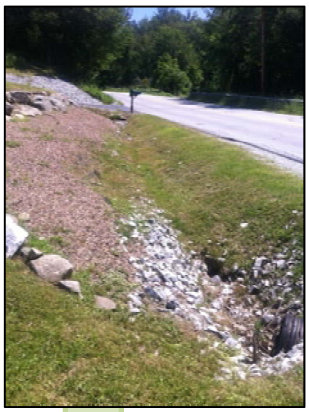

STEVENS BROOK FLOW RESTORATION PLAN (FRP)

MS4 GENERAL PERMIT REQUIREMENT (IV.C.1)

FINAL REPORT

May 26, 2017

Prepared for:

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I. Disclaimer

The intent of this plan is to present the data collected, evaluations, analyses, designs, and cost estimates for the Stevens Brook Flow Restoration Plan (FRP) Project, completed under a contract between the City of St. Albans and the hired consultant team, Watershed Consulting Associates, LLC (WCA). The Stevens Brook FRP was prepared to meet the compliance requirement for the National Pollutant Discharge Elimination System General Permit 3-9014 (Vermont Department of Environmental Conservation 2012) for stormwater discharges to impaired waters for Stevens Brook impervious surface owners: the City of St. Albans and the Town of St. Albans.

II. Executive Summary

This Flow Restoration Plan (FRP) for the Stevens Brook watershed 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 Stevens Brook Stormwater Management Plan (SWMP) prepared by the Town of St. Albans and the City of St. Albans, two of the three MS4 permittees. The MS4 permitees in this watershed are the Town of St. Albans, the City of St. Albans, and the Vermont Department of Transportation (VTrans). Although three MS4 entities own impervious cover within the Stevens Brook watershed, VTrans has elected to prepare its own FRP document. All proposed projects including the VTrans projects are included in this document to provide a watershed-wide plan. The plan was developed in accordance with the Municipal Separate Storm Sewer System (MS4) General Permit #3-9014 Subpart IV.C.1 as a part of the participating MS4s Stormwater Management Program (SWMP). This FRP will serve as a long-term planning tool for the two MS4s to implement stormwater best management practices (BMPs) throughout the watershed in the effort to return Stevens Brook to its attainment condition.

As a part of the FRP development, an assessment was completed to determine to what extent current stormwater controls have reduced high flows (flows occurring less than 0.3% of the time, equivalent to greater than the 1-year design storm) from the Pre-2002 condition, as required by the Stevens Brook Total Maximum Daily Load (TMDL) for stormwater. The Vermont Best Management Practice Decision Support System (BMPDSS) model, a GIS-based hydrologic model used to assess the impact of various stormwater BMP scenarios, was used for the assessment. The BMPDSS estimated 3.8% of the high flow target was met with existing BMPs, designed to meet the 2002 Vermont Stormwater Management Manual (VTSWMM) design standards, when compared to the Pre-2002 condition. Therefore, additional BMPs are required to meet 100% of the actionable flow target.

In addition to the identification of stormwater controls, the TMDL flow targets take into account the expected non-jurisdictional impervious area growth in the watershed over the next 20 years, which was determined using a GIS analysis. An assumed 15 acres of non-jurisdictional impervious growth was used to develop the TMDL requirements.

Development of the FRP involved field inspection of all existing BMPs with an expired stormwater permit followed by review and revision of the previously run BMPDSS model scenarios. Several revisions to existing BMP drainage areas and BMP design configurations were identified during field inspection and accounted for in the revised models. After the existing model scenarios were reviewed, new BMPs were identified, inspected, and assessed in the BMPDSS.

The final evaluated BMP list includes 27 projects distributed across the Town of St. Albans, the City of St. Albans, and on VTrans owned property. The proposed BMPs were assessed with the BMPDSS model, and determined to provide a -21.1% reduction in high flow, which addresses 115% of the TMDL high flow target ($Q_{0.3\%}$) through reduction of runoff from the 1-year design

storm. The high flow target mitigated by each project (%) and cumulative target addressed (%) was determined for each project. The planning level cost for implementation of the FRP is approximately $5,300,000 (excluding VTrans).

A comprehensive ranking matrix was developed to prioritize the proposed projects based on criteria including considerations for the cost, design, aesthetics, and other project benefits and constraints. The ranking provides a tool for the MS4s to use as they prioritize projects with available financial resources. The prioritization was also used to develop a long-term implementation schedule.

The goal of this project was to develop an FRP for the Stevens Brook watershed, to assist the City and Town of St. Albans in the effort to help protect and restore Vermont's stormwater impaired streams. The allocation of impervious ownership between the MS4s in the watershed was determined, and guided the plan development.

III. Background

Stevens Brook, upstream of Pearl Street in the City, is currently on the State of Vermont's impaired waters list and determined to be primarily a result of stormwater runoff. In the effort to restore Stevens Brook and lift its impaired designation, a flow based TMDL was developed for the brook outlining required reductions in stormwater high flows and increases in baseflows. The flow targets are the basis for the FRP, developed in accordance with the MS4 general permit subpart IV.C.1 as a required part of the MS4's Stormwater Management Program (SWMP).

The purpose of the FRP is to outline a plan for the retrofit of existing impervious cover with stormwater management BMPs, such as detention basins and bioretention filters, to meet the TMDL flow targets. The TMDL set forth that watershed hydrology must be controlled in the SBW to reduce high flow discharges and increase baseflow in order to restore degraded water quality and achieve compliance with the Vermont Water Quality Standards. Components of the FRP, as outlined in the MS4 general permit, include:

- The identification of retrofits to existing BMPs with expired State stormwater permits,
- New BMP controls and design plans for selected BMPs,
- A financial plan, and
- A regulatory analysis.

Three MS4s, including the City and Town of St. Albans, and VTrans, own impervious cover within the impaired Stevens Brook watershed. The contributing MS4s are allowed to prepare a joint-FRP for the watershed, or separate plans addressing their individual contributions. The TMDL flow targets are watershed-wide. Therefore, the approach for this independent study was to develop a watershed-wide FRP, with consideration of the individual MS4's flow-target allocation based on impervious ownership.

III.1 TMDL Flow Targets

In the effort to restore Stevens Brook to its attainment condition and lift its impaired designation, a flow-based Total Maximum Daily Load (TMDL) was developed for Stevens Brook using flow as a surrogate for pollutant loading. This document outlines required reductions in stream high flows and increases in stream low flows.

The basis for the TMDL required high flow reductions was the comparison of modeled Flow Duration Curves (FDCs) between this impaired watershed and comparable attainment watersheds. A 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 normalized high flow and low flow were extracted by drainage area. The percent change between impaired and attainment FDCs were 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.

A future growth factor was included in the TMDL to account for future non-jurisdictional impervious growth within each watershed. Non-jurisdictional growth is by definition impervious area that does not require a stormwater permit and is not managed by a stormwater BMP. Therefore, the long term stormwater management plan must account for this type of growth as it will be unmanaged impervious area. VT DEC estimated a future growth of 15 acres in the watershed based on local development and projected growth for Stevens Brook. The approved TMDL flow targets for Stevens Brook are shown in Table 1.

Table 1 TMDL targets for Stevens Brook

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

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 FRP BMP identification for this study.

Included in the 2012 MS4 permit issuance were new requirements for municipalities to develop FRPs to implement 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
6) Identification of any third party implementation

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

III.2 MS4 Allocation of Flow Targets

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

St. Albans City owns the majority of impervious cover within the Stevens Brook Watershed (70.6%) and thus is responsible for the majority of high flow reductions (17.16%). The remaining impervious area is owned by St. Albans Town (22.7%), while VTrans owns the remaining 6.7%. The TMDL flow targets were allocated to each MS4 based on their impervious ownership where St. Albans Town is responsible for a 5.51% flow reduction and VTrans is responsible for the remaining 1.63% flow reduction (Table 2).

Table 2 Stevens Brook flow targets allocated by MS4

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

IV. Existing Data Review

IV.1 Permit Review

As per subpart IV.C. of the approved MS4 general permit, all expired stormwater permits in the watershed were acquired and reviewed. Existing stormwater systems approved under an expired permit were field verified for compliance with the written permit (Table 3). Field retrofit assessments were then completed at each site with CPv detention structures for system upgrades to the 2002 Vermont Stormwater Management Manual (VTSWMM) design standards.

Table 3 Expired permit stormwater BMPs

Site Name	Permit #	Permit Expiration Date	Address	CPv Storage
City of St. Albans				
St. Albans Town Education Center	1-1206	12/31/1999	169 South Main Street	Y
The Switchyard	2-0907	7/1/1985	Lake & Pine Streets	Y*
St Albans Industrial Park Access Road	2-0147	7/1/1985	Lemnah Drive	---
Lower Welden Street Housing Project	2-0963	7/1/1985	94-100 Lower Welden ST	---
St Albans Industrial Park Lot #1	2-1157	7/1/1988	Lemnah Drive	---
Coote Field Industrial Park	1-0702	3/31/1993	Lake Street/Houghton St.	---
St Albans City Industrial Park Lot #4	1-1264	6/3/2001	Lemnah Drive	---
Town of St. Albans				
Northwestern Medical Center Campus	1-1477.0102	3/31/2006	Home Health Circle	Y
Grice Brook Retirement Community	1-1194	12/31/1999	Grice Brook Circle	Y
Hill Farm Estates	1-0650	12/31/1992	Hill Farm Estates Rd	---

*It was determined that the Switchyard currently meets the CPv standard, despite its current expired permit, and was therefore proposed for retrofit.

IV.2 VT DEC BMPDSS Model Assessment

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

IV.2.1 Pre-2002 Model Revisions

The following considerations were documented upon review of the Pre-2002 model:

- Combined sewer subwatersheds were included in the P8-UCM modeling effort by Tetra Tech, used to develop synthetic FDCs, from which the flow targets were derived. An estimated 205 additional acres of drainage to Stevens Brook was modeled by Tetra Tech, resulting in a potential over estimation of the high flow percent reduction. The VT DEC is aware of this matter.
- WCA's subwatershed delineations (WCA 2009) for the City and Town of St. Albans were used by the VT DEC in the Vermont BMPDSS models. Therefore, combined sewer subwatersheds were excluded from the BMPDSS model.
- The Stevens-Rugg diversion structure was accounted for within the Pre-2002 model. The discharge coefficient (model parameter) was modified to ensure that water was routed

over the diversion. The discharge coefficient needs to be manually altered by the user in order for the model to operate properly.

The following revisions were made to the model:

- Drainage areas were revised for two existing BMPs, reducing the overall watershed area by 12 acres
- Five subwatersheds were augmented to account for new BMPs and field verified drainage paths.

IV.2.2 Post-2002 Model Revisions

Through a thorough assessment of the Post-2002 model, it was confirmed that all existing (non-expired) permitted sites were accounted for in the BMPDSS. The Post-2002 model was updated to include all BMPs installed after 2002 including:

- Five rain gardens on Rugg Street,
- Six rain gardens on Bishop Street,
- Five rain gardens on Quintin Court,
- Firehouse tree box filters,
- An infiltration trench on Driscoll Drive,
- A gravel wetland at the St. Albans park and ride (Figure 1),
- And pervious concrete sidewalks and proposed rain gardens at Taylor Park.

Figure 1. Gravel Wetland at St. Albans Park & Ride

There were several existing permitted sites that do not have volume based or infiltration BMPs and therefore those sites were not included in the model. There were two new pending permits, #6520-INDS and #6602-INDS, with proposed construction that were not included in the Post-2002 model because the permit was unavailable at the time of the plan development. The St. Albans Town Zoning Manager confirmed that the project covered under permit #5841-INDS was on hold indefinitely at the time of model revisions, and therefore the BMPs associated with this project were not added to the model.

Rain gardens for three, green-street projects were considered in the Post-2002 model (Bishop, Rugg, and Quintin). The sizes of drainage areas for individual rain gardens were too small to be counted in the model due to the low resolution of the Hydraulic Response Unit, which are 30 meters by 30 meters. Therefore, the drainage areas of these practices were lumped into one larger drainage area so that they could be incorporated into the model.

IV.2.3 Diversion Structure

The Stevens-Rugg diversion structure, first built in 1957, is a historic structure designed to address flooding issues in the City of St. Albans by diverting stream flow from Stevens Brook to Rugg Brook. After an extensive study of the structure in the early 2000s, a new water quality and

flood equalization system was constructed at the site to minimize increased stormwater flows to Rugg Brook and provide enhanced water quality treatment.

The VT DEC modeled the diversion structure in the Pre-2002 and Post-2002 models as a regulator which acts as a flow splitter, diverting flow from Stevens Brook to Rugg Brook. The existing structure was designed to divert flow from Stevens Brook to Rugg Brook during high flows by way of a culvert and weir structure. The discharge coefficient (model parameter) was reduced from the default value of 0.6 to a lower value of 0.37, in order to allow the model to divert flow from Stevens Brook. According to the Dubois & King design, 15% of the 1-year storm is to be diverted from Stevens Brook to Rugg Brook. Alterations to the diversion structure in 2006 are reflected in the Post-2002 model. WCA corresponded with the VT DEC about the parameters selected for the diversion, and it was determined that the structure was correctly modeled according to the diversion structure design parameters and therefore these inputs were not altered.

IV.2.4 Post-2002 Model Results

The VT DEC Post-2002 model estimated that existing BMPs in the watershed reduced high flows by 0.6% or 2.5% of the TMDL high flow targets. Following a re-running of the Post-2002 model with the revisions described above, the high flow reduction was increased to 0.92% or 3.8% of the high flow reduction target (Table 4).

Table 4 Stevens Brook high flow target reduction progress with revised Post-2002 model run

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Post-2002 Model	High Flow Q 0.3 (± %) Reduction Remaining with Post-2002 Model	High Flow (Q 0.3) Target addressed (%)
St. Albans City	-17.23%	-0.24%	-16.99%	1.4%
St. Albans Town	-5.53%	-0.44%	-5.09%	8.0%
VTrans	-1.64%	-0.24%	-1.40%	14.8%
Watershed Total	**-24.40%**	**-0.92%**	**-23.48%**	**3.8%**

V. Required Controls Identification

The process of BMP identification consisted of first assessing the existing BMPs with expired permits for retrofit potential to meet the 2002 VTSWMM design standards. Upon review of the existing BMPs, WCA determined that additional new BMPs would be required to meet the high flow target (Figure 2).

Figure 2. Five proposed swales for VTrans median in credits model

The team then conducted an initial desktop assessment of the watershed to identify open spaces ideal for BMP implementation with priority on City and Town owned land. In addition, the location of BMPs was considered so that storage could be provided throughout the watershed and focused on areas with a high percentage of impervious coverage where flows were expected to be highest. After an initial list of retrofits were identified, a field assessment was completed at each site documenting the engineering feasibility of each retrofit including utility conflicts, natural resources, transportation constraints, collateral benefits (visibility and pedestrian safety), ease of Operation and Maintenance (O&M), and the amount of impervious treated. The team also verified drainage areas for the proposed BMPs. The proposed BMPs were then designed using HydroCAD to meet the CPv storage criteria for warm waters. CPv estimates for each BMP are summarized in Table A-2 (Appendix 2), along with HydroCAD model outputs in Appendix 3.

WCA prepared conceptual designs for the recommend BMPs, designed to the 2002 VTSWMM design standards for CP_v storage (1-year design storm), provided in Appendix 4. BMP feasibility was determined based on available space, mapped Natural Resources Conservation Service mapped soils, 1-foot topographic elevation contours derived from 2008 Rock River LIDAR, and mapped stormwater and wastewater infrastructure. Additional above ground utility constraints were noted in addition to land ownership, O&M, and safety considerations. An in-depth engineering assessment will still be required at each site to confirm the presence/absence of utilities, natural resource constraints, and potential transportation impacts, as part of the final design process.

V.1 BMPDSS Model Results

The final recommended BMPs list was developed based on an iterative assessment using the BMPDSS modeling tool. An initial BMP list was assessed in the BMPDSS Credit 1 run, which included expired permit retrofits, was estimated to address 73% of the high flow reduction. The remainder of the watershed was then assessed for additional potential BMPs to address the remaining flow reduction. A revised model run (Credit 2) was completed with several additional BMPs, and estimated to address 98% of the high flow target. A final model run with the recommended BMP list and revised design estimated a -28.1% reduction in the high flow, addressing 115% of the flow target. A 15% factor of safety was estimated, suggesting that the proposed BMPs plan was conservative and may be reduced.

The results of the model runs are summarized in Table 5 below.

Table 5 Stevens Brook BMPDSS Credit model results

Model Run	Description	High Flow Reduction (%)
TMDL Target for Stevens Brook		-24.4%
VT DEC Post-2002 Condition Model	VT DEC's existing model, includes all Post-2002 BMPs (10/15/12)	-0.60%
WCA Revised Post-2002 Model	Revised Post-2002 model (4/12/13)	-0.92%
Percent of target managed with revised Post-2002 model		3.8%
Credit 1 model	Proposed BMP scenario with only retrofits to existing BMPs with expired permits. (6/25/13)	-18.0%
Percent of target managed with Credit 1 model run		73%
Credit 2 model	Proposed BMP scenario 2. (10/15/13)	-23.9%
Percent of target managed with Credit 2 model run		98%
Credit 3 model	Final proposed BMP scenario. (12/21/13)	-28.1%
Percent of target managed with Credit 3 model run		115%

Of this 115% high flow reduction, the City of St. Albans addressed 92.8% of their high flow target. The Town of St. Albans addressed 183.5% of their target (Table 6).

Table 6 Stevens Brook BMPDSS final Credit model results allocated by MS4

Owner	Target High Flow Q 0.3 (± %) Reduction	High Flow Q 0.3 (± %) Reduction Achieved with Credit Model	High Flow Q 0.3 (± %) Reduction Remaining with Credit Model	High Flow (Q 0.3) Target addressed (%)
St. Albans City	-17.80%	-16.52%	-1.28%	92.8%
St. Albans Town	-5.09%	-9.33%	4.25%	183.5%
VTrans	-1.52%	-2.25%	0.74%	148.5%
Watershed Total	**-24.40%**	**-28.10%**	**3.7%**	**115.2%**

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

VI. Proposed Best Management Practices (BMPs)

The final Credit model scenario included the addition of twelve new detention BMPs, nine new infiltration BMPs, and six retrofits to existing BMPs with expired permits. Credit toward the flow target is also from existing stormwater structures including four BMPs designed to Post-2002 standards, and eight LID infiltrative practices. Additional information is summarized for each BMP in Appendix 2 (Table A-2), including the impervious cover treated, percent impervious of the BMP drainage area, total area treated, and estimated CPv storage by the HydroCAD design model (Appendix 1).

The proposed BMPs are summarized in Table 7, including the impervious cover treated, drainage area, and CPv storage estimated by the HydroCAD® model. A map of the proposed BMP locations is included in Appendix A. The individual and cumulative percent of the high flow target mitigated is also included in Table 7.

Table 7 Stevens Brook BMPDSS final Credit model BMPs

Proposed BMP ID	Address	Model	BMP Type	BMP Land Ownership	Permit #	Impervious Cover Managed (acres)	Runoff Area (acres)	Channel Protection Volume		Percent of High Flow Target Managed	Cumulative Percent of High flow Target Managed
								CF	ac-ft	%	%
GMP Cooling Ponds Retrofit	Lower Welden Dr.	Proposed	Retrofit Basins	Private	NP	54.6	89.6	274428	6.30	9.28%	10.20%
Hungerford- Lower Basin	Rewes Rd.	Proposed	Basin	Private	NP	31.7	91.4	181340	4.16	5.38%	15.59%
NWMC-Main Pond (Hill Farm Estates)	Crest Rd., Hill Farm	Existing/Retrofit	Retrofit Basin	Private	1-1477, 1-0650	15.3	45.4	156816	3.60	2.60%	18.19%
St. Albans Town Education Center	169 South Main Street	Existing/Retrofit	Retrofit Basin	Private	1-1206	9.0	49.0	42253	0.97	1.52%	19.71%
Greenwood Cemetery	Upper Gilman St.	Proposed	Basin	City/Private	NP	5.2	22.6	48482	1.11	0.89%	20.60%
Lemnah Dr.	Lemnah Dr.	Proposed	Basin	City	NP	5.1	12.1	44257	1.02	0.87%	21.47%
65 Bishop St- Pocket Yard	65 Bishop St.	Proposed	Storage Chambers	City/Private	NP	4.9	32.9	28967	0.67	0.83%	22.30%
65 Bishop St- Pocket Yard	65 Bishop St.	Proposed	Storage Chambers	City/Private	NP	4.9	32.9	28967	0.67	0.83%	23.13%
Industrial Park (SB Collins)	Lemnah Dr.	Proposed	Basin	Private	2-1157	3.8	5.7	22651	0.52	0.64%	23.78%
NWMC-South Pond A	Crest Rd.	Existing/Retrofit	Retrofit Basin	Private	1-1477	3.8	5.6	32496	0.75	0.64%	24.41%
Upper Fairfield	Fairfield Hill Rd	Proposed	Basin	Private	NP	3.2	34.3	62421	1.43	0.55%	24.96%
Grice Brook Retirement Community	Grice Brook Rd	Proposed	Basin	Private	1-1194	2.8	18.8	58806	1.35	0.47%	25.43%
Homeland Security	79 Lower Weldon St.	Proposed	Storage Chambers	Federal	NP	2.8	2.8	13983	0.32	0.47%	25.90%
East View Subdivision - New Pond	East View Dr.	Proposed	Basin	Private	NP	2.7	13.1	9801	0.23	0.47%	26.37%
Fairfield	Fairfield Hill Rd/I-89	Proposed	Basin	VTrans	NP	2.2	28.4	31799	0.73	0.37%	26.74%
Houghton St.- State of VT	Houghton St.	Proposed	Basin	State	NP	1.5	2.4	9235	0.21	0.26%	27.00%

Maple St.	La Salle/Maple St.	Proposed	Infiltration	Private	NP	1.0	1.3	6316	0.15	0.17%	27.17%
NWMC-South Pond B	Home Health Circle	Existing/Retrofit	Retrofit Basin	Private	1-1477	1.0	1.8	6708	0.15	0.16%	27.33%
Governor Smith Retrofit	Congress/Smith St.	Existing/Retrofit	Retrofit Basin	Private	NP	0.8	15.3	18513	0.43	0.14%	27.47%
SDC118	I-89	Proposed	Median	VTrans	NP	0.5	1.1	2544	0.06	0.09%	27.56%
Median A1	I-89	Proposed	Median	VTrans	NP	0.5	0.9	2468	0.06	0.09%	27.65%
SDC140b	I-89	Proposed	Median	VTrans	NP	0.5	1.0	2359	0.05	0.09%	27.74%
SDC105b	I-89	Proposed	Median	VTrans	NP	0.5	1.0	2333	0.05	0.08%	27.82%
SDC408	I-89	Proposed	Median	VTrans	NP	0.4	0.9	2047	0.05	0.07%	27.89%
SDC98b	I-89	Proposed	Median	VTrans	NP	0.4	0.9	1968	0.05	0.07%	27.96%
Median A2	I-89	Proposed	Median	VTrans	NP	0.4	0.7	1881	0.04	0.07%	28.03%
SDC105c	I-89	Proposed	Median	VTrans	NP	0.4	0.8	1799	0.04	0.07%	28.10%

VI.1 City of St. Albans BMPs

St. Albans Town Education Center Basin Retrofit (City/ Expired Permit)

The St. Albans Town Education Center (SATEC) basin was permitted under expired permit 1-1206. The existing basin is undersized, and has limited outlet control (Figure 3). The proposed retrofit is to expand the pond, add additional flow control, and potentially treat water quality.

Figure 3. SATEC Basin

The site is located on the school property. The school and the City will need to decide if the expired permit will be incorporated into MS4 or the Residual Designation Authority (RDA) program. Assistance from VT DEC will be required to help determine the optimal regulatory approach.

Green Mountain Power Cooling Ponds Retrofit (City):

Abandoned cooling ponds owned by Green Mountain Power are proposed for use as a large scale water quality treatment and flow detention facility (Figure 4). A new storm line connection would be required from South Main Street to Allen Street along Lower Weldon. The design team estimated that the cooling ponds could be retrofitted to provide water quality treatment and mitigate over 6 acre-feet of runoff volume.

Figure 4. Green Mountain Power Cooling Ponds

The cooling ponds are located adjacent to the Green Mountain Power, St. Albans diesel plant substation, which is an active underground storage tank and diesel hazardous waste site (#20114205). A site investigation was completed during the summer of 2013, as follow up to the substation remediation. Green Mountain Power submitted a site investigation report in August 2013, which stated the investigation findings did not warrant additional remedial actions. The investigation is pending approval from the VT DEC sites management section. Landuse restrictions for the ponds will need to be determined before further development of this retrofit opportunity is completed.

The VT DEC Hazardous Waste Division will need to be engaged during development of this project. The ponds are privately owned therefore an easement or sale of the land would be needed for the project to move forward.

Hungerford Lower Basin (City):

A large scale retrofit project (feasibility and preliminary design completed under the Enterprise Resource Planning contract #29-18102) is proposed on the Hungerford property within the Town (Figure 5). Runoff is proposed to be routed from the Stevens Brook impaired watershed into a water quality treatment and flow detention structure on the Hungerford Family Trust property. The BMP is estimated to provide over 20% of the flow target reduction.

Figure 5. Hungerford Lower Basin

Environmental permitting feasibility and framework needs to be discussed in depth with the VT DEC. Land is privately owned and therefore an easement or sale of the land would be required.

65 Bishop Street Pocket Yard Swale

An underground storage system is proposed for implementation on a City owned parcel, located North of 65 Bishop Street, possibly extending onto adjacent private land (Figure 6). The site is one of few open spaces within the large residential area east of the City downtown. A new stormwater line would divert flow from an existing catch basin capturing a 33-acre drainage area. An easement would be required in order to implement the new stormwater line. Acquisition of adjacent private land would be required to accommodate the entire structure. The BMP is proposed on City owned land but also may extend onto adjacent private land. To route flow into the BMP, an easement would be required across private properties.

Figure 6. An underground storage system
CR: http://www.stormtech.com/images/pic_engineer.jpg

Greenwood Cemetery Basin

The proposed BMP would be located on private open land adjacent to the existing Greenwood Cemetery (Figure 7). A water quality and flow detention BMP is proposed. It would capture runoff from a 23-acre area located in the residential district of the City. Flow from an existing stormwater line would be diverted into the facility and then discharged back to the same line.

Figure 7. Open land adjacent to the Greenwood Cemetery

The BMP is proposed on private land, which may be reserved for expansion of the existing cemetery. An alternative BMP design is possible within the City ROW, on Upper Gilman Road, if it is deemed infeasible to use the private land for the proposed BMP.

Lemnah Drive Basin

A water quality treatment and flow detention BMP is proposed along Lemnah Drive just south of the Stevens Brook crossing and parallel to the railroad. This BMP would serve to detain and treat runoff from the industrial area along Lemnah Drive and some City homes and streets.

Figure 8. Lemnah Drive

The proposed project is on City owned land and redevelopment plans along Lemnah Drive could impact BMP placement. There is potential for incorporating the retrofit with the stormwater management needs of the planned Lemnah Drive redevelopment project.

Industrial Park Basin (City/Expired Permit)

A water quality and flow detention basin is proposed for an existing drainage way, just east of the S.B. Collins property. The site currently collects drainage from an outlet pipe connected to a system of catch basins east of the railroad tracks, and from the S.B. Collins facility by a second pipe.

Figure 9. Drainage way, east of S.B. Collins Property

The industrial park including S.B. Collins holds an expired permit (#2-0147) as well as lot one, east of the railroad tracks (expired permit #2-1157). The permittee and the City will need to decide if the expired permit will be incorporated into the MS4 or RDA program. The site appears to be partially within the Central Vermont railroad ROW, which will require railroad approval. Additional assistance from the VT DEC will be required to help determine the optimal regulatory approach.

Governor Smith Road Pond Retrofit (City)

The existing Governor Smith Road subdivision pond was designed and implemented after 2002. The pond is not permitted under a state stormwater permit because the project was below the 1-acre threshold. The pond was modeled based on the record drawing and determined to be not up to the CPv standard. A proposed reduction in the low flow orifice would provide additional CPv storage and credit toward the flow targets.

Figure 10. Governor Smith Road pond

The pond is privately owned; therefore the Homeowner's Association would need to be engaged as a partner with the City in order to implement the proposed pond outlet retrofit.

Homeland Security Storage Unit (City)

A subsurface storage unit is proposed for placement beneath the Homeland Security facility parking lot. With no available space for an open detention structure, an underground storage unit was determined to be the best option for this location. The storage unit would capture drainage from 2.8 acres of impervious area including the parking lot and roof of the facility.

As the parking lot is part of a federal facility, Homeland Security will need to be engaged as a partner with the City for implementing the retrofit project.

Figure 11. Homeland Security facility parking lot

Houghton Street Basin (City)

An existing shallow swale, west of the State of Vermont facility, along Houghton Street currently captures runoff from the parking lot and roof of an adjacent building. The proposed retrofit would involve adding water quality improvements and flow control.

The project site is owned by the State of Vermont. Implementing a retrofit on State property would support the Vermont Governor's Green Infrastructure Initiative.

Figure 12. Project site by the State's facility on Houghton Street

Maple Street Infiltration and Detention Basin (City)

An open lot just north of an existing parking lot along Maple Street was identified as an ideal site for a shallow infiltration and flow detention basin. The structure would capture runoff from 1.3 acres of impervious coverage on the existing privately owned lot.

The proposed project would be located on private land and within the City ROW. The landowner would need to be engaged as a partner with the City for project implementation.

Figure 13. Open lot on Maple Street for shallow infiltration and flow detention

VI.2 Town BMPs

NWMC Main Pond Expansion and Hill Farm Estates Retrofit (Expired Permit)

The existing Northwestern Medical Center (NWMC) main pond is permitted under expired permit #1-1477. Available open space adjacent to the existing stormwater pond and the expired permit make this site ideal for retrofit. The goal with the retrofit would be to route additional drainage to the expanded pond from the Hill Farm Estates subdivision (under expired permit #1-0650) north of the medical center, and upgrade the pond to 2002 VTSWMM standards.

Figure 14. NWMC's main pond

Assistance from the VT DEC is recommended to coordinate with the Hill Farm Estates Homeowners Association and the NWMC to determine the best regulatory approach in order to renew the expired permits, and develop a cost share to fund the pond retrofit. Additionally, it will be important to coordinate with the NWMC planning staff on their proposed expansion plans for the Center.

Grice Brook Retirement Community Basin (Expired Permit)

The existing site is permitted under expired permit #1-1194. Runoff from the Grice Brook Retirement Community currently drains from the site via a series of swales and culverts to a steep embankment with significant erosion (see photo at right). Runoff eventually enters the SATEC pond, which is undersized and has limited outlet control. A new pond is proposed at the bottom of the slope to provide water quality benefit and flow control.

Figure 15. Eroded embankment by Grice Brook Retirement Community

The VT DEC wetlands program and the Army Corps of Engineers is to be engaged at the start for the project planning process to evaluate wetland presence, function, and value at the site location. The site is located on the Town's school property and therefore a land sale or easement would be required. Drainage area of the pond includes agricultural runoff as well as the permitted Grice Brook facility. A cost share is recommended between the Town and parties contributing drainage. The expired permittees and the Town will need to decide if expired permits for the Grice Brook facility will be incorporated into MS4 or the RDA program. Assistance from the VT DEC will be required to help determine the optimal regulatory approach.

NWMC North "Pond A" Retrofit (Town/ Expired Permit)

The existing NWMC north "Pond A" was designed prior to 2002 VTSWMM standards. Retrofits to the pond include a reduction of the low flow orifice for additional flow control and potential installation of pretreatment forebays.

The site is located on private property. The permittee and the Town will need to decide if the expired permit will be incorporated into MS4 or the RDA program. Assistance from the VT DEC will be required to help determine the optimal regulatory approach.

Figure 16. NWMC Pond A

NWMC South "Pond B" Retrofit (Town/ Expired Permit)

The existing NWMC south "Pond B" located south of the Franklin County Rehab Center was designed prior to 2002 VTSWMM standards. Retrofits to the pond include: reducing the low flow orifice to 1 inch and installation of pretreatment forebays.

The permittee and the Town will need to decide if the expired permit will be incorporated into MS4 or the RDA program. Assistance from the VT DEC will be required to help determine the optimal regulatory approach.

Figure 17. NWMC Pond B

East View Subdivision Basin (Town)

The East View subdivision currently lacks a stormwater management system onsite. A water quality and detention basin is proposed to manage runoff from the development before discharging the runoff out of the impaired watershed.

The proposed project is located on private land and within the Town ROW. The HOA is to be engaged as a partner with the Town for project implementation. Plans for a new sidewalk along Congress Street will need to be considered with BMP implementation.

Figure 18. East View subdivision

VI.3 VTrans BMPS

Upper Fairfield Basin (VTrans)

The proposed location for the Upper Fairfield retrofit site is located off of Fairfield Hill Road (VT-36, VTrans-owned) on a private parcel within the Town, capturing approximately 34 acres of drainage from VT-36, neighboring homes, and driveways. A water quality treatment and flow control basin is proposed.

Figure 19. Private land on Fairfield Hill Road

Private land would need to be acquired in order to implement the BMP, and the land was advertised for sale as of November 2013. The benefit of the proposed facility location is the ability to control flow at the top of the watershed before stormwater flows enter the main stream channel and gain velocity and erosive strength.

Fairfield Road Basin (VTrans)

A water quality and flow detention retrofit is proposed within the I-89 ROW, designed to capture runoff from 28 acres including a portion of Fairfield Road (VT-36) and Town residences along the road (Figure 20). The structure will need to be designed according to Federal Highway Administration (FHWA) guidelines for safety. A new culvert under Fairfield Road would be required to route flow from the north side of VT-36 into the facility. The proposed BMP would treat runoff from VTrans and Town impervious cover, and therefore a cost share is recommended.

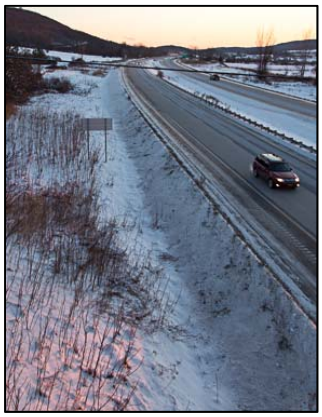

Figure 20. I-89 ROW

VTrans Median BMPs (8 Median Sites)

Eight sites within the VTrans I-89 ROW were identified as potential sites for water quality and flow detention BMPs to detain and treat runoff from I-89. The sites are all located in existing vegetated stormwater conveyances within the I-89 median. Key features of the structures include earthen check dams designed to create up to 1.5 feet of ponding depth behind each dam, amended soils consisting of a 50/50 blend of sand and native soil at the surface, and a pure sand filter below. The structures are designed with a perforated underdrain to be located below the sand filter, connected to the nearest downstream outlet structure or daylighted. A typical plan is attached under Appendix 4 to demonstrate the typical layout of the median sand filter BMP, which would be replicated for all median sites.

Figure 21. VTrans owned land in I-89 ROW

The sites are all on VTrans land. Environmental permitting including primarily potential wetland impacts needs to be considered for each site. Designs are required to comply with FHWA safety standards for the interstate system.

VII. Design and Construction Schedule

A D&C schedule is a required element of the final approved FRP, providing an outline for the implementation of the proposed FRP over a 17-year timeframe. A D&C was prepared with the 16 projects that will be implemented by the Town of St. Albans and the City of St. Albans. The projects were spaced out over the timeframe in five separate phases. The first four phases consist of three year periods and the final phase includes four years. The timeline considered: effort for design, acquisition of necessary permits and/or regulatory approvals. The estimated total cost by MS4. It should be noted that both the Town of St. Albans and the City of St. Albans have projects proposed projects in multiple watersheds, and as such the schedule presented below may appear not well distributed across the timeframe. This is due to the schedule projects in Rugg Brook watershed. Summed project costs are shown by implementation phase in Table 8. The schedule by project is shown in Table 9 for the City of St. Albans and Table 10 for the Town of St. Albans. Two projects are seen on both Table 9 and 10 as these projects are shared between the Town and City. Only the portions of their allocated costs are included in Table 8. Adjustments to the flow targets may impact the schedule and full implementation of the proposed projects. Additionally, the D&C is a working document and will be revised based on new information about the projects and/or stream conditions.

Table 8 Total cost by implementation phase for both MS4 entities

MS4	Phase 1 (1-3 years)	Phase 2 (4-6 years)	Phase 3 (7-9 years)	Phase 4 (10-12 years)	Phase 5 (13-16 years)	Total Cost
St. Albans Town	--	$277,000	$25,000	$91,000	$362,250	$755,250
St. Albans City	$470,000	$2,720,500	--	$499,000	$816,750	$4,506,250

Table 9 City of St. Albans proposed BMP implementation schedule

Project Name	Impervious Acres	Proposed Implementation Schedule
St. Albans Town Education Center	9.0	Phase 1 (1-3 years)
Lemnah Dr.	5.1	Phase 1 (1-3 years)
Hungerford- Lower Basin	31.67	Phase 2 (4-6 years)
GMP Cooling Ponds Retrofit	54.6	Phase 2 (4-6 years)
Houghton St.- State of VT	1.5	Phase 4 (10-12 years)
Maple St.	1.0	Phase 4 (10-12 years)
Industrial Park (SB Collins)	3.8	Phase 4 (10-12 years)
Greenwood Cemetery	5.2	Phase 4 (10-12 years)
Governor Smith Retrofit	0.8	Phase 5 (13-16 years)
Homeland Security	2.8	Phase 5 (13-16 years)
65 Bishop St- Pocket Yard	4.9	Phase 5 (13-16 years)

Table 10 Town of St. Albans Proposed BMP Implementation Schedule

Project Name	Impervious Acres	Proposed Implementation Schedule
NWMC-Main Pond (Hill Farm Estates)	15.3	Phase 2 (4-6 years)
NWMC-South Pond A	3.8	Phase 3 (7-9 years)
NWMC-South Pond B	1.0	Phase 4 (10-12 years)
East View Subdivision - New Pond	2.7	Phase 4 (10-13 years)
Grice Brook Retirement Community	2.8	Phase 5 (13-16 years)
65 Bishop St- Pocket Yard	4.9	Phase 5 (13-16 years)

VII.1 Cost-Share Allocation

A cost-share was applied for projects with multiple MS4 jurisdictions based on a percentage factor. This combined the percent runoff contribution and percent impervious surface ownership within the BMP drainage area into an overall percent allocation. The percent runoff contribution was determined using site specific HydroCAD models for each BMP drainage area. The percent impervious was determined through a GIS exercise, using 2011 impervious cover mapping prepared by the Lake Champlain Basin Program. The cost-share allocation applied provides one example for how the MS4s can share the financial responsibility for projects with contributing areas from multiple jurisdictions. The cost breakdown, percent runoff volume and percent impervious area are summarized in Appendix 7 for the following projects: St. Albans Town Education Center, 65 Bishop St- Pocket Yard, NWMC-Main Pond (Hill Farm Estates), Fairfield, and Upper Fairfield. It was determined that the Town of St. Albans does not bear responsibility for the St. Albans Town Education Center project after this analysis was completed. The table is still included in Appendix 7 for reference.

VIII. Financial Plan

City of St. Albans

In order to maintain sustainable local tax and fee rates, and ensure the ability of local voters to pass any required bonds, the City of St. Albans assumes that significant state and federal funds will be available for final engineering and implementation of the BMPs listed by this FRP. The City is assuming at least an 50% match from external grant sources, such as the Clean Water Initiative. If sufficient external funds do not materialize, the City will have to delay the implementation of BMPs and update the schedules in this FRP. The City will spend the next 2 years exploring a stormwater utility as a source of local funding for the BMPs as well as the overall stormwater program associated with the MS4 permit and other related items.

In the case of multi-jurisdictional BMPs, the City is willing to pursue cost sharing of planning, construction, and O&M costs based on how much land is treated within the MS4 (City/Town/VTrans). For BMPs associated with expired stormwater permits, the City will pursue financial participation of the landowner on a case-by-case basis.

Town of St. Albans

The Town of St. Albans hopes to establish a Stormwater Utility prior to December 31, 2018. This Stormwater Utility will cover the entire town, not just the MS4 areas. The Town plans to create a comprehensive utility similar in scope to the existing South Burlington and Williston stormwater utilities and will integrate the Green Stormwater Infrastructure LID spreadsheet developed by VLCT. At this time, the Town assumes an annual assessment per single family dwelling at $120. Based on 2010 census data, this should generate a maximum of ~$350,000 annually prior to offering discounts for installing and or improving stormwater mitigation structures. Assuming a maximum discount of 25%, in the "best" case with all properties receiving a maximum discount, our stormwater utility would generate ~$250,000 annually. At ~$250,000 spread over 20 years nominally matches the expected cost for FRP implementation for the Town. Non-residential properties will be assessed at Equivalent Residential Unit (ERU) and based on square footage of building. This amount would be in addition to pursuing grants from State and Federal sources (i.e., the Clean Water Initiative) combined with negotiating fair cost sharing arrangements with all expired, existing, and future stormwater permit holders.

While the Town does expect to apply for grants and loans, the Stormwater Utility will ensure funding as it is assumed that all grant and loan programs will be extremely competitive. The Town expects to apply for any and all grant and loan programs that it may be eligible for, but the Town is also planning to have its own funding source from the utility to meet its MS4 obligation prior to 2032. The Town does expect to negotiate fair cost sharing arrangements with any and all expired, existing, and future stormwater permit holders on sharing the cost to rehabilitate and or reconstruct their stormwater mitigation structure and other associated facilities.

VIII.1 BMP Cost Estimates

A spreadsheet-based method, originally developed by Horsley-Witten 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. It is expected that these costs will change as further design is completed and site conditions and constraints are better understood. Cost estimates are based on limited site investigation, but are useful for planning purposes. All estimates presented are based on 2014 dollars.

The 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.

Unit Costs and Site Adjustment Factors: construction costs were estimated using unit costs and a site adjustment factor summarized in Table 11 below. Unit costs were assigned for each BMP type, and a site adjustment multiplier was applied depending on the type of site.

Table 11 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

Derived from Horsley Witten Memorandum Dated January 9th 2014 (Page 11)

Site Specific Costs: Cost of significant utility or other work related to the construction of the BMP itself. Site specific costs are variable based on past experience.

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

Permits and Engineering Costs: Used either 20% (for largest storage volume projects), and 35% for smaller or complex projects.

Land Acquisition Costs *(Modified*): A variation from the HW method was applied. Based on an estimate from the City Assessor, the land acquisition cost was calculated as $120,000 per acre required for the BMP, applied to projects on private land. It should be noted that this value is based on a limited estimate and not necessary 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.

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: The annual O&M was calculated as 3% of the base construction costs, with a maximum of $10,000.

Minimum Cost Adjustment: After total project costs were determined for each proposed BMP based on the HW methodology, costs were reviewed and adjusted so that projects involving an outlet retrofit, such as a new outlet structure, were assigned a minimum cost of $10,000, and a project involving an expansion retrofit were assigned a minimum cost of $25,000.

VIII.1.1 BMP Cost Estimates Tables

The total cost for implementation of the FRP projects was determined, with assumed cost sharing for the joint-MS4 projects based on managed impervious area and runoff volume (Table 12). This is an approximate estimate and is subject to change based on more refined design, and cost sharing agreements. The cost breakdown is relatively consistent with the impervious cover breakdown in the watershed.

Table 12 Total project cost estimate for FRP projects by MS4, assuming cost sharing for joint-MS4 projects

MS4	Total Project Cost
Town of St. Albans	$919,000
City of St. Albans	$4,506,250
Total:	**$5,425,250**

Tables 13 and 14, below, include a summary of the project cost estimates by BMP by MS4.

Table 13 City of St. Albans proposed BMP cost estimates

Project Name	Impervious Area (Acres)	Design Control Volume (ac-ft)	Base Unit Cost ($/cft)	Site Adjustment Factor	Permits & Engineering Contingency	Minimum Project Cost ($10k for simple retrofits; $25k otherwise)	Final Project Cost	Final Project Cost Rounded to Nearest $1,000	St. Albans City Cost Allocation (% of total project cost)	St. Albans City Cost Allocation ($)	Cost/ Impervious Acre
St. Albans Town Education Center**	9.0	0.78	$2	1	$47,750	$25,000	$220,180	$220,000	100%	$220,000	$20,579
Lemnah Dr.	5.1	1.02	$2	1.5	$46,653	$25,000	$250,266	$250,000	100%	$250,000	$35,353
Hungerford- Lower Basin	31.67	4.16	$2	1	$126,847	$25,000	$908,202	$908,000	100%	$908,000	$15,449
GMP Cooling Ponds Retrofit	54.6	6.30	$2	2	$384,199	$25,000	$1,673,671	$1,674,000	100%	$1,674,000	$27,141
NWMC-Main Pond (Hill Farm Estates)**	15.3	3.60	$2	1	$ 109,771	$25,000	$ 553,963	$ 554,000	25%	$138,500	$27,637
Houghton St.- State of VT	1.5	0.21	$2	1.5	$5,489	$25,000	$60,531	$61,000	100%	$61,000	$21,665
Maple St.	1.0	0.15	$4	1.5	$7,841	$25,000	$70,325	$70,000	100%	$70,000	$47,045
Industrial Park (SB Collins)	3.8	0.52	$2	2	$31,712	$25,000	$159,516	$160,000	100%	$160,000	$32,273
Greenwood Cemetery	5.2	1.11	$2	1.5	$29,011	$25,000	$207,786	$208,000	100%	$208,000	$33,282
Governor Smith Retrofit	0.8	0.13	$2	0.25	$1,014	$10,000	$10,000	$10,000	100%	$10,000	$4,712
Homeland Security	2.8	0.32	$12	2	$117,089	$25,000	$451,630	$452,000	100%	$452,000	$164,229
65 Bishop St- Pocket Yard	4.9	0.67	$12	1	$122,578	$25,000	$472,800	$473,000	75%	$354,750	$96,687
** Although this project is a retrofit of an existing BMP, it was determined that due to site specific complexity, costs would be comparable to a new BMP. As such, a site adjustment factor of 1 was used.							**Total**	**$5,040,000**	**Total**	**$4,506,250**	

Table 14 Town of St. Albans proposed BMP cost estimates

Project Name	Impervious Area (Acres)	Design Control Volume (ac-ft)	Base Unit Cost ($/cft)	Site Adjustment Factor	Permits & Engineering Contingency	Minimum Project Cost ($10k for simple retrofits; $25k otherwise)	Final Project Cost	Final Project Cost Rounded to Nearest $1,000	St. Albans Town Cost Allocation (% of total project cost)	St. Albans Town Cost Allocation ($)	Cost/ Impervious Acre
NWMC-Main Pond (Hill Farm Estates)**	15.3	3.60	$2	1	$109,771	$25,000	$553,963	$554,000	50%	$277,000	$27,637
NWMC-South Pond A	3.8	0.75	$2	0.25	$5,717	$25,000	$25,000	$25,000	100%	$25,000	$5,881
NWMC-South Pond B	1.0	0.15	$2	0.25	$1,143	$25,000	$25,000	$25,000	100%	$25,000	$4,643
East View Subdivision - New Pond	2.7	0.23	$2	1.5	$10,520	$25,000	$65,536	$66,000	100%	$66,000	$14,809
Grice Brook Retirement Community	2.8	1.35	$2	1	$23,522	$25,000	$244,094	$244,000	100%	$244,000	$51,322
65 Bishop St- Pocket Yard	4.9	0.67	$12	1	$122,578	$25,000	$472,800	$473,000	25%	$118,250	$96,687
Fairfield	2.1	0.68	$2	1	$79,976	$25,000	$108,532	$109,000	75%	$81,750	$51,904
Upper Fairfield	3.4	1.28	$2	0.5	$75,272	$25,000	$163,761	$164,000	50%	$82,000	$48,235
** Although this project is a retrofit of an existing BMP, it was determined that due to site specific complexity, costs would be comparable to a new BMP. As such, a site adjustment factor of 1 was used.							**Total**	**$1,660,000**	**Total**	**$919,000**	

IX. Regulatory Analysis

City of St. Albans

Stormwater runoff within the City of St. Albans's portion of the Stevens Brook watershed is regulated primarily by the VTDEC. There is no regulation by VTrans, since all streets within the City portion of the watershed are Class 1 roads. VTDEC regulates new developments through issuance of Stormwater Discharge Permits with technical requirements as outlined in the 2002 Vermont Stormwater Manual. The City is required by its MS4 permit to draft and adopt its own ordinances and bylaws for the regulation of stormwater management by new land development. The City intends to have the necessary ordinances and bylaws adopted in 2017. Once this is complete, no further modifications to the above regulatory framework should be required. The only potential issue concerning regulatory authority for implementation of the City's BMPs would be the Town of St. Albans's current Interim Stormwater Bylaw prohibiting new multi-user or offsite stormwater management facilities. This bylaw seems to effectively prohibit the proposed Hungerford-Lower Basin BMP, which would be located in land in the Town of St. Albans. The City will be able to pursue that BMP once the interim bylaw is expired, revised, or repealed.

The City has provided to the State a list of expired stormwater permits that will be incorporated into the City's MS4 permit and an additional list of permits of sites proposed for Residual Designation Authority (RDA) permitting through VT ANR. The City has incorporated two expired stormwater permits within the City's portion of the impaired Stevens Brook watershed. The City will assume O&M of the incorporated stormwater systems and will report on any pertinent activities as part of the MS4 requirements. The City requests that VTDEC RDA the 7 other permits, with the possibility that the St Albans Central School Expansion permit could be incorporated back into the MS4 once discussions take place with the school board. Ultimately the City hopes that implementation of the RDAs and any other stormwater permits by third parties (the landowners and VTDEC) will contribute to the community's water quality goals.

Town of St. Albans

The Town of St. Albans has decided that all expired stormwater permits be incorporated into the Town's MS4 permit. The Town does not request that the State exercise Residual Designation Authority (RDA) on any of the expired permits in Stevens Brook at this time. The Town is working diligently to contact the homeowners responsible for the expired permits to complete the needed maintenance and discuss the Town's intention of taking over the permits. In many cases this is a difficult and time consuming task given no homeowner associations exist. It remains a possibility that the Town may request RDA assistance from the Agency of Natural Resources if an agreement for the Town to take over an expired permit cannot be reached. Additional regulatory authorities will likely be required. The Town plans to establish a Stormwater Utility prior to December 31, 2018.

The Town does not expect to have any "third party" implementation beyond VTrans. However, the Town does expect financial participation from "third parties", namely the appropriate permit holders and/or current owners. The extent of financial participation from appropriate permit holders and/or owners will certainly vary, but the Town will be negotiating with the appropriate permit holders and/or owners during the Final Design and Permitting phase of each project.

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 Best Management Practice (BMP) scenarios. This tool was developed by a private consultant for the VT DEC to use as the assessment tool for the compliance of stormwater TMDLs.

Channel Protection Volume (CPv)- The stormwater volume generated from the 1-year, 24-hour rainfall event (1.9 inches). The VT stormwater CPv design standard requires 12 hours of extended detention storage of the CPv in warm-water fish habitat (24 hours for cold-water fish habitat), as a means to reduce channel erosion.

Detention BMP- A BMP, such as a pond of biofilter, which stores stormwater for a defined length of time before it eventually drains to the receiving body of water. Stormwater is not retained in the practice. Detention BMPs aim to reduce 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 which meets 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 which 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, etc.

Non-Jurisdictional Impervious- Non-jurisdictional growth is an impervious area that does not require a stormwater permit and it not managed by a stormwater BMP (where impervious growth is less than one acre).

Residual Designation Authority (RDA)- The State's authority to issue an RDA permit to discharges not covered by the MS4 Permit. 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 (TMDL)- Vermont developed stormwater 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 streams and ultimately to Lake Champlain. The approved TMDL is defined by a reduction in high flows, defined as greater than the 1-year storm event (approximately 1.94 inches in St. Albans). The TMDL also includes a non-actionable low flow target which is an increase in baseflow.

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 who the water body will be regulated by and how it will be returned to its acceptable condition. This includes maximum loading, sources of pollution, and criteria for determining if the TMDL is met.

TMDL High Flow Target- The TMDL target is percent change between the baseline condition (Pre-2002) and the existing or proposed condition (Post-2002) high flow. The high flow is the flow rate in the stream that is exceeded only 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 is the percent change between the baseline condition (Pre-2002) and the existing or proposed condition (Post-2002) 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