infiltration gallery in the open space to mitigate runoff from the Holiday Inn Parking lot and hotel.	2023	\$ 189,000	\$ 247,000
BB0016	Underwood Stormwater Pond	No Permit	South Burlington	DP	The confluence of the existing stormline along Spear St, just South of Nowland Farm Rd. has been the source of flooding during large storm events. The proposed project would involve a retrofit of the existing roadside swale into a detention basin, designed to provide CPv (1-year) for a 44.3 acre area.	2025	\$ 222,000	\$ 308,000
BB0001	1690 Shelburne Road	No Permit	VTrans	UD	Detain unmanaged portion of Route 7 in underground detention chamber.	2028	\$ 199,000	\$ 302,000

## **APPENDIX 6**

### **BARTLETT BROOK EXPIRED PERMITS LIST**

**Table A-9: Bartlett Brook Expired Permit Discharges and Proposed Retrofits**

BMP in BMPDSS Model	Permit Number	Project Name	RDA/Other <sup>1</sup>	Permit Issued	Existing Manner of Discharge <sup>2</sup>	Proposed System Upgrades under FRP <sup>3</sup>
No Channel Protection Volume (CPv) BMP covered under Permit	1-0202.XXXX	Meadowwood at Spear	n/a	6/1/1976	CB	Drains to proposed Keri Lane BMP (Infiltration Gallery)
	1-0665.XXXX	Pillsbury Manor	n/a	9/30/1988	GS, RS, ST	Proposed Underground detention chamber assessed. Determined not necessary to meet FRP targets.
	1-0705.XXXX	Freedom Nissan	6342-9030	5/23/1988	CB, GS	No retrofit proposed. System currently covered under RDA permit.
	1-0734	Champ Car Care	n/a	11/29/1988	CB, GS	Drains to proposed BBTS Expansion Project (Wetland Pond)
	1-1134.XXXX	Freedom Nissan	6342-9030	5/10/1993	OF	No retrofit proposed. System currently covered under RDA permit.
	1-1220.9908	Allen Rd Community Care	n/a	5/12/1996	CB, (2)ST	Proposed Infiltration Basin assessed. Determined not necessary to meet FRP
	1-1291.0112	US Route 7 Expansion	5625-9010	12/20/2002	CB, OF	Covered under 5625-9010. Portion of coverage area drains to proposed BBTS Expansion Project (Wetland Pond), and a portion drains to proposed Shelburne Rd. Project (Detention Chamber)
	2-0153.XXXX	WESCO Distributors	n/a	4/26/1983	CB	Drains to proposed BBTS Expansion Project (Wetland Pond)
Channel Protection Volume (CPv) BMP covered under Permit	2-0180.XXXX	Shelburne Plastics	n/a	9/26/1983	GS	Drains to proposed BBTS Expansion Project (Wetland Pond)
	3121-9010	Willie Racine Jeep Isuzu	n/a	11/24/2003	GS, (2)DP, CB	Drains to proposed BBTS Expansion Project (Wetland Pond). Limited space to manage on-site.
	3017-9010	IDX Headquarters - 25 GMD	n/a	6/2/2003	IB	No retrofit proposed. Current system meeting VT 2002 SWMM standard for CPv.
	1-1404.9912	Irish Farms Residential Subdivision	n/a	5/31/2000	CB, (3)DP, GS	Irish Farms Pond Retrofit: Upgrade Pond B to gravel wetland, and new outlet control for Pond C.
	1-1372.9905	Staybridge Suites & Harbor Sunset Hotel	6296-9030	9/1/1999	CB, ST, DP, (2) IG	Proposed alternative option to route upper portion of Staybridge runoff to the Holiday Inn BMP rather than upgrade existing detention pond.
	1-1155.9806	Pinnacle at Spear	n/a	4/21/1999	CB, (2)DP, OF	Upgrade Pond A and B with new outlet control and increase storage.
	1-0949.XXXX	Bouyea-Fassetts Building	6281-9030	6/6/1990	OF, IB	No retrofit proposed. System currently covered under RDA permit.
	1-0523.XXXX	Champ Carwash	6280-9030	11/3/1987	GS, OF, DP	No retrofit proposed. System currently covered under RDA permit.
	2-1073.XXXX	Howard Johnson's	6297-9030	12/20/1985	DW, CB, OF, ST	Portion of coverage area drains to proposed Holiday Inn Project (Infiltration Gallery)
	2-0261.XXXX	Overlook at Spear/Summit at Spear	n/a	4/17/1985	CB, GS, (4)DP	Neighborhood GSI Retrofit: Propose 6 collections of biofilters or infiltration basins in the ROW, within the drainage area for the 4 on-stream ponds covered under #2-0261. Retrofit of on-stream ponds determined less feasible than distributed GSI retrofit.
	2-0120.XXXX	Bay Court/Harbor Heights/Keri Rd	6294-9030 & 6294-9030.1	8/11/1982	CB, (4)SF	Drains to proposed Keri Lane BMP (Infiltration Gallery)

\* Table Originally Prepared by Emily Schelley (VT DEC, last revised 1-31-14), Revised by WCA (2014).

<sup>1</sup> RDA: Residual Designation Authority- Private Permittees requests to have their expired stormwater system covered under an RDA permit, which overwrites their expired permit

<sup>2</sup> Manner of Discharge: CB: Catch Basin, GS: Grass Swale, RS: Retention Swale, ST: Settling Tank, OF: Control orifice, IB: Infiltration Basin, DP: Detention Pond, DW: Dry Well, IG: Infiltration Gallery, SF: Sand Filter

<sup>3</sup> Expired permit retrofits were determined based on direct benefit to the Flow Restoration Targets. Expired permits with a CPv(extended detention of the 1-year design storm) BMP were assessed for retrofit opportunity, and if the flow reduction benefit was determined negligible, a retrofit was not proposed. It was determined beneficial to route several expired permit systems to a larger retrofit project, rather than retrofit the existing system on-site.