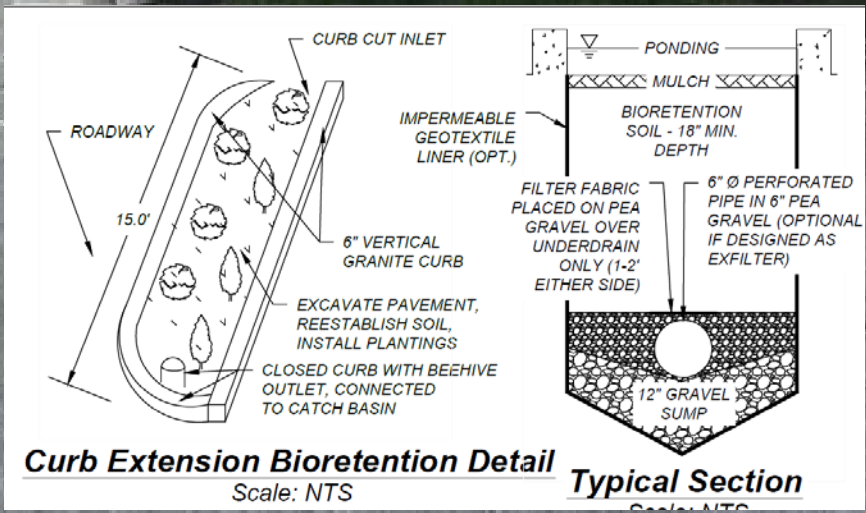
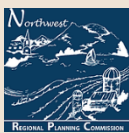


Stormwater Master Plan Town of Richford, Vermont



PROJECT NO. 17-079-B PREPARED FOR:

17-079-B



Amanda Holland / Regional Planner
Northwest Regional Planning
Commission
75 Fairfield Street
St. Albans, VT 05478

SUBMITTED BY:

Gabe Bolin, PE/ Sr. Water Resources Engineer
Stone Environmental, Inc.
535 Stone Cutters Way
Montpelier, VT 05602
gbolin@stone-env.com
603.273.9253

Stormwater Master Plan

Town of Richford, Vermont

Cover: On-street parking spaces adjacent to Town Hall along Main Street in Richford; and concept design for a curb extension bioretention (i.e. ‘bump out’) retrofit to provide water quality treatment for runoff from Main Street and steeply sloped roads adjacent to Main Street.

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Acknowledgements

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1. Introduction

Water knows no political boundaries, and thus evaluations of water quality tend to be undertaken within watershed boundaries and involve land areas in multiple towns. From a water quality perspective, it would be ideal to manage water resources along watershed lines—but the reality is that many decisions, particularly those about land use, are made at the level of towns or individual sites.

A Stormwater Master Plan is responsive to existing landscape characteristics across all watersheds within local political bounds. It connects land use, stormwater management, floodplain management, river management, and public infrastructure needs to more effectively address all of the issues which contribute to water quality impairment or improvement. Within this Plan, localized stormwater problems are examined at a larger scale (e.g., throughout the village center) to determine their relative contributions and aid in setting priorities for addressing challenges related to stormwater runoff. As adjoining municipalities also take increasingly comprehensive views of stormwater management issues and planning, these plans are one-stop resources that can improve coordination and increase opportunities for collaboration in meeting watershed-related needs across political boundaries.

1.1. Project Overview

As precipitation falls on an undisturbed, natural landscape and moves through the hydrologic cycle, it flows through a complex system of vegetation, soil, groundwater, and surface water. Natural events have shaped these components over time to create a system that can efficiently handle stormwater through evaporation, transpiration, infiltration, and runoff. Alterations to the landscape change the way it responds to precipitation events. Management of land use, rainfall, storm runoff, and surface water (streams and lakes) are interrelated, and the management practices chosen all influence water quality and stream health.

Watersheds are interconnected networks in which a change at any location can carry throughout the system. There are many factors that influence exactly how stormwater runoff from a particular site will affect other areas of the watershed. The degree and type of impact varies from location to location, but it can be significant relative to other sources of pollution. Stormwater runoff affects water quality, water quantity, habitat and biological resources, public health, and the aesthetic appearance of the receiving water. Stormwater controls, in contrast, are typically conceived and implemented on a project-by-project basis. These projects are analyzed for their individual stormwater impacts, not in the context of their impact on an interconnected hydrologic and hydraulic system. It is well documented, however, that the cumulative effects of individual land surface changes dramatically influence flooding conditions and contribute to water quality degradation (NRC 2009).

What is a watershed? A watershed is any area of land in which all water runoff from its surface flows to the same drainage point. Watersheds are sometimes referred to as drainage areas. Watersheds are important because they are the basic unit of analysis for all surface water management. They come in all shapes and sizes, and are defined based on the intended study area.



Watershed management practices have direct impacts on water quality both locally (in the Missisquoi River) and in downstream waterbodies (Lake Champlain). Decisions that affect land use have stormwater management ramifications and, in turn, impact all downstream water resources.

Vermont's streams, rivers and lakes are vital economic resources. The quality of local receiving waters affects both economic interests and quality of life in the surrounding areas. Throughout the Missisquoi River basin, the local economy depends, in part, on the revenue gained from outdoor activities enjoyed in and on the water. Protecting the quality of surface waters is one of the most important commitments communities can make to protect the economic interests of residents.

Taken together, these elements emphasize the need for a holistic planning effort that considers the interconnected nature of land use, stormwater management, and river management in order to achieve overall watershed goals. The Vermont Department of Environmental Conservation (VTDEC) issued Vermont Stormwater Master Planning Guidelines in 2013 (most recently updated in June 2016) to provide a consistent framework for the many communities and stakeholders undertaking stormwater planning efforts—and critically, to make better use of limited dollars by targeting high priority stormwater projects. Richford's plan generally follows Template #2A from this guidance, "Hybrid site and community retrofit approach with green stormwater infrastructure stormwater management".

1.2. Project Goals

The ultimate objective of this stormwater master planning project is to support the Town in improving stormwater management, by providing a list of high priority water resource concerns and conceptual solutions that support the development and implementation of future restoration projects in an efficient and targeted manner.

This Stormwater Master Plan first incorporates information from existing plans and datasets to create a single, town-specific resource to guide future stormwater management activities. The resulting stormwater management planning information and resources are included in Section 2 of this report.

This Stormwater Master Plan also:

- Provides a means for comparing anticipated benefits of individual stormwater improvement projects;
- Provides recommendations to address stormwater problems, including a prioritized list of problem areas that can assist the Town in directing resources to high priority projects; and
- Presents conceptual solutions for stormwater management measures in select high priority problem areas.

1.3. Problem Definition – Project Area and the Missisquoi River

The Town of Richford is located in Franklin County; the Town has a total area of 43.3 square miles and as of the 2010 census, the population of Richmond was 2,308 (US Census Bureau 2018). The Missisquoi River flows into town from the northeast and flows out of town into neighboring Berkshire. The entire Town of Richford lies within the Missisquoi River watershed, therefore all areas of interest, including Richford's village center and the Richford Elementary School campus, drain to the Missisquoi River, and ultimately to Lake Champlain (Figure 1, Appendix A).

The Missisquoi River watershed encompasses a watershed area of about 855 square miles, of which 619 square miles are in Vermont (6.4 percent of Vermont), and 236 square miles are in Canada. The basin occupies portions of Franklin and Orleans Counties in Vermont. Approximately 60 percent of the watershed benefits from forested cover, most of it located in the towns of Lowell, Jay, Westfield, and Montgomery.

Agricultural and urban (developed land and roads) land uses comprise 24% and 5% of the landscape, respectively. The agricultural areas are spread throughout the watershed, but are more concentrated in the Mid- and Lower Missisquoi River, heading west towards Lake Champlain. The water quality issues identified in the basin tend to be associated with excessively high phosphorus levels due to phosphorus loadings from agricultural, urban, and road runoff, and eroding river channels due to a lack of equilibrium in the river system (VTDEC 2016). The entire Missisquoi River Basin, including Richford, is part of the area subject to the Lake Champlain Phosphorus TMDL issued by the U.S. EPA in 2016.

2. Existing Plans and Data

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Richford's water, wastewater, and stormwater infrastructure; water resources; and the important interface between water resources and local land use decisions. At times these evaluations followed watershed boundaries, and at other times they have followed political boundaries. The following sections identify these evaluations and highlight information most relevant to Richford and to developing a list of strategic, prioritized projects that could be undertaken to improve water quality and increase resilience. Reference documents, including those described in this section, and pre-existing data used to further inform the development of this Plan are included in Appendix B. Geospatial pre-existing data are provided graphically in Figure 1 (Town Base Map) and Figure 2 (Village Base Map) in Appendix A.

2.1. Watershed-Based Assessments

The ongoing assessments described below are generally led by the State of Vermont's Agency of Natural Resources (ANR). These include basin planning efforts, stream geomorphic assessment and in-stream water quality assessment work, and TMDL implementation, each of which are briefly described below where information is available for Richford.

2.1.1. Tactical Basin Planning

The main goal of tactical basin planning is to guide ANR in its own work and in collaborative projects with the public, municipalities, and other state and federal agencies. The basin plans have a five-year scope. The Town of Richford is located in the Missisquoi River Basin (Basin #6), where a plan was adopted by ANR in December 2016. The central component of this Tactical Basin Plan is an implementation table with targeted actions to protect high quality waters and to address identified water quality issues. One of the top priority actions stated in the plan for the Town of Richford was to 'provide technical assistance on stormwater master planning to identify and prioritize actions' (Table 16, Page 99 of the plan) (VTDEC, 2016).

2.1.2. Other Vermont ANR-Sponsored Programs

Additional ANR-based data sources reviewed prior to the start of field visits for the purpose of locating potential stormwater problem areas (Section 3) included:

- **Stream Geomorphic Assessments:** Stream geomorphic assessments relevant to Richford, as noted in the 2016 Missisquoi Bay Tactical Basin Plan (Table 7), and available here: <https://anrweb.vt.gov/DEC/SGA/finalReports.aspx>.

2.2. Town-Wide Assessments and Programs

In addition to the watershed-based assessments, a number of assessments and datasets are developed on a municipality-by-municipality basis. These include direct feedback from the Town, work by the Vermont Agency of Transportation and Vermont Department of Environmental Conservation, and past and current planning initiatives.

- Direct Input from Town Staff: Per the Town road foreman, some of the town’s biggest concerns regarding stormwater problem areas and non-point source pollution include runoff from steeply sloped private drives and associated erosion. Agricultural inputs along Drew and Pinnacle Roads were also identified as problem areas. The presence of soil and groundwater contamination related to historical land uses in the village area was identified as a major consideration for stormwater retrofit siting, particularly for practices that may infiltrate runoff. Areas with a high potential for the presence of contamination were mapped by Stone and NRPC in 2012-2013 as part of an Area-Wide Assessment. This mapping was incorporated into the base dataset for the Stormwater Master Plan, allowing consideration of these concerns during field inspections. The potential for presence of historical contamination was also incorporated into prioritization (Section 4.2).
- Vermont Agency of Transportation-Sponsored Programs: The VTTrans online bridge and culvert inventory for Town-controlled bridges and culverts (available at <https://www.vtculverts.org/>) was reviewed prior to field screening and evaluation of potential stormwater problem areas (Section 3). The agency’s Small Culverts Inventory dataset was also reviewed to assess VTTrans-owned and controlled drainage infrastructure associated with Vermont Route 105 (<http://vtransmaps.vermont.gov/webmaps.htm>).
- Vermont DEC-Sponsored Programs: Much of the Richford village area is served by closed-system stormwater infrastructure, which was mapped by Vermont DEC in 2009. Detailed stormwater infrastructure mapping and state-issued post-construction stormwater permitting records were examined in order to identify additional stormwater management opportunities. The infrastructure mapping data represent an important supplement to VTTrans’ online bridge and culvert inventories and were invaluable during evaluations of existing problem areas and retrofit opportunities (Section 3 and as further described below) (https://anrweb.vt.gov/DEC/_DEC/SWMapping.aspx?Folder=Town%20Reports%20and%20Maps\Richford).

In addition, the age, style, size, and upkeep of existing facilities permitted by DEC – particularly facilities constructed prior to 2002 – may make them candidates for improvement to enhance stormwater management capabilities. Post-construction stormwater management permits for the planning area (as available from the ANR Atlas at <http://anrmaps.vermont.gov/websites/anra5/>, “Stormwater Permits – Issued” data layer) were reviewed during field screening of potential stormwater problem areas (Section 3) and development of potential implementation projects (Section 4).

Another resource utilized during the desktop assessment was the Richford Road Erosion Inventory Assessment, which includes a list of projects either implemented or in process related to a 2015 road erosion survey completed in preparation of the Municipal Roads General Permit (provided by NRPC and included in Appendix B). The assessment was conducted to help the Town prepare for compliance with the, then pending, Municipal Roads General Permit (MRGP), later issued in early 2018. The assessment looked at how well hydrologically-connected, 100- meter road segments were complying with MRGP standards such as road crown, berm issues, ditches, cross culverts, driveway culverts, outfalls, and presence of rill or gully erosion. The intent of the MRGP is to reduce stormwater-related erosion from municipal roads by stabilizing municipal road drainage systems to basic maintenance standards and taking preventative measures to mitigate erosion when necessary.

Data from the 2013 Richford Area Wide Brownfield Redevelopment Plan (completed by Stone) were reviewed with respect to historical contamination. Brownfields-related work completed since the Area-Wide Assessment, specifically regarding 111 and 113 Main Street, was provided by NRPC and reviewed prior to commencement of field inspections in Spring 2018.

3. New Data Collection and Identification of Stormwater Problem Areas

One of the objectives of this plan is to make recommendations to improve the functioning of aging infrastructure, using GSI-type retrofits where appropriate. To achieve this goal, a thorough effort was made to identify existing problem areas, and then to evaluate existing conditions and potential solutions.

3.1. Identification and Initial Evaluation of Stormwater Problem Areas

Initially, we identified the location and nature of existing drainage problems and stormwater management concerns, and gathered field data for further analysis where appropriate. The approach to identifying potential problem areas included the following elements:

- Reviewing existing plans and data, as described in Section 2, and noting the location of any concerns related to stormwater
- Engagement with Town and State of Vermont staff
- Targeted site visits to verify problem areas during the spring of 2018, with a focus on:
 - Areas of existing development, and particularly the village center;
 - Infrastructure not addressed by the Municipal Roads General Permit (example large culverts on perennial streams);
 - Areas where private property is impacting public property/ROW;
 - Areas of localized erosion.
- Documentation (with photos) of existing problem areas

A total of 20 problem areas and ideas for conceptual solutions were logged with a custom survey form developed by Stone, using Survey123 for ArcGIS and handheld mobile devices. This application ensured consistent data collection across all locations. Retrofit summary sheets for all of the problem areas identified were developed, and are attached to this memo (Appendix C). Blank cells on the summary sheets indicate a lack of information available to sufficiently provide an answer. Appendix D contains maps of the drainage areas for each identified problem area or strategic retrofit opportunity.

Nine of the potential problem areas were located in the village center, two were identified on the school campus and the remainder were located within the Town, but outside of the village center (Figure 3, Appendix A).

4. Prioritization of Stormwater Management Opportunities and Decision Matrix

The following tables and narrative build upon the problem area and retrofit opportunity descriptions included in the retrofit opportunity sheets (Section 3 and Appendix C) to include documentation of drainage area characteristics, potential BMPs to be implemented, and the stormwater volume reduction and pollutant removal benefits that may be achieved by implementing the proposed improvements. An implementation matrix is then presented, which ranks each retrofit opportunity and proposed solution relative to existing environmental concerns, overall environmental priority, constructability, and ease of operation.

4.1. Drainage Area Characteristics and Retrofit Benefits

Key characteristics and assessment results for each identified stormwater problem area or strategic retrofit opportunity within the project area are summarized in Table 1. The following characteristics are included for each identified problem area or retrofit opportunity:

- Site identification number (with approximate treatment practice locations shown on Figure 3)
- Site name
- Drainage area characteristics:
 - Primary Hydrologic Soil Group (HSG), as derived from the Franklin County Soil Survey for the drainage area
 - Total drainage area (acres)
 - Impervious surfaces within the drainage area (acres)
 - Percent impervious cover in the drainage area
- Drainage area runoff volumes and phosphorus loading estimates:
 - Estimated Water Quality Volume (WQv) (in cubic feet) for the entire area draining to the proposed BMP, based on the 2017 VSMM Water Quality Treatment Standard’s required runoff capture and treatment depth of 1 inch¹
 - Estimated Hydrologic Conditions Volume / Channel Protection Volume, in acre-feet and cubic feet, based on the 2017 VSMM Channel Protection Standard’s requirement to provide treatment for the difference in runoff volumes between pre-development and post-development site runoff for the one-year, 24-hour storm¹. The volumes reported in the table assume that the present condition represents the “post-development” condition.
 - Estimated total phosphorus base load (lbs/year) for the WQv, calculated using the Vermont DEC online Stormwater Treatment Practice Calculator². The average annual pollutant (phosphorus) loading export rates applied in Table 1 are those developed for the Missisquoi River basin (2,533 lb/acre-year for developed impervious, and 0.560 lb/acre-year for developed pervious), consistent

¹ 2017 Vermont Stormwater Management Manual Rule and Design Guidance, effective July 1, 2017. Available at http://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/Permitinformation/2017%20VSMM_Rule_and_Design_Guidance_04172017.pdf

² Vermont DEC, Stormwater Treatment Practice Calculator. <https://anrweb.vt.gov/DEC/CleanWaterDashboard/STPCalculator.aspx>

-
- with the modeling completed by Tetra Tech in developing the Vermont Lake Champlain P TMDL³.
- Proposed Best Management Practices (BMPs), storage volumes, and phosphorus load reduction estimates:
 - Proposed BMP type
 - Proposed storage volume, or treatment capacity, assumed at this screening stage to be equal to treatment of the “first inch” of runoff or the Water Quality Volume (WQv). The retrofit opportunity treatment volumes were optimized by maximizing the area available for treatment while accounting for various BMP void ratios and reasonable runoff storage depths.
 - Estimated BMP phosphorus removal efficiency, total phosphorus load reduction on an annual basis (lbs/year), and post-treatment phosphorus load (lbs/year). These are calculated based on the estimated total phosphorus base load, proposed storage volumes/treatment capacities, and percent pollutant removal efficiencies for proposed BMP types determined using the Vermont DEC Stormwater Treatment Practice Calculator². The calculator applies algorithms developed within the stormwater BMP performance curve approach developed by USEPA Region 1⁴.
 - Implementation cost estimates and cost-benefit metrics:
 - Proposed BMP implementation cost, estimated on a price per cubic foot of storage basis. Costs for implementing proposed stormwater BMPs were estimated using the cost function employed in Vermont’s Best Management Practice Decision Support System (BMPDSS), as well as current installation cost estimates per cubic foot of BMP storage volume provided in 2016 guidance from U.S. EPA Region 1⁵. The costs are calculated based on the following equation:
 - total cost = installation cost (I) + land cost (L) + fixed cost (F), where I = BMP installation cost per cubic foot (CF) of storage volume for each type of practice in 2016 dollars, updated to account for inflation to the year 2018 using a 2.5% inflation rate L = \$0 as easement or land purchase costs for individual BMPs are not known F = project-specific estimate of design/permitting costs, estimated at 30% of construction costs.
 - A cost adjustment factor was applied for each proposed BMP to account for anticipated and site-specific implementation challenges. The assumption made was that it would cost more to install a new BMP in a developed area (with more site constraints) than it would cost to install the same BMP in a previously undeveloped area. The unit-based BMP installation costs were developed using a cost adjustment factor of 1 (new BMP in undeveloped area). Proposed BMPs on private property were given an adjustment factor of 1.5; and BMPs on town land or within the town right-of-way were given a cost adjustment factor of 2.0. Projects that were thought to have difficult access or which may be difficult or expensive to implement due to the likely presence of historical site contamination were also given an adjustment factor of 2.5.
 - Phosphorus removal cost-benefit: The total implementation cost for each BMP was divided by the estimated total annual phosphorus load reduction, resulting in a cost per pound of P removed.

³ Tetra Tech, 2015, Lake Champlain Basin SWAT Model Configuration, Calibration and Validation.

<https://www.epa.gov/sites/production/files/2015-09/documents/swat-model-configuration-calibration-validation.pdf>

⁴ Tetra Tech. 2015. 2015 Lake Champlain BMP Scenario Tool Requirements and Design.

<https://www.epa.gov/sites/production/files/2015-09/documents/lake-champlain-bmp-scenario-tool-report.pdf>.

⁵ 2016 EPA Memorandum: Methodology for developing cost estimates for Opti-Tool. Technical memorandum prepared by Karen Matelska, EPA Region 1, February 20, 2016. Available at <https://www3.epa.gov/region1/npdes/stormwater/ma/green-infrastructure-stormwater-bmp-cost-estimation.pdf>

4.2. Implementation Matrix

Through the field screening, development of the retrofit opportunity sheets, and desktop evaluation to define and refine drainage areas and their respective characteristics, Stone recorded observations that were used to develop a draft “implementation score” for each opportunity (Table 2). In this assessment, a higher score indicates a higher overall implementation priority. Each identified opportunity was ranked relative to the following criteria:

- **Existing environmental concerns** – score was assigned based on the type(s) of problems present, with 1 point added for each of the following concerns presented by the site’s current condition: water quality concerns; infrastructure vulnerability; localized drainage issues/flooding; gulying resulting from existing drainage systems, and stream bank or in-stream erosion. Although sites are generally anticipated to receive between 1 and 3 points, the maximum score a site can receive is 5.
- **Environmental priority** – relative environmental impact on nearest receiving water (e.g., proximity, location) and how “active” the problem area was during the site visit, with 1 being the smallest impact and 5 being the greatest impact.
- **Constructability** – relative ease with which a project could be implemented, including whether the recommended practice(s) could be constructed on publicly-owned land or with a willing landowner-partner, existing access to the site, and the amount of additional assessment and engineering design work that would be required to move the project to implementation. The maximum score a site can receive is 3, indicating a project that should move quickly and easily to implementation.
- **Ease of operation** – operational considerations, including amount and frequency of maintenance likely required, and whether maintenance activities will be straightforward to complete. The maximum score a site can receive is 3, indicating a project with infrequent maintenance needs that are easily completed.
- **Phosphorus removal cost-benefit** – qualitative evaluation of the cost per pound of phosphorus removed by each proposed BMP, where a score of 3 indicates a cost-benefit of <\$25,000 / lb P removed, a score of 2 indicates a cost-benefit of \$25-75,000 / lb P removed, and a score of 1 indicates a cost-benefit of >\$75,000 / lb P removed.
- **Existing/historical contamination risk** – consideration of the potential hazard, costs, and additional measures needed with respect to installing a BMP within or near a property with existing and/or historical contamination, with 1 representing a high likelihood of current or historical contamination, and 3 representing little to no risk of contamination on or adjacent to the proposed retrofit site.

The type of ownership of each project location, an initial indication of project cost, and the amount of additional engineering that will be needed for implementation are also presented in the matrix. These measures are not included in each implementation score, but are qualitatively scored as follows:

Project Type “key”:

- Private** Private property
- State** State property or right-of-way
- Town** Public property (town-owned land or right-of-way)
- Hybrid** Hybrid; part public land, part private land

Estimated Implementation Cost “key”:

- L** less than \$25,000
- M** \$25-\$100,000
- MH** \$100-\$250,000
- H** more than \$250,000

Need for Additional Engineering “key”:

- L** Project can be implemented without formal engineering
- M** Project requires some amount of engineering design to ensure proper sizing
- H** Project requires full engineering

4.3. Results

Prioritization results provided in Table 2 indicate that the highest ranked projects are MR-2 (Upstream Tributary) and MR-33 (Missisquoi Trib), each with an implementation score of 18 and 19, respectively. Although both projects likely release substantial sediment loads via stream bank erosion, these projects were not selected for conceptual design because they do not match well with scoring criteria or priorities considered during funding decisions made for the VTDEC Ecosystem Restoration Program, the targeted grant program for retrofit opportunities identified through the Stormwater Master Plan development process. These projects will be considered in the future, as more well-suited funding opportunities arise.

During meetings with the Town and the NRPC in early September 2018, the following projects were chosen for development of conceptual designs:

- Richford Elementary School Projects #1 and 2 (MR-11 and MR-34)
- Bioretention practice at TD Bank (MR-9)
- A total of 4 curb extension bioretention (“bump out”) projects along Main Street (MR-10, MR-15, MR-31 and MR-32)

Meeting notes and additional information regarding project selection are provided in Appendix F.

Both elementary school projects had relatively high implementation scores (14 and 15, respectively), and both may be efficiently implemented on school grounds utilizing one contractor. The opportunity to install two projects on one site is an advantage in terms of cumulative water quality improvements. The school may also be required to comply with the forthcoming developed lands general permit, commonly referred to as the “three-acre permit”, once the rule is promulgated⁶. Implementation of these projects would assist the school in complying with these anticipated regulatory requirements.

The TD Bank bioretention practice (#9) was selected for conceptual design following input from the Town indicating that during storm events, runoff flows off Main Street, between TD Bank and the gas station, and ultimately runs down the river bank. This opportunity is a high priority for the Town in terms of the potential for both water quality treatment and flow attenuation.

The “bump out” projects along Main Street were selected based on their cumulative water quality improvement benefits, relative ease of installation, and applicability as high-visibility demonstration projects. Moving forward to conceptual design, pre-treatment and strategic placement of the bump outs are considerations, particularly with regard to minimizing loss of parking along Main Street and in front of municipal buildings.

⁶ See <http://dec.vermont.gov/watershed/stormwater/stormwater-rule-update> for updates on the 2018 Stormwater Rule, its relationship to the “three-acre general permit”, and anticipated timelines for Developed Lands General Permit rule development.

Table 1. Summary of Drainage Area Characteristics and Retrofit Benefits

Site ID	Site Name	Drainage Area Characteristics, Runoff Volumes, and Phosphorus (P) Base Load Estimates										Proposed BMPs, Storage Volumes, and P Load Reduction Estimates					Implementation Cost Estimates and Cost-Benefit Metrics					
		Primary Soil HSG	Drainage Area (acres)	Developed Impervious Area (acres)	Developed Pervious Area (acres)	% Impervious	Estimated WQv (acre-feet)	Estimated HCv / CPv (acre-feet)	Estimated WQv (CF)	Estimated HCv / CPv (CF)	Estimated Total Base P Load (lbs/year)	Proposed BMP Type	Proposed Storage Volume (CF)	BMP P Removal Efficiency (%)	Estimated Total P Load Reduction (lbs/year)	Estimated Total P Load Post Treatment (lbs/year)	BMP Unit Construction Cost (2018 \$/CF)	BMP Construction Cost Estimate (2018 \$)	BMP Design / Permitting Costs (2018 \$)	Cost Adjustment Factor	Total Estimated Implementation Cost (2018 \$)	Phosphorus Removal Cost-Benefit (\$/lb P removed)
1	North Avenue and Dewey Street	C/D	2.11	0.51	1.60	24	0.048	0.105	2,070	4,570	2.22	Gravel Wetland	2,400	56%	1.25	0.97	\$6.00	\$15,000	\$4,500	1.5	\$29,250	\$23,400
2	Upstream tributary	D	18.44	4.24	14.19	23	0.399	0.915	17,400	39,860	18.92	Regenerative Conveyance	8,000	70%	13.24	5.68	\$7.50	\$60,000	\$18,000	2.5	\$195,000	\$14,728
3	Private farm culvert on Hamilton Place Ext.	D	8.23	0.49	7.74	6	0.069	0.4090	2,990	17,820	5.70	No New BMP Proposed	0	0%	0.00	5.70	\$0.00	\$0	\$0	0	\$0	\$0
4	North Ave and River St. @ Missisquoi River	C/D	8.73	3.10	5.63	36	0.269	0.41	11,720	17,860	11.09	Gravel Wetland	4,000	34%	3.76	7.33	\$6.00	\$24,000	\$7,200	2	\$62,400	\$16,596
5	Vista Park	B	6.46	3.81	2.65	59	0.31	0.255	13,610	11,110	11.18	Bioretention	7,500	40%	4.50	6.68	\$10.56	\$80,000	\$24,000	2	\$208,000	\$46,222
6	Bioswale Across From Vista Supermarket	B	0.20	0.17	0.03	87	0.01	0.01	600	350	0.46	Bioretention	600	51%	0.24	0.22	\$10.56	\$7,000	\$2,100	2	\$18,200	\$75,833
7	Powell St. Bump Out	B	0.94	0.40	0.54	43	0.03	0.037	1,460	1,610	1.32	Bioretention	100	9%	0.12	1.20	\$10.56	\$2,000	\$600	2	\$5,200	\$43,333
8	Vista Supermarket back parking lot	B	2.12	0.55	1.57	26	0.0495	0.084	2,160	3,660	2.30	Deep Sump Catch Basin	1,800	25%	0.58	1.72	\$2.13	\$4,000	\$1,200	2.5	\$13,000	\$22,414
9	TD Bank Bioretention	A	0.63	0.52	0.11	82	0.042	0.01	1,820	390	1.38	Bioretention	2,500	55%	0.76	0.62	\$10.56	\$27,000	\$8,100	2	\$70,200	\$92,368
10	Town Hall Bump Out	A	0.95	0.48	0.47	50	0.040	0.013	1,730	570	1.48	Bioretention	250	18%	0.27	1.21	\$10.56	\$3,000	\$900	2	\$7,800	\$28,889
11	Richford Elementary Project No. 1	B/D	0.50	0.45	0.05	90	0.036	0.025	1,560	1,090	1.17	Bioretention	2,250	56%	0.66	0.51	\$10.56	\$24,000	\$7,200	2	\$62,400	\$94,545
12	Noyes Street Swale	A	1.98	0.47	1.51	24	0.045	0.027	1,940	1,180	2.07	Bioretention	2,000	85%	1.77	0.30	\$10.56	\$22,000	\$6,600	2	\$57,200	\$32,316
13	Center Street bioretention	A	3.55	0.87	2.68	25	0.1	0.0	3,480	2,130	3.75	Bioretention	2,400	78%	2.93	0.82	\$10.56	\$26,000	\$7,800	2	\$67,600	\$23,072
14	Center Street Bump Outs	A	4.95	0.96	3.99	19	0.09	0.1	3,950	2,960	4.73	Bioretention	200	7%	0.35	4.38	\$10.56	\$3,000	\$900	2	\$7,800	\$22,286
15	Troy St. - Main St. Bump Out	A	0.75	0.27	0.48	36	0.023	0.010	1,000	440	0.95	Bioretention	500	38%	0.36	0.59	\$10.56	\$6,000	\$1,800	2	\$15,600	\$43,333
16	10' culvert at Guilmette		1785.60	17.86	1767.74	1	8.9	49.9	388,900	2,174,950	1062.40	No New BMP Proposed	0	0%	0.00	1062.40	\$0.00	\$0	\$0	0	\$0	\$0
17	Rt. 105 Paved Swale	C/D	1.63	0.42	1.22	25	0.038	0.081	1,660	3,530	1.75	Grass Swale	3,750	25%	0.43	1.32	\$2.11	\$8,000	\$2,400	2.5	\$26,000	\$60,465
18	Maple Street Swale	C/D	3.12	0.55	2.58	18	0.055	0.155	2,380	6,750	2.87	Grass Swale	4,000	19%	0.55	2.32	\$2.11	\$9,000	\$2,700	1.5	\$17,550	\$31,909
31	Main Street Bump Out No. 2	A	0.83	0.15	0.68	19	0.015	0.011	660	480	0.78	Bioretention	125	23%	0.18	0.60	\$10.56	\$2,000	\$600	2	\$5,200	\$28,889
32	Main Street Bump Out No. 3	A	0.75	0.30	0.45	40	0.026	0.01	1,120	440	1.03	Bioretention	125	15%	0.15	0.88	\$10.56	\$2,000	\$600	2	\$5,200	\$34,667
33	Missisquoi Trib	C/D	31.83	5.51	26.32	17	0.557	1.58	24,260	68,820	29.10	Regenerative Conveyance	12,000	70%	20.37	8.73	\$7.50	\$90,000	\$27,000	2.5	\$292,500	\$14,359
34	Richford Elementary Project #2	B/D	2.46	0.84	1.62	34	0.074	0.122	3,210	5,310	3.06	Gravel Wetland	4,000	59%	1.80	1.26	\$6.00	\$24,000	\$7,200	2	\$62,400	\$34,667

Table 2. Stormwater Opportunity Prioritization and Implementation Matrix

Site ID	Site Name	Need	Proposed Approach	Web Soil Survey Mapped HSG	Existing Environmental Concerns (scale 1-5)	Environmental Priority (scale 1-5)	Constructability (scale 1-3)	Ease of Operation (scale 1-3)	P Removal Cost Effectiveness (Scale 1-3)	Contamination Risk (scale 1-3)	Implementation Score	Project Type	Estimated Implementation Cost	Green Infrastructure Opportunity (Y or N)	Need for Additional Engineering	Advance to Concept Design
1	North Avenue and Dewey Street	Retrofit opportunity	Re-route existing storm sewer system drainage to gravel wetland in right of way to improve water quality treatment and alleviate localized flooding during storm events. Wetland will discharge to the north, to meet existing stream.	C/D	2	1	3	2	3	3	14	Town	M	Y	M	
2	Upstream tributary	Stabilization	Upsize existing culvert discharging to stream, and stabilize actively eroding channel with plantings.	D	4	4	1	3	3	3	18	Private	MH	N	H	
3	Private farm culvert on Hamilton Place Ext.	No New BMP Proposed	Install stone splash pad and check dams to slow flow and reduce erosion. Potentially include plantings to increase channel roughness, slow down flow, and promote storage and infiltration, where feasible.	D												
4	North Ave and River St. @ Missisquoi River	Retrofit opportunity	Install gravel wetland in adjacent town owned land (park to the west) to accept flow from existing SW piping system. Also consider swirl separator installed in place of catch basin directly upstream. Restore bank and riparian area along River. Include armoring at outfall pipe.	C / D	4	3	2	2	3	2	16	Town	M	Y	M	
5	Vista Park	Retrofit opportunity	Disconnect the outfall that discharges to the river in this location and send flow to a proposed bioretention basin in the park across the road from Vista Supermarket and the fire station. The bioretention basin should be underdrained and allow no infiltration due to contaminated soils in the vicinity. Adequate depth and use of private property need to be further investigated.	B	3	2	1	2	2	1	11	Private	MH	Y	H	
6	Bioswale Across from Vista Supermarket	Retrofit opportunity	Install a bioswale between the parking lot and sidewalk across the road from Vista Supermarket. Grade the parking lot to drain to swale. Consider installing multiple stages to ease maintenance, and consider an underdrain.	B	3	3	3	2	1	1	13	Town	L	Y	L	
7	Powell St. Bioretention Bump Out	Retrofit opportunity	Install a small bump-out in front of Richford Community Housing (10 to 12 Powell St.), to collect sediment running down the roadway. The proposed BMP should not include infiltration due to contaminated soils in the vicinity.	B	2	3	2	2	2	1	12	Town	L	Y	M	
8	Vista Supermarket back parking lot	Retrofit opportunity	Install sediment basin / wet pond at low point in parking lot. Potentially disconnect existing catch basin to capture more sediment. This would require removal of multiple parking spaces. Do not infiltrate due to soil contamination in the vicinity. Consider swirl separator in place of sediment basin.	B	4	4	1	1	3	1	14	Private	L	Y	H	
9	TD Bank Bioretention	Retrofit opportunity	Install a bioretention practice to capture flow and sediment off Main St. and bank parking lot. Restore bank where rill erosion has occurred. Design to prevent infiltration due to nearby land uses.	A	4	4	2	1	1	1	13	Hybrid	M	Y	H	★
10	Town Hall Bioretention Bump Out	Retrofit opportunity	Install up to 4 bump-outs in front of Town Hall. Install bump-outs over existing closed drainage system to increase infiltration. Consider removing or capping existing grate inlets at the Town Hall driveway and directing surface flows to the proposed bump-outs.	A	2	2	2	2	2	2	12	Town	L	Y	M	★

Site ID	Site Name	Need	Proposed Approach	Web Soil Survey Mapped HSG	Existing Environmental Concerns (scale 1-5)	Environmental Priority (scale 1-5)	Constructability (scale 1-3)	Ease of Operation (scale 1-3)	P Removal Cost Effectiveness (Scale 1-3)	Contamination Risk (scale 1-3)	Implementation Score	Project Type	Estimated Implementation Cost	Green Infrastructure Opportunity (Y or N)	Need for Additional Engineering	Advance to Concept Design
11	Richford Elementary Project No. 1	Retrofit opportunity	Install a bioswale along the school access road to capture and treat runoff from access drive. Increase the size of the culvert under the access road - it is rusted out and under sized. Bank full width of the channel at this location is 4-5'.	B/D	2	3	3	2	1	3	14	Town	M	Y	M	★
12	Noyes Street Swale	Retrofit opportunity	Install a grass swale along Noyes Street just uphill of Larry's Auto - include vegetation and check dams. Potentially replace culvert at driveway above the swale. Erosion currently ~160' long and 2-5' wide.	A	4	2	1	2	2	3	14	Town	M	Y	L	
13	Center Street bioretention	Retrofit opportunity	Capture road and driveway runoff and send to a 20' x 30' bioretention basin, if soils don't conflict. If infeasible, create water features for water quality and incorporate park elements. Land ownership is private.	A	2	2	1	2	3	3	13	Private	M	Y	M	
14	Center Street Bump Outs	Retrofit opportunity	Install traffic calming bump outs along Center Street to infiltrate and remove runoff from the existing closed drainage network.	A	2	2	2	2	3	2	13	Town	L	Y	M	
15	Troy St.-Main St. Bump Out	Retrofit opportunity	Install traffic calming bump outs or curb cut bioretention at the park located near the intersection of Troy and Main Streets.	A	2	2	2	2	2	1	11	Town	L	Y	M	★
16	10' Culvert at Guilmette	No New BMP Proposed		-												
17	Rt. 105 Paved Swale	Retrofit opportunity	Remove paved swale along western portion of roadway. Install stone and check dams within footprint of existing swale, 285' along Vermont 105. Stone line the corner at Maple Street. Clean sediment and re-vegetate 120' of swale along Maple Street.	C/D	4	3	2	2	2	3	16	Town	M	Y	M	
18	Maple Street Swale	Retrofit existing BMP	Enlarge swale, stabilize with stone and vegetation. Improve the channel geometry at the outlet to promote better flow through system. The swale is ~130' directed to the Mobil parking lot, then curves around the parking lot for another ~100' before discharging to a wetland. One of the adjacent homeowners reported that the swale backs up and floods both adjacent properties often.	C/D	3	3	2	1	2	3	14	Private	L	Y	M	
31	Main Street Bump Out No. 2	Retrofit opportunity	Install additional traffic calming bump outs along Main Street.	A	2	2	2	2	2	1	11	Town	L	Y	M	★
32	Main Street Bump Out No.3	Retrofit opportunity	Install additional traffic calming bump outs along Main Street.	A	2	2	2	2	2	1	11	Town	L	Y	M	★
33	Missisquoi Trib	Stabilization	Moderate to severe active bank erosion on the right side of an unnamed tributary to the Missisquoi River. The left bank and floodplain are in stable condition. Stabilize the right bank and channel with river stone and plantings. Widen the channel where necessary to accommodate increased watershed flows. This project requires private property access.	C/D	5	4	1	3	3	3	19	Private	H	N	H	
34	Richford Elementary Project No. 2	Retrofit existing BMP	Retrofit existing swale that receives runoff from front parking lot with gravel wetland to increase storage, water quality and recharge benefits. Project could either stand alone or be combined with ID# 11 (Richford Elementary Bioswale) as demonstration projects. Both offer substantial opportunity for infiltration and water quality benefits to 2 different streams that are within close proximity to the Missisquoi River.	B/D	2	3	3	2	2	3	15	Town	M	Y	M	★

5. Conceptual Solutions for High Priority Stormwater Problems and Opportunities

Following the prioritization of stormwater management opportunities and discussion with the Town and NRPC (Section 4), a total of seven project sites were advanced to conceptual design. Projects were selected based on prioritization score, size and capacity of the treatment opportunity, and water quality treatment potential.

Per the project scope, three opportunities were anticipated to advance to concept design. However, efficiencies were realized by replicating concepts for projects of similar nature (i.e. curb extension bioretention), and by combining concept projects on school property. Ultimately, five retrofit concepts were proposed within the Village center and two were proposed at the Richford Elementary School (Appendix E).

The five retrofit locations advanced to concept design in the Village center were:

- 10, Town Hall Bump-out (curb extension bioretention)
- 15, Troy and Main Street Bump-out (curb extension bioretention)
- 31, Main Street Bump-out #2 (curb extension bioretention)
- 32, Main Street Bump-out #3 (curb extension bioretention)
- 9, TD Bank Bioretention (bioretention)

The two opportunities advanced to concept design at the Richford Elementary School were:

- 11, Richford Elementary Project #1, Along School Access Drive (bioretention swale)
- 34, Richford Elementary Project #2, Parking Lot Swale (gravel wetland)

For each of the concept designs, a brief description of the proposed implementation project is presented, followed by an opinion of probable cost for implementation of the proposed restoration design, permitting requirements, and next steps. Unit costs are based on Vermont Agency of Transportation (VTTrans) two-year average unit prices, ranging from July 2015 to June 2017⁷, as adjusted based on recent construction projects managed by Stone staff. All opinions of probable costs were developed assuming they would be bid on and constructed by commercial contractors. Construction costs will most likely be lower than the estimates provided if work is completed by the municipality.

⁷ <https://vtrans.vermont.gov/sites/aot/files/estimating/documents/2YearEnglishAveragedPriceList11.pdf>

Curb extension bioretention practices are proposed at strategic locations along Main Street to provide for water quality treatment. Constraints include the need to minimize loss of parking spaces, and significantly, the presence of historical contamination at or adjacent to practice locations.

The five practices are proposed downslope of the Town Hall driveway along the northwestern side of the road (location 10), at the intersection of Troy and Main Street along the eastern side of the road (location 15) near the park, and at two locations along the northwestern side of Main Street (locations 31 and 32), all aimed at capturing flow from adjacent roadways. The proposed practices are estimated to be 15' long x 4' wide.

Dimensions will be refined in future design phases to minimize loss of parking spaces and maximize water quality treatment. Underdrains connected to a beehive outlet are proposed at each practice, so collected flow can be routed to the closed drainage system following treatment and high flows can be safely conveyed. The design standard used for these retrofits was best-fit treatment of the water quality volume for the contributing drainage area of all four practices (a total of 3.28 acres, with 1.2 acres of impervious surface). Full compliance with the WQv treatment standard would manage 1.0" of rain in a 24-hour period at each site, a total of 4,510 CF. Given the limited available space for the practices, they are collectively estimated to manage 22% of the WQv or 1,000 ft³ of runoff. A 30% design plan for the four sites is included in Appendix E.

5.1.1.1. Cost Estimates and Revised Benefit Metrics

A preliminary implementation cost estimate is provided below (Table 3). This amount differs from the amount initially projected for this site (Table 1), as design-specific amounts and costs were developed to support this high-priority retrofit concept. Cost-benefit metrics were adjusted based on the design-specific cost estimate. A cost item is included to account for soil testing, to screen for soil contamination prior to construction. Excavation unit prices were also increased, assuming that 50% of the excavated material will require transport and disposal offsite at the Casella landfill in Coventry, VT, approximately 31 miles from the project. Costs for disposal at this facility assume that soils will contain moderate levels of contamination (PAHs, lead, and arsenic), typical of urban soils.

The estimated cost for implementation of this project is \$78,100.

- The cost per pound of phosphorus treated is \$81,354.
- The cost per impervious acre treated is \$65,083.
- The cost per cubic foot of runoff treated is \$78.10.

Table 3. Locations 10, 15, 31, and 32 – Curb Extension Bioretention, Opinion of Probable Cost, 30% Design

	ITEM	AMOUNT	UNIT COST	TOTAL	
Locations 10, 15, 31, & 32	EXCAVATION OF SURFACES AND PAVEMENTS	4	CY	\$23	\$102
	EXCAVATION (INCLUDES COST INCREASE TO ACCOUNT FOR 50% CONTAMINATED SOIL EXCAVATION, TRANSPORT AND DISPOSAL)	84	CY	\$45	\$3,800
	1-1.25" STONE	9	CY	\$30	\$271
	PEA GRAVEL	8	CY	\$40	\$320
	6" UNDERDRAIN PIPE	100	LF	\$25	\$2,500
	BEEHIVE OUTLET	4	EA	\$200	\$800
	TIE-IN TO EXISTING DRAINAGE SYSTEM	4	LS	\$4,000	\$16,000
	PLANTING SOIL, 90% SAND, 10% TOPSOIL	27	CY	\$30	\$800
	VERTICAL GRANITE CURB	80	LF	\$35	\$2,800
	PLANTINGS	27	SY	\$40	\$1,067
	SEED	3	LB	\$7.25	\$22
	MULCH	3	CY	\$150	\$450
	TRAFFIC CONTROL	1	LS	\$5,000	\$5,000
	EROSION PROTECTION AND SEDIMENT CONTROL	1	LS	\$2,000	\$2,000
CONSTRUCTION TOTAL				\$35,932	
<i>FINAL DESIGN (25%)</i>				<i>\$8,983</i>	
<i>PERMITTING (15%)</i>				<i>\$5,390</i>	
<i>STAKE OUT (10%)</i>				<i>\$3,593</i>	
<i>SOIL TESTING TO SCREEN FOR CONTAMINATION (LS)</i>				<i>\$8,000</i>	
<i>MOBILIZATION / DEMOBILIZATION (15%)</i>				<i>\$5,390</i>	
<i>CONSTRUCTION OVERSIGHT (10%)</i>				<i>\$3,593</i>	
<i>CONTINGENCY (20%)</i>				<i>\$7,186</i>	
TOTAL (ROUNDED TO NEAREST \$100)				\$78,100	

5.1.1.2. Permitting Needs

Anticipated permitting needs are summarized below.

Construction Stormwater Permit: Disturbance at these sites is not anticipated to require a construction stormwater permit. Construction activities should still be conducted in accordance with the requirements and guidance of the Vermont DEC’s *Low Risk Site Handbook for Erosion Prevention and Sediment Control*.

Operational Stormwater Permit: No operational stormwater permit is anticipated to be required.

Local Permitting: No local permits are anticipated.

Other Permits:

No Act 250 permitting review or actions are anticipated to be required.

No Wetlands permitting is anticipated for these projects.

No River Corridor or Stream Alteration permits are anticipated to be required.

No VTrans Section 1111 permit is anticipated to be required.

5.1.1.3. Next Steps

The Town of Richford Road Foreman has agreed to advance these projects, and since all work will occur within the Town right-of-way, only technical constraints and design refinements remain. Further work will involve refinement of the retrofit designs with respect to size and layout to maximize water quality treatment and minimize loss of parking spots, verification of existing utilities and tie-ins of underdrains, and assessment/presence of contaminated soils and/or groundwater in the immediate vicinity of the proposed retrofits.

5.1.2. Location 9, TD Bank Bioretention

During large storm events, stormwater runoff that exceeds the capacity of the existing closed drainage system along Main Street flows over land to the northeast along the eastern side of Main Street, then flows southeast onto a partially paved area located between the TD Bank parking lot and the Sunoco gas station. Runoff from the 0.63-acre drainage area runs through this area, which is sloped towards the Missisquoi River, and discharges over the river bank. Rill erosion along the bank was observed during field inspections.

Limited stormwater infrastructure exists on site, including an underdrain and outfall that was not observed during field surveys. Constraints include maintenance of access to the TD Bank parking lot to the south and access to the gas station to the north. The gas station has direct access to the site off Main Street, but TD Bank does not. Potential historical contamination was documented adjacent to this site, which may constrain project installation.

The originally proposed retrofit is a 24' x 50' lined bioretention practice located in the eastern portion of the easement. A geotextile liner to prevent infiltration of petroleum products in the event of a spill at the gas station is included in the conceptual design. An underdrain is proposed that routes treated stormwater to a dedicated storm pipe and outfall system that discharges to the river. Discharge at the outfall is protected with stone. Curbing would surround the practice, with curb cuts allowing flow from the TD Bank parking lot and Main Street into the practice. The project also includes restoration of rill erosion along the river bank. The design standard used for this retrofit was best-fit treatment of the water quality volume for the contributing drainage area. Full compliance with the WQv treatment standard would manage 1.0" of rain in a 24-hour period, and at this site, it is possible to site a bioretention practice that will manage 137% of the WQv or 2,500 ft³ of runoff. A 30% design plan is included in Appendix E.

The area identified for siting of this retrofit was initially identified as a Town-owned easement approximately 40' wide by 200' long, with about 120' of that length potentially available for upland stormwater practices (the remainder is sloped river bank). During review of this concept design, it was discovered that the Town does not yet own an easement in this area but will following construction of rail trail improvements in 2019-2020. In addition, the rail trail's access to Main Street is designed to overlap substantially with the area identified in the draft 30% design for siting of the bioretention practice. Notes have been added to the concept design that indicate alternate siting options to be explored in future phases of design for stormwater improvements at this location. In addition, there is an opportunity to coordinate this concept design with a larger visioning project for the Richford Riverwalk, which is being led by the Richford Economic Advancement Corporation (REAC) with NRPC and consultant support. Moving the concept bioretention area proposed in this section to the flat area south of the proposed trailhead parking and providing stable overflow to the proposed swale at the base of that steep slope between Main Street and the bike path would provide both water quality treatment and an educational and visual focal point at the trailhead. Further exploration of this opportunity with all

stakeholders is warranted, as is coordination regarding existing soil contamination in the vicinity of this project. A summary of site considerations and recommendations for next steps is provided in Appendix F.

5.1.2.1. Cost Estimates and Revised Benefit Metrics

A preliminary implementation cost estimate is provided below (Table 4). This amount differs from the amount initially projected for this site (Table 1), as design-specific amounts and costs were developed to support this high-priority retrofit concept. Cost-benefit metrics were adjusted based on the design-specific cost estimate. A cost item is included to account for soil testing, to screen for soil contamination prior to construction. Excavation unit prices have been increased, assuming that 50% of the excavated material will require transport and disposal offsite to the Casella landfill in Coventry, VT, approximately 31 miles from the project. Costs for disposal at this facility assume that soils will contain moderate levels of contamination (PAHs, lead, and arsenic), typical of urban soils.

The estimated cost for implementation of this project is \$86,100.

- The cost per pound of phosphorus treated is \$113,289.
- The cost per impervious acre treated is \$136,666.
- The cost per cubic foot of runoff treated is \$34.44.

Table 4. Location 9, TD Bank Bioretention, Opinion of Probable Cost, 30% Design

	ITEM	AMOUNT	UNIT COST	TOTAL	
Location 9	EXCAVATION OF SURFACES AND PAVEMENTS	22	CY	\$23	\$511
	EXCAVATION (ACCOUNTING FOR 50% CONTAMINATED SOIL EXCAVATION, TRANSPORT AND DISPOSAL)	263	CY	\$45	\$11,847
	1-1.25" STONE	21	CY	\$30	\$633
	PEA GRAVEL	23	CY	\$40	\$933
	6" UNDERDRAIN PIPE	124	LF	\$25	\$3,100
	IMPERMEABLE LINER	206	SY	\$10	\$2,056
	PLANTING SOIL, 90% SAND, 10% TOPSOIL	178	CY	\$30	\$5,333
	VERTICAL GRANITE CURB	128	LF	\$35	\$4,480
	OVERFLOW OUTLET	1	LS	\$500	\$500
	STONE FILL, TYPE II (FOR BIORETENTION OUTLET AND EROSION REPAIR)	7	CY	\$45	\$315
	PLANTINGS (FOR BIORETENTION AND EROSION REPAIR)	145	SY	\$40	\$5,813
	SEED	6	LB	\$7.25	\$44
	MULCH	12	CY	\$150	\$1,800
	TRAFFIC CONTROL	1	LS	\$4,000	\$4,000
	EROSION PROTECTION AND SEDIMENT CONTROL	1	LS	\$2,000	\$2,000
	CONSTRUCTION TOTAL				\$43,365
	FINAL DESIGN (25%)				\$10,841
PERMITTING (10%)				\$4,337	
STAKE OUT (5%)				\$2,168	
SOIL TESTING TO SCREEN FOR CONTAMINATION (LS)				\$8,000	
MOBILIZATION / DEMOBILIZATION (10%)				\$4,337	
CONSTRUCTION OVERSIGHT (10%)				\$4,337	
CONTINGENCY (20%)				\$8,673	
TOTAL (ROUNDED TO NEAREST \$100)				\$86,100	

5.1.2.2. *Permitting Needs*

Anticipated permitting needs are summarized below.

Construction Stormwater Permit: Disturbance at this site is not anticipated to require a construction stormwater permit. Construction activities should still be conducted in accordance with the requirements and guidance of the Vermont DEC's *Low Risk Site Handbook for Erosion Prevention and Sediment Control*.

Operational Stormwater Permit: No operational stormwater permit is anticipated to be required.

Local Permitting: No local permits are anticipated.

Other Permits:

No Act 250 permitting review or actions are anticipated to be required.

Wetlands permitting is not anticipated for this project. However, due to the potential presence of riparian wetlands associated with the river, a site visit with Wetlands program staff to confirm the presence or absence of wetlands is warranted.

River Corridor permitting is anticipated for this project; the proposed retrofit is located partially within the mapped river corridor. A meeting with the DEC Rivers Program representative is warranted.

Floodplain related permits may be required, either through the Town via their enrollment in the National Flood Insurance Program, or through the State, through the River Corridor & Floodplain Protection Rule, for activities exempt from municipal regulation. Stone has contacted Rebecca Pfeiffer, the state Regional Floodplain Manager for additional input regarding floodplain permit requirements, and is awaiting a response.

5.1.2.3. *Next Steps*

The proposed project will ultimately be located within a Town easement, but meetings with the adjacent property owners (TD Bank and Sunoco station) are warranted, due to constraints and potential impacts to these adjacent properties. Further work will involve refinement of the retrofit design with respect to size and layout to maximize water quality treatment and minimize environmental impacts, particularly with regard to work in the mapped river corridor. This project should be coordinated with the construction of the rail trail extension project (STP BIKE(36)S, Richford Rail-Trail Extension)⁸, where construction is anticipated in 2019-2020, as well as with the visioning project for the Richford Riverwalk, being spearheaded by REAC with NRPC and consultant support.

5.2. Elementary School Concept Designs

5.2.1. Location 11, Richford Elementary School Project #1 (Bioretention Swale)

The access road to the Richford Elementary School campus is approximately 750 feet long. The forested area on the eastern side of the road provides a reasonable disconnection and water quality benefit for stormwater runoff discharging to that side of the road. The school campus on the western side of the access road is an open grassed field, which is sloped to convey runoff to a moderately sized unnamed stream (5-6' bankfull width). The stream runs under the access road via an 18" CMP culvert in poor condition, then runs another few hundred feet to a crossing under Route 105, finally discharging into the Missisquoi River approximately

⁸ <http://www.aot.state.vt.us/FactSheet/default.aspx?pin=00F020>

1,200 feet from the access road cross culvert. The approximate 0.5-acre drainage area includes runoff from the western half of the access road.

The open field provides ample space for a bioretention swale, and there is no existing stormwater infrastructure adjacent to the proposed practice. Primary constraints include the need to maintain access to the school during the academic year; therefore, this project would need to be constructed during the summer months.

The proposed retrofit includes a 225' long by 10' wide bioretention swale located parallel to the access road. The practice would provide water quality treatment and removal of sediment and phosphorus from stormwater runoff. The practice will discharge approximately 15 feet from the unnamed stream; the swale will 'daylight' along the gentle slope and be stabilized at the outlet via Type II stone. The project also includes replacement of the existing culvert under the access road. The design standard used for this retrofit was best-fit treatment of the water quality volume for the contributing drainage area (0.50 acres). Full compliance with the WQv treatment standard would manage 1.0" of rain in a 24-hour period. A bioswale practice can be sited that will manage 144% of the WQv or 2,250 ft³ of runoff. A 30% design plan is included in Appendix E.

5.2.1.1. Cost Estimates and Revised Benefit Metrics

A preliminary implementation cost estimate is provided below (Table 5). This amount differs from the amount initially projected for this site (Table 1), as design-specific amounts and costs were developed to support this high-priority retrofit concept. Cost-benefit metrics were adjusted based on the design-specific cost estimate.

The estimated cost for implementation of this project is \$72,500.

- The cost per pound of phosphorus treated is \$109,850.
- The cost per impervious acre treated is \$161,110.
- The cost per cubic foot of runoff treated is \$32.22.

5.2.1.2. Permitting Needs

Anticipated permitting needs are summarized below.

Construction Stormwater Permit: Disturbance at this site is not anticipated to require a construction stormwater permit. Construction activities should still be conducted in accordance with the requirements and guidance of the Vermont DEC's *Low Risk Site Handbook for Erosion Prevention and Sediment Control*.

Operational Stormwater Permit: No operational stormwater permit is anticipated to be required.

Local Permitting: No local permits are anticipated.

Other Permits:

No Act 250 permitting review or actions are anticipated to be required.

Wetlands permitting is not anticipated for this project. However, due to the potential presence of riparian wetlands associated with the unnamed stream, a site visit with Wetlands Program staff to confirm the presence or absence of wetlands is warranted.

A Stream Alteration permit may be required, particularly for replacement of the cross culvert.

Table 5. Location 11, Richford Elementary School Bioswale, Opinion of Probable Cost, 30% Design

	ITEM	AMOUNT	UNIT COST	TOTAL	
Location 11	PROJECT DEMARCATION FENCING	470	LF	\$1.25	\$588
	GEOTEXTILE FOR SILT FENCE	75	SY	\$5	\$375
	COMMON EXCAVATION	265	CY	\$20	\$5,300
	TRANSPORT EXCAVATED MATERIAL OFFSITE	265	CY	\$10	\$2,650
	STONE FILL, TYPE II	3	CY	\$45	\$135
	6" UNDERDRAIN PIPE	225	LF	\$25	\$5,625
	3/4" DENSE GRADED DOUBLE WASHED CRUSHED STONE	16	CY	\$40	\$653
	3/8" DOUBLE WASHED PEA STONE	6	CY	\$45	\$248
	BIORETENTION PLANTING MEDIA	44	CY	\$32	\$1,404
	BIORETENTION PLANTINGS	145	SY	\$50	\$7,263
	CULVERT REPLACEMENT	1	LS	\$12,000	\$12,000
	SEED	5	LB	\$7.25	\$36
	TRAFFIC CONTROL	1	LS	\$2,000	\$2,000
	EROSION PROTECTION AND SEDIMENT CONTROL	1	LS	\$2,000	\$2,000
CONSTRUCTION TOTAL				\$40,277	
FINAL DESIGN (25%)				\$10,069	
PERMITTING (10%)				\$4,028	
STAKE OUT (5%)				\$2,014	
MOBILIZATION / DEMOBILIZATION (10%)				\$4,028	
CONSTRUCTION OVERSIGHT (10%)				\$4,028	
CONTINGENCY (20%)				\$8,055	
TOTAL (ROUNDED TO NEAREST \$100)				\$72,500	

5.2.1.3. Next Steps

Stone has spoken with Richford Elementary School Principal Beth O’Brien regarding both school projects. Overall, Principal O’Brien is supportive of the projects and asked to be kept up to date. Preliminary calculations performed by Stone indicate that that this property may exceed 3 acres of impervious surface and thus may be designated under the forthcoming Developed Lands General Permit program. The potential requirement for the district to implement retrofit projects in order to comply with this program was a primary reason for gaining support.

A review of the draft Stormwater Permitting Rule that defines the requirements of the forthcoming 3 acre permit unfortunately did not provide a complete answer on whether the proposed school projects will result in the school being in complete compliance if both projects are implemented. The rule indicates that 3 acre parcels will need to satisfy the redevelopment standard of the Vermont Stormwater Management Manual, and essentially the entire impervious surface of three or more acres shall be treated as though it is being redeveloped. Given those guidelines, Stone anticipates that once both projects are implemented it is likely that the school would be in complete compliance. However, it is difficult to make a final determination until the final rule is developed and released.

Further work will involve refinement of the retrofit design with respect to size and layout to maximize water quality treatment and minimize environmental impacts, particularly concerns regarding work in the mapped river corridor area.

5.2.2. Location 34, Richford Elementary School Project #2 (Gravel Wetland)

The majority of the parking lot located at the front of the Richford Elementary School drains to a swale that runs parallel to the long edge of the lot. The swale collects runoff from the parking lot and travels approximately 300 feet southwest, discharging to Loveland Brook, a tributary to the Missisquoi River.

While the swale provides a modest water quality benefit, we propose to retrofit the existing swale into a gravel wetland. Primary constraints include the need to maintain access while school is in session; this project would need to be constructed during the summer months.

The proposed retrofit includes retrofitting 200' of the existing swale with a 200' long by 10' wide gravel wetland located in the footprint of the swale. The practice would provide water quality treatment and removal of sediment and phosphorus from stormwater runoff via collection of 1.0" of rain in a 24-hour period (i.e. the WQv). The practice will include an outlet structure that discharges to the existing swale via a short run of 24" HDPE pipe and 15' of protective riprap. The design standard used for this retrofit was best-fit treatment of the water quality volume for the contributing drainage area (2.46 acres). It is possible to site a gravel wetland practice that will manage 125% of the WQv or 4,000 ft³ of runoff. A 30% design plan is included in Appendix E.

5.2.2.1. Cost Estimates and Revised Benefit Metrics

A preliminary implementation cost estimate is provided below (Table 6). This amount differs from the amount initially projected for this site (Table 1), as design-specific amounts and costs were developed to support this high-priority retrofit concept. Cost-benefit metrics were adjusted based on the design-specific cost estimate.

The estimated cost for implementation of this project is \$71,700.

- The cost per pound of phosphorus treated is \$39,833.
- The cost per impervious acre treated is \$85,357.
- The cost per cubic foot of runoff treated is \$17.93.

5.2.2.2. Permitting Needs

Anticipated permitting needs are summarized below.

Construction Stormwater Permit: Disturbance at this site is not anticipated to require a construction stormwater permit. Construction activities should still be conducted in accordance with the requirements and guidance of the Vermont DEC's *Low Risk Site Handbook for Erosion Prevention and Sediment Control*.

Operational Stormwater Permit: No operational stormwater permit is anticipated to be required.

Local Permitting: No local permits are anticipated.

Other Permits:

No Act 250 permitting review or actions are anticipated to be required.

No Wetlands permitting is anticipated for this project, but given the retrofit project's landscape position, a site visit with Wetlands program staff to confirm the presence or absence of wetlands is warranted.

Although the existing swale discharges to Loveland Brook within an existing River Corridor, this type of permitting is not anticipated since the retrofit will occur outside of the corridor. A Stream Alteration permit is not anticipated to be required.

Table 6. Richford Elementary School Gravel Wetland, Opinion of Probable Cost, 30% Design

	ITEM	AMOUNT	UNIT COST	TOTAL	
34	PROJECT DEMARCATION FENCING	425	LF	\$1.25	\$531
	GEOTEXTILE FOR SILT FENCE	67	SY	\$5	\$333
	COMMON EXCAVATION	200	CY	\$20	\$4,000
	TRANSPORT EXCAVATED MATERIAL OFFSITE	200	CY	\$10	\$2,000
	PRECAST REINFORCED CONCRETE MANHOLE WITH TRASH RACK, AND 24" CAST IRON GRATE	1	EA	\$6,000	\$6,000
	24" CPEP (SL)	15	LF	\$65	\$975
	STONE FILL, TYPE II	6	CY	\$45	\$267
	3/4" DENSE GRADED DOUBLE WASHED CRUSHED STONE	104	CY	\$40	\$4,148
	3/8" DOUBLE WASHED PEA STONE	17	CY	\$45	\$770
	WETLAND SOIL	35	CY	\$50	\$1,737
	6" UNDERDRAIN PIPE	200	LF	\$25	\$5,000
	6" UNDERDRAIN CLEANOUT WITH CAP	4	EA	\$125	\$500
	6" PERFORATED RISER WITH CAP	4	EA	\$125	\$500
	WETLAND PLANTS	156	SY	\$50	\$7,778
	SEED	7	LB	\$7.25	\$51
	MULCH	8	CY	\$150	\$1,200
	TRAFFIC CONTROL	1	LS	\$2,000	\$2,000
	EROSION PROTECTION AND SEDIMENT CONTROL	1	LS	\$2,000	\$2,000
CONSTRUCTION TOTAL				\$39,790	
FINAL DESIGN (25%)				\$9,948	
PERMITTING (10%)				\$3,979	
STAKE OUT (5%)				\$1,990	
MOBILIZATION / DEMOBILIZATION (10%)				\$3,979	
CONSTRUCTION OVERSIGHT (10%)				\$3,979	
CONTINGENCY (20%)				\$7,958	
TOTAL (ROUNDED TO NEAREST \$100)				\$71,700	

5.2.2.3. Next Steps

See discussion in Section 5.2.1.3 regarding contact with the School District and compliance with the forthcoming 3-acre permit. Further work will involve refinement of the retrofit design with respect to size and layout to maximize water quality treatment and minimize environmental impacts.

6. Recommendations

This document represents an extensive effort to identify and evaluate stormwater problem areas and strategic retrofit opportunities throughout Richford's village and at the Richford Elementary School campus. A total of five high priority stormwater improvement projects were advanced to concept design in the Village, and an additional two projects were advanced to concept design on the elementary school campus. These conceptual solutions all represent improvements that the Town or the School District could pursue directly, or could work with partners to pursue funding to address.

The practices, projects, and program identified in this plan individually and collectively can have a substantial benefit for water quality, resilience to larger storm events, and increased awareness and interest in stormwater management generally. While the high-priority concepts stand to provide some of the more substantial benefits, the Town and its partners are encouraged to move forward with the additional retrofits and practices outlined here (Appendix G includes a summary of these projects to be uploaded into VTDEC's Watershed Projects Database for tracking). These potential improvements have been identified through a planning process encouraged and recognized by VTDEC, so they will be good candidates for implementation funding through the VTDEC Clean Water Fund grant program (<http://dec.vermont.gov/watershed/cwi/cwf>). Alternately, and particularly for lower-cost strategic retrofits, such as the bioswale across from Vista Supermarket (Location 6), final design and construction funding could be pursued through the Lake Champlain Basin Program's Pollution Prevention grant program (<http://www.lcbp.org/about-us/grants-rfps/request-for-proposals-rfps/>).

Beyond addressing the specific problem areas identified in this plan, there are often opportunities to improve management of stormwater runoff that arise as part of routine municipal projects, such as the substantial reconstruction of a road surface or intersection. Grant funds may be available to cover the incremental cost of addressing stormwater runoff as part of such projects, if stormwater management is considered early enough in the design process and does not exceed regulatory thresholds for state stormwater permits. Any party choosing to advance one of these priority projects will likely need to consult on a case-by-case basis with the VT DEC Stormwater Program to determine whether or not a specific project will be subject to state jurisdiction. Regardless, it is often significantly more cost-effective and efficient to incorporate stormwater management measures into a planned municipal project as compared to the construction of a stand-alone stormwater management retrofit.

Finally, we recommend that all project partners keep up with "current events" related to implementation of the Lake Champlain Phosphorus TMDLs. The Vermont Agency of Transportation, for instance, is now working to develop its framework for implementing Phosphorus Control Planning across its entire transportation system in the Vermont Lake Champlain Basin through its TS4 General Permit. While implementation is not immediate, in the coming years VTTrans will be completing retrofit assessments for its roads and facilities throughout Richford. Projects in this plan that involve VTTrans drainage should continue to be coordinated with that agency and its permitting and compliance efforts, to the benefit of all parties. In addition, under the forthcoming Developed Lands General Permit, parcels and common plans of development with more than 3 acres of impervious surface that has either never been permitted, or was

permitted for operational stormwater before 2002, will be required to obtain permit coverage and develop new retrofits to treat stormwater from their impervious surfaces. The Richford Elementary School is one example of a property that may ultimately be designated. The campus includes significant impervious surfaces and its existing stormwater management infrastructure is limited, providing only minor water quality benefits.

7. References

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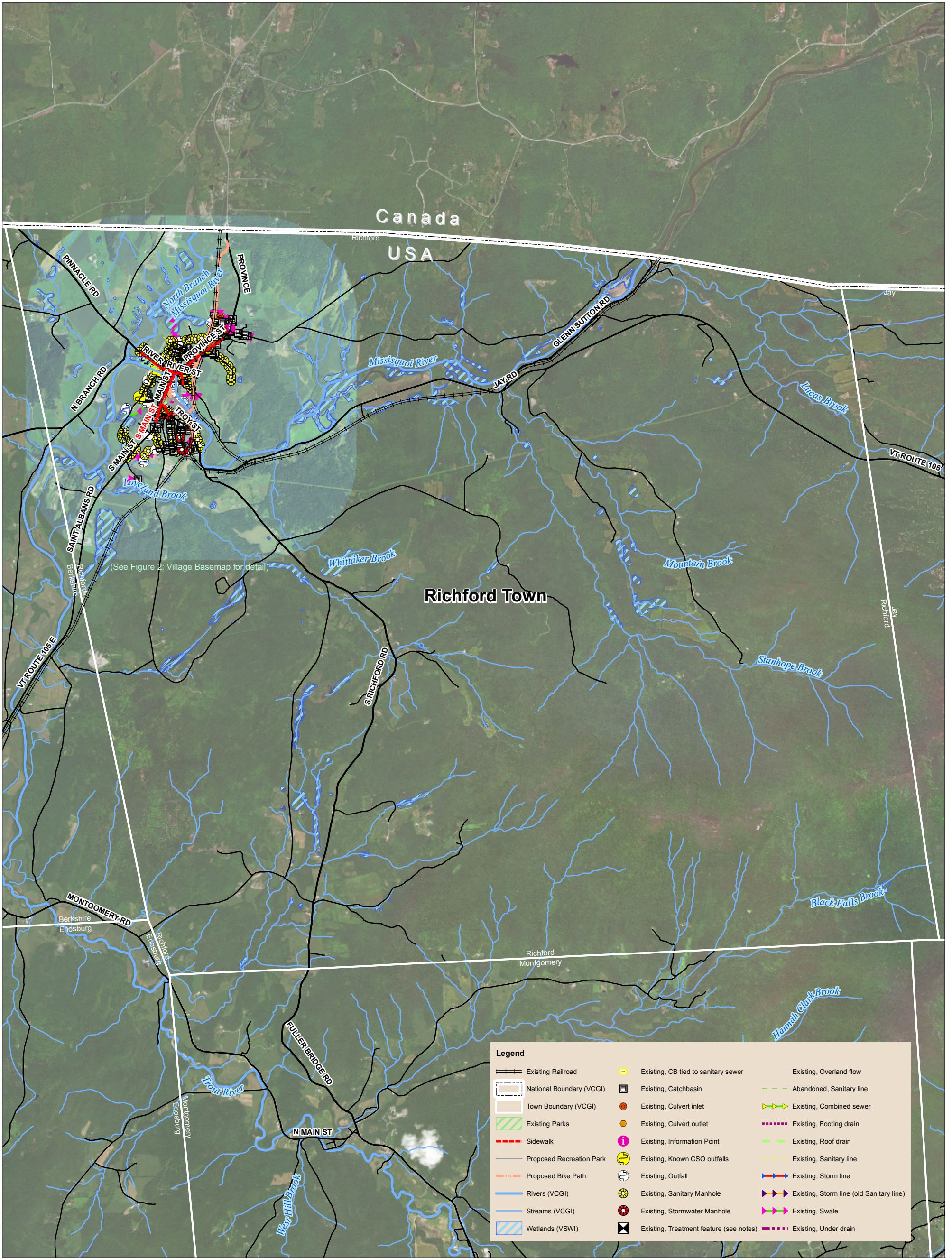
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Vermont Department of Environmental Conservation, Watershed Management Division, 2016. Missisquoi Bay Tactical Basin Plan, December 2016. Accessed at https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/2016-12-30_MissisquoiBasinPlanFinal.pdf on November 29, 2018.

Vermont Department of Environmental Conservation, Watershed Management Division, 2015. Missisquoi River Watershed Including Pike and Rock Rivers in Vermont, Updated Water Quality and Aquatic Habitat Assessment Report, August 2015. Last accessed at https://dec.vermont.gov/sites/dec/files/documents/WSMD_mp_MissisqBayBasin_assessmnt_rpt_Aug2015.pdf on November 29, 2018.

Vermont Department of Environmental Conservation, Watershed Management Division, 2017. 2017 Vermont Stormwater Management Manual Rule and Design Guidance, effective July 1, 2017. Available at http://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/Permitinformation/2017%20VSMM_Rule_and_Design_Guidance_04172017.pdf

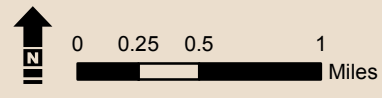
Appendix A. Maps



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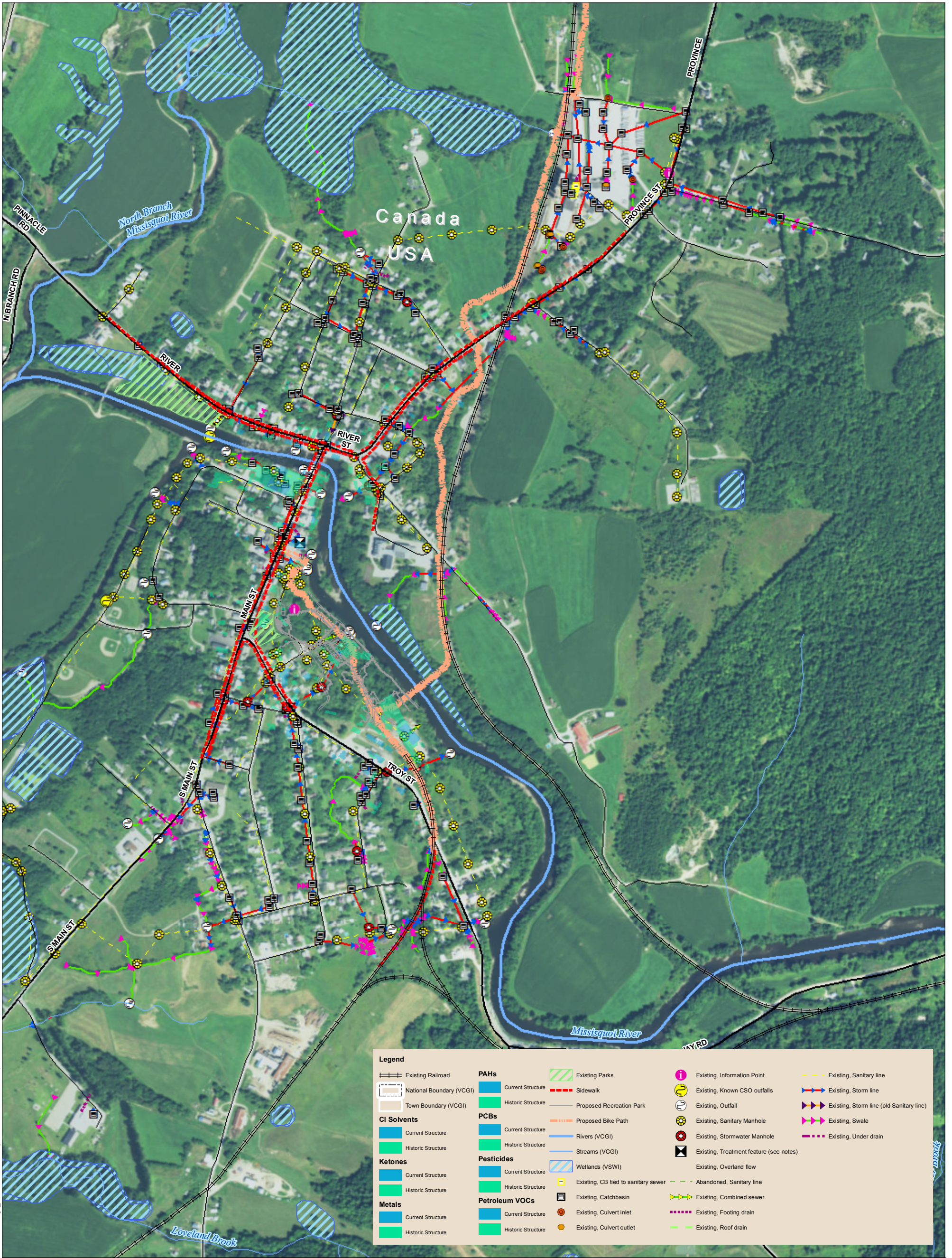
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 Basemap: ESRI World Imagery



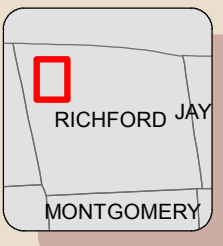
Town Base Map

**Richford
Stormwater Master
Planning**

Figure 1



Legend	
	Existing Railroad
	National Boundary (VCGI)
	Town Boundary (VCGI)
Cl Solvents	
	Current Structure
	Historic Structure
Ketones	
	Current Structure
	Historic Structure
Metals	
	Current Structure
	Historic Structure
PAHs	
	Current Structure
	Historic Structure
PCBs	
	Current Structure
	Historic Structure
Pesticides	
	Current Structure
	Historic Structure
Petroleum VOCs	
	Current Structure
	Historic Structure
	Existing Parks
	Sidewalk
	Proposed Recreation Park
	Proposed Bike Path
	Rivers (VCGI)
	Streams (VCGI)
	Wetlands (VSWI)
	Existing, CB tied to sanitary sewer
	Existing, Catchbasin
	Existing, Culvert inlet
	Existing, Culvert outlet
	Existing, Information Point
	Existing, Known CSO outfalls
	Existing, Outfall
	Existing, Sanitary Manhole
	Existing, Stormwater Manhole
	Existing, Treatment feature (see notes)
	Existing, Overland flow
	Abandoned, Sanitary line
	Existing, Combined sewer
	Existing, Footing drain
	Existing, Roof drain
	Existing, Sanitary line
	Existing, Storm line
	Existing, Storm line (old Sanitary line)
	Existing, Swale
	Existing, Under drain



Sources: Roads, Hydrography, Infrastructure, Soils, Hydrography, Administrative Boundaries: VCGI
 Basemap: ESRI World Imagery

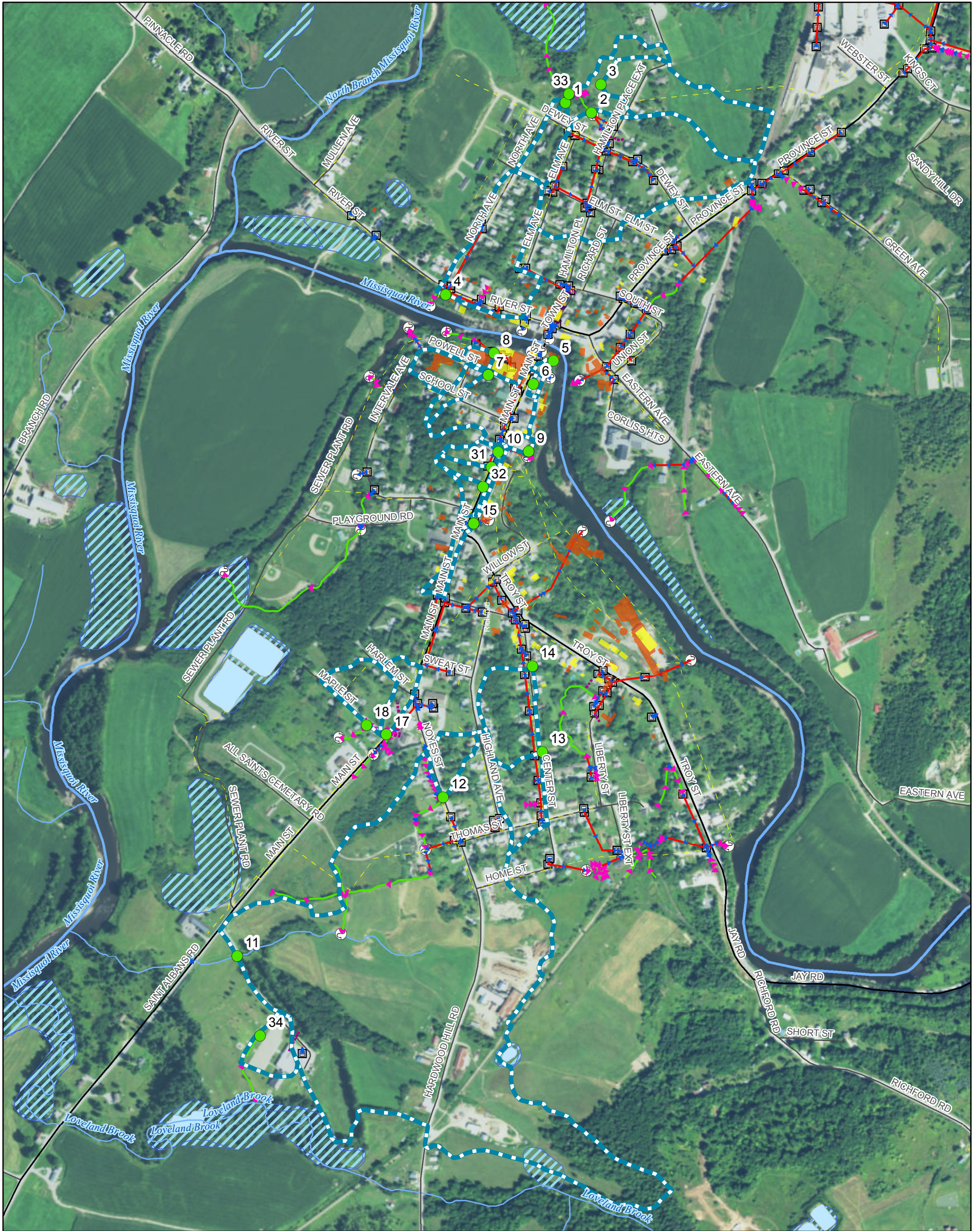


Village Base Map

Richford Stormwater Master Planning

Figure 2

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LEGEND

- Retrofit Opportunity Location
- Retrofit Drainage Area
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Storm line (old Sanitary line)
- Existing, Swale
- Existing, Under drain
- Existing, Catchbasin
- Existing, Outfall
- VT State highway
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Rivers (VCGI)
- Streams (VCGI)
- Wetlands (VSWI)
- NHD Waterbody
- National Boundary (VCGI)

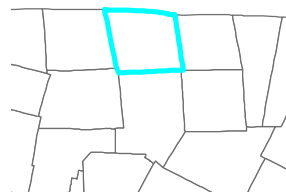
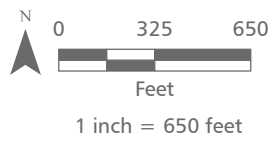


Figure 3
Retrofit Locations

Richford Stormwater Master Plan

Prepared for
Northwest Regional Planning Commission
Town of Richford

Sources: VCGI, VT ANR, Stone Environmental, Esri World Imagery

Path: O:\PROJ-17\WRM\17-079-B Richford SWMP\GIS\MapDocuments\PpresentationsAndReports\RichfordSWMP_Retrofits_Summary.mxd
Saved: 11/30/2018 by AmyM

Appendix B. Inventory of Existing Plans and Data

The inventory of plans and data compiled at the beginning of Richford's Stormwater Management Plan process includes existing GIS datasets (parcels, stormwater infrastructure, environmental resources, soils data, hazardous waste sites, etc.), as well as previously completed plans, reports, and designs relevant to the stormwater planning work undertaken here.

The complete data library may be downloaded from the following link:

<https://www.dropbox.com/s/neggbar2tz74uqe/Richford%20GIS%20Data.zip?dl=1>

Appendix C. Problem Area Data Sheets

ID#: 1																			
Name: North Avenue and Dewey Street																			
Concept Description: Report from homeowner that property across street gets flooded due to drainage system 'backing up'. Propose to take existing storm sewer system offline and send to bioretention or gravel wetland in right of way to manage runoff from the existing closed drainage system and alleviate localized flooding due to inadequate drainage.																			
Notes/Feasibility: Confirm right of way widths. Proposing gravel wetland due to poorly drained soils. Gravel wetland to discharge to the north, to meet up with existing stream.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public	Project Candidate: Yes																		
Land Use Type: Single Family Residential (< 1 ac. lots)	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Bioretention																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Low																		
Soils: Munson, (MuB) C/D; WT 0.5 - 2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: Yes</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: Yes</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: Yes</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: Yes	Water Quality: Yes	Access: Yes	Recharge: No	Land Use: No	Demonstration: No	Utilities:	Repair:	Polluted:	Reuse: No	High WT: Yes	Other:	Wetlands:		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: Yes																	
Water Quality: Yes		Access: Yes																	
Recharge: No	Land Use: No																		
Demonstration: No	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT: Yes																		
Other:	Wetlands:																		
	Other:																		
Use in Retrofit DA: Paved Road, Low Traffic, Urban Roof, Lawn, Urbanized, Multi-Family Roof																			
SIZING INFORMATION																			
Drainage Area (ac): 2.11																			
Impervious Area (ac): 0.51																			
Practice Area Avail. (ft²): 600																			
Existing Head Available? <0.5'																			

Date: 05/04/2018 08:44 AM

Assessed by: Branden Martin

ID#: 2																			
Name: Upstream tributary																			
Concept Description: Moderate to severe erosion in channel due to adjustments to impervious flows from Dewey St. and Hamilton Pl stormwater piping system. Undersized culvert also a erosion contributor. Original proposal: Stabilize channel with river stone and plantings. Widen channel at some locations. Right size culvert. Current proposal: Upsize culvert and install plantings along channel for stabilization.																			
Notes/Feasibility: Private property. Possible opportunity on vacant/open areas at Dewey/Hamilton SW corner? DEC Basin Planner stated ERP will not fund stabilization-only work – explore further drainage area/upland priorities. 3-4 % slope.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Private	New BMP / Retrofit Existing: New BMP																		
Land Use Type: Single Family Residential (< 1 ac. lots)	Proposed Retrofit Practice(s): Ditch stabilized with stone lining (> 5-8% slope), Culvert repair or replacement, Outfall stabilization, Plunge Pool, Stream steps																		
Land Use Detail:	Non-Structural Controls:																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Low																		
Sources/pollutants: Sediment, nutrients	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: No</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: Yes</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair: Yes</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: Yes</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: No	Soils: No	Water Quality: Yes	Access: Yes	Recharge: No	Land Use: Yes	Demonstration: No	Utilities:	Repair: Yes	Polluted: No	Reuse: No	High WT:	Other:	Wetlands: Yes		Other:
Benefits:		Conflicts:																	
Storage: No		Soils: No																	
Water Quality: Yes		Access: Yes																	
Recharge: No		Land Use: Yes																	
Demonstration: No	Utilities:																		
Repair: Yes	Polluted: No																		
Reuse: No	High WT:																		
Other:	Wetlands: Yes																		
	Other:																		
Soils: Buxton, (BxE) D; WT 1.5 - 2'																			
Use in Retrofit DA: Pitched Residential Roof, Paved Road, Low Traffic, Lawn, Low Compaction																			
SIZING INFORMATION																			
Drainage Area (ac): 18.44																			
Impervious Area (ac): 4.24																			
Practice Area Available (ft²): 6,000																			
Existing Head Available? N/A																			

Date: 05/04/2018 08:44 AM

Assessed by: Gabe Bolin

ID# 2, Image 1



ID# 2, Image 2



ID# 2, Image 3



ID# 2, Image 4



ID#: 3																			
Name: Private farm culvert on Hamilton Place Ext.																			
Concept Description: Install stone splash pad, check dams to slow flow and reduce erosion. Potentially include plantings to increase channel roughness, slow down flow and promote storage and infiltration, where feasible.																			
Notes/Feasibility Private property. Met owner, talks were positive and at this point, he's on board with the project. Project most appropriate for NRCS funding if owner qualifies, MRGP if doesn't qualify. Property may not qualify as a farm – it is our understanding owner is a landscaper, not a farmer.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Private	Project Candidate: Yes																		
Land Use Type: Single family residential, agriculture (?)	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Ditch stabilized with stone lining (>5-8% slope), Culvert headwall repair, Check Dam																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment, potential fertilizer inputs (e.g., athletic fields, golf courses, farms)	Maintenance Burden: Low																		
Soils: Buxton, (BxE) D; WT 1.5 - 2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: No</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: Yes</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: No</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: No	Soils: No	Water Quality: Yes	Access: Yes	Recharge: No	Land Use: No	Demonstration: No	Utilities:	Repair:	Polluted: No	Reuse: No	High WT: No	Other:	Wetlands:		Other:
Benefits:		Conflicts:																	
Storage: No		Soils: No																	
Water Quality: Yes		Access: Yes																	
Recharge: No		Land Use: No																	
Demonstration: No	Utilities:																		
Repair:	Polluted: No																		
Reuse: No	High WT: No																		
Other:	Wetlands:																		
	Other:																		
Use in Retrofit DA: Paved Road, Lawn, Low Compaction, Pitched Residential Roof																			
SIZING INFORMATION																			
Drainage Area (ac): 8.23																			
Impervious Area (ac): 0.49																			
Practice Area Available (ft²): 4,000																			
Existing Head Available? N/A																			

Date: 05/04/2018 08:44 AM

Assessed by: Branden Martin

ID# 3, Image 1



ID# 3, Image 2



ID# 3, Image 3



ID#: 4																			
Name: North Ave and River St. @ Missisquoi River																			
Concept Description: Open space in line with North Avenue at river shows evidence of rill erosion. Install gravel wetland in adjacent town owned land (park to the west) to accept flow from existing SW piping system. Also consider swirl separator in place of catch basin directly upstream. Restore bank and riparian area along river; include armoring at outfall pipe.																			
Notes/Feasibility: Area constrained by River Corridor and existing Flood Control Project by USACOE. Follow-up needed with DEC Rivers Program and Stream Alteration engineer. If project in floodplain not possible, consider only a swirl separator in River Street or North Ave to remove sediment.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public	Project Candidate: Yes																		
Land Use Type: Single family residential, open space	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Rill erosion repair (1"-11" erosion depth), Outfall stabilization, Bioretention, stormceptor, gravel wetland																		
Existing BMP on Site? No	Non-Structural Controls: Educational signage																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Low																		
Soils: Munson, (MuB) C/D; WT 0.5 - 2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: Yes</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: Yes</td> </tr> <tr> <td>Other:</td> <td>Wetlands: Yes</td> </tr> <tr> <td></td> <td>Other: Floodplain</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: Yes	Water Quality: Yes	Access: No	Recharge: No	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted:	Reuse: No	High WT: Yes	Other:	Wetlands: Yes		Other: Floodplain
Benefits:		Conflicts:																	
Storage: Yes		Soils: Yes																	
Water Quality: Yes		Access: No																	
Recharge: No		Land Use: No																	
Demonstration: Yes	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT: Yes																		
Other:	Wetlands: Yes																		
	Other: Floodplain																		
Use in Retrofit DA: Paved Road, Low Traffic, Lawn, Compacted																			
SIZING INFORMATION																			
Drainage Area (ac): 8.73																			
Impervious Area (ac): 3.10																			
Practice Area Available (ft²): 1,000																			
Existing Head Available? ~1-2'																			

ID# 4, Image 1



ID# 4, Image 2



ID# 4, Image 3



ID# 4, Image 4



ID#: 5																			
Name: Vista Park																			
Concept Description: Disconnect the outfall that discharges to the river in this location and send flow to a proposed bioretention basin in the park across the road from Vista Supermarket and the fire station. A large portion of the closed drainage along Main Street is directed to this location. Town informed us on 7/5 that park is privately owned. Use of outfall may not be feasible.																			
Notes/Feasibility: It is unclear if we have adequate depth to get water to daylight before outlet. To be assessed further, as needed, via 'Richford Renaissance' permit, Stone's IDDE report and any available infrastructure information.																			
GENERAL SITE INFORMATION	RETROFIT DETAILS																		
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Private	New BMP / Retrofit Existing: New BMP – unknown. Another may already exist.																		
Land Use Type: Transport-Related (roadway or ROW), Park	Proposed Retrofit Practice(s): Bioretention, Gravel Wetland																		
Land Use Detail:	Non-Structural Controls: Educational signage																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Low																		
Sources/pollutants: Sediment																			
Soils: Ondawa, (Od) B; WT '1'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: Yes</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other: Mapped river corridor</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: No	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted: Yes	Reuse: No	High WT:	Other:	Wetlands: No		Other: Mapped river corridor
Benefits:		Conflicts:																	
Storage: Yes	Soils: No																		
Water Quality: Yes	Access: No																		
Recharge: No	Land Use: No																		
Demonstration: Yes	Utilities:																		
Repair:	Polluted: Yes																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other: Mapped river corridor																		
Use in Retrofit DA: Urban Roof, Pitched Residential Roof, Commercial Roof, Commercial/Industrial Parking, Paved Road, High Traffic, Paved Parking or Driveway																			
SIZING INFORMATION																			
Drainage Area (ac): 6.46																			
Impervious Area (ac): 3.81																			
Practice Area Available (ft²): 2,500																			
Existing Head Available? To be determined																			

Date: 05/04/2018 08:44 AM

Assessed by: Branden Martin

ID# 5, Image 1



ID# 5, Image 2



ID# 5, Image 3



ID# 5, Image 4



ID#: 6																			
Name: Bioswale Across From Vista Supermarket																			
Concept Description: Install a bioswale between the parking lot and sidewalk across the road from Vista Supermarket. Grade the parking lot to drain to swale.																			
Notes/Feasibility: Consider installing multiple stages to make maintenance easier. Also consider underdrain. On 7/5 the Town informed us that there may be a tunnel under the road at this location, and that the parking lot is owned by the Peoples Trust Bank.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public/private	Project Candidate: Yes																		
Land Use Type: Transport-Related (roadway or ROW), Multi-family Residential	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Bioretention, Basin, Dry Swale, Rain Garden																		
Existing BMP on Site? No	Non-Structural Controls: Educational signage																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Moderate																		
Soils: Ondawa, (Od) B; WT '1'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: Yes</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other: Mapped river corridor</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: No	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted: Yes	Reuse: No	High WT:	Other:	Wetlands:		Other: Mapped river corridor
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: No		Land Use: No																	
Demonstration: Yes	Utilities:																		
Repair:	Polluted: Yes																		
Reuse: No	High WT:																		
Other:	Wetlands:																		
	Other: Mapped river corridor																		
Use in Retrofit DA: Gravel or Compacted Parking or Driveway, Lawn, Low Compaction, Multi-Family Roof																			
SIZING INFORMATION																			
Drainage Area (ac): 0.20																			
Impervious Area (ac): 0.17																			
Practice Area Available (ft²): 400																			
Existing Head Available? <1'																			

Date: 05/04/2018 08:44 AM

Assessed by: Gabe Bolin

ID# 6, Image 1



ID# 6, Image 2



ID# 6, Image 3



ID#: 7																			
Name: Powell St. bump out																			
Concept Description: Small bump out proposed in front of Richford Community Housing (10 to 12 Powell St.), to collect sediment running down road.																			
Notes/Feasibility: Proposed BMP does not include infiltration due to contaminated building on other side of street.																			
GENERAL SITE INFORMATION	RETROFIT DETAILS																		
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Public	New BMP / Retrofit Existing: New BMP																		
Land Use Type: Transport-Related (roadway or ROW), single family residential, commercial	Proposed Retrofit Practice(s): Bioretention, Bump-Out																		
Land Use Detail:	Non-Structural Controls: Educational signage																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Medium																		
Sources/pollutants: Sediment	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: No</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: Yes</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: No	Soils: No	Water Quality: Yes	Access: No	Recharge: No	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted: Yes	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: No		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: No		Land Use: No																	
Demonstration: Yes	Utilities:																		
Repair:	Polluted: Yes																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Soils: Ondawa, (Od) B; WT '1'																			
Use in Retrofit DA: Gravel or Compacted Parking or Driveway, Paved Road, Low Traffic																			
SIZING INFORMATION																			
Drainage Area (ac): 0.94																			
Impervious Area (ac): 0.40																			
Practice Area Available (ft²): 200																			
Existing Head Available? N/A																			

Date: 05/01/2018 12:19 PM

Assessed by: Gabe Bolin

ID# 7, Image 1





ID# 7, Image 3



ID#: 8																			
Name: Vista Supermarket back parking lot																			
Concept Description: Install sediment basin at low point in parking lot to capture and manage sediment load being delivered to river. Potentially disconnect existing catch basin to capture more sediment. Act 250 documentation indicates a detention pond was proposed west of this area ~2005. The feature was not observed during site visit, due to the basin being completely filled with sediment.																			
Notes/Feasibility: Enlarging the existing basin would require removal of parking spaces. Do not infiltrate due to potential subsurface contamination; consider swirl separator to remove sediment. Act 250 permit 6F0538 and associated letter to VTDEC (2005) indicates entire site included 1.1 ac impervious but no permit required.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Private	Project Candidate: Yes																		
Land Use Type: Commercial	New BMP / Retrofit Existing: Retrofit Existing BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Pre-treatment Forebay, Dry Detention Pond, Bioretention Basin, Swirl Separator																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Moderate																		
Soils: Ondawa, (Od) B; WT '1'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: Yes</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: Yes</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other: Mapped river corridor</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: Yes	Recharge: No	Land Use: Yes	Demonstration: No	Utilities:	Repair:	Polluted: Yes	Reuse: No	High WT:	Other:	Wetlands:		Other: Mapped river corridor
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: Yes																	
Recharge: No		Land Use: Yes																	
Demonstration: No		Utilities:																	
Repair:	Polluted: Yes																		
Reuse: No	High WT:																		
Other:	Wetlands:																		
	Other: Mapped river corridor																		
Use in Retrofit DA: Commercial/Industrial Parking, Paved Parking or Driveway, Commercial Roof																			
SIZING INFORMATION																			
Drainage Area (ac): 2.12																			
Impervious Area (ac): 0.55																			
Practice Area Available (ft²): 900																			
Existing Head Available? 2', potentially more																			

Date: 05/04/2018 08:44 AM

Assessed by: Branden Martin

ID# 8, Image 1



ID# 8, Image 2



ID# 8, Image 3



ID# 8, Image 4



ID# 8, Image 5



ID# 8, Image 6



ID#: 9																			
Name: TD Bank Bioretention																			
Concept Description: Bioretention practice to capture flow and sediment off Main St. and bank parking lot. Restore bank where rill erosion has occurred, via appropriate methods (plantings or armoring).																			
Notes/Feasibility: Design to prevent infiltration due to adjacent gas station. Be aware of soft bank soils when designing discharge. On 7/5 the Town provided limits of their approximate ROW. See Image 2 below.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Private and public, see Image 2 below	Project Candidate: Yes																		
Land Use Type: Commercial	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Rill erosion repair (1"-11" erosion depth), Bioretention, Basin																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Medium																		
Soils: Windsor, (WsB) A; WT '1'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: Potentially</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other: Mapped river corridor</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: Yes	Demonstration: No	Utilities:	Repair:	Polluted: Potentially	Reuse: No	High WT:	Other:	Wetlands:		Other: Mapped river corridor
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes	Land Use: Yes																		
Demonstration: No	Utilities:																		
Repair:	Polluted: Potentially																		
Reuse: No	High WT:																		
Other:	Wetlands:																		
	Other: Mapped river corridor																		
Use in Retrofit DA: Commercial Roof, Commercial/Industrial Parking, Paved Road, Moderate Traffic																			
SIZING INFORMATION																			
Drainage Area (ac): 0.63																			
Impervious Area (ac): 0.52																			
Practice Area Available (ft²): 1,250																			
Existing Head Available? ~4-5'																			

Date: 05/01/2018 12:53 PM

Assessed by: Gabe Bolin

ID# 9, Image 1



ID# 9, Image 2





ID#: 10																			
Name: Town Hall Bump Out																			
Concept Description: Install up to 4 bump outs in front of town hall entrance. Install over existing storm system to increase infiltration.																			
Notes/Feasibility: Consider capping or removing existing grate inlet at Town Hall entrance.																			
GENERAL SITE INFORMATION	RETROFIT DETAILS																		
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Public	New BMP / Retrofit Existing: New BMP																		
Land Use Type: Transport-Related (roadway or ROW), commercial	Proposed Retrofit Practice(s): Bioretention, Bump-Out																		
Land Use Detail:	Non-Structural Controls: Educational signage																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Medium																		
Sources/pollutants: Sediment	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted: No	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes	Land Use: No																		
Demonstration: Yes	Utilities:																		
Repair:	Polluted: No																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Soils: Windsor, (WsB) A; WT '1'																			
Use in Retrofit DA: Commercial Roof, Commercial/Industrial Parking, Paved Road, Moderate Traffic, Lawn, Compacted																			
SIZING INFORMATION																			
Drainage Area (ac): 0.95																			
Impervious Area (ac): 0.48																			
Practice Area Available (ft²): 250																			
Existing Head Available? ~5'																			

Date: 05/01/2018 01:10 PM

Assessed by: Gabe Bolin

ID# 10, Image 1

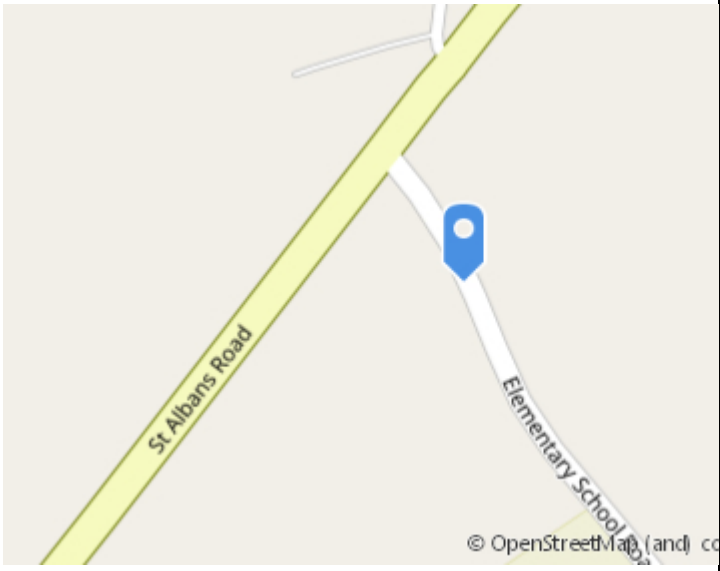


ID# 10, Image 2



ID# 10, Image 3



ID#: 11																			
Name: Richford Elementary Project #1																			
Concept Description: Install bioswale along school access road to capture and treat runoff. Upsize culvert under the access road - it's significantly rusted out and under sized.																			
Notes/Feasibility: Bank full width at this channel is 4-5'. Is the school subject to a 3-acre permit? What are they required to treat? Could be addressed by 1 project.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public	Project Candidate: Yes																		
Land Use Type: Educational, Transport-Related (roadway or ROW)	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Bioretention, Dry Swale																		
Existing BMP on Site? No	Non-Structural Controls: Educational signage																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediments	Maintenance Burden: Medium																		
Soils: Rumney (Ru), B/D; WT 0-1.5'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: Yes</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: Yes</td> </tr> <tr> <td>Other: Potential fish/AOP passage benefits – 1 other crossing between this site and Missisquoi River, at Rt. 105 (and it's sized well)</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: Yes	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: Yes	Demonstration: Yes	Utilities:	Repair:	Polluted: No	Reuse: No	High WT: Yes	Other: Potential fish/AOP passage benefits – 1 other crossing between this site and Missisquoi River, at Rt. 105 (and it's sized well)	Wetlands:		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: Yes																	
Water Quality: Yes		Access: No																	
Recharge: Yes		Land Use: Yes																	
Demonstration: Yes	Utilities:																		
Repair:	Polluted: No																		
Reuse: No	High WT: Yes																		
Other: Potential fish/AOP passage benefits – 1 other crossing between this site and Missisquoi River, at Rt. 105 (and it's sized well)	Wetlands:																		
	Other:																		
Use in Retrofit DA: Paved Parking or Driveway, Lawn, School or Institutional Campus																			
SIZING INFORMATION																			
Drainage Area (ac): 89.90																			
Impervious Area (ac): 12.25																			
Practice Area Available (ft²): 2,500																			
Existing Head Available? ~1-2'																			

Date: 05/04/2018 08:43 AM

Assessed by: Branden Martin

ID# 11, Image 1



ID# 11, Image 2



ID# 11, Image 3



ID# 11, Image 4





ID#: 12																			
Name: Noyes Street Swale																			
Concept Description: Just upstream of Larry's Auto. Install swale along road, include vegetation and check dams. Possibly also replace culvert at drive just up road from swale.																			
Notes/Feasibility: Currently there is ~160' of erosion along edge of road up from swale, 2-5" wide. Town wants to place stone along this ditch but there is resistance from landowners.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public and private	Project Candidate: Yes																		
Land Use Type: Single Family Residential (< 1 ac. lots), Commercial, Transport-Related (roadway or ROW)	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Rill erosion repair (1"-11" erosion depth), Check Dam, Bioretention, Dry Swale																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Medium																		
Soils: Missisquoi (MsD), A; WT 'L'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: No	Demonstration: No	Utilities:	Repair:	Polluted:	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes	Land Use: No																		
Demonstration: No	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Use in Retrofit DA: Paved Parking or Driveway, Gravel or Compacted Parking or Driveway, Paved Road, Low Traffic, Lawn, Compacted																			
SIZING INFORMATION																			
Drainage Area (ac): 1.98																			
Impervious Area (ac): 0.47																			
Practice Area Available (ft²): 1,000																			
Existing Head Available? ~3-4'																			

Date: 05/01/2018 05:21 PM

Assessed by: Gabe Bolin

ID# 12, Image 1



ID# 12, Image 2





ID#: 13																																					
Name: Center Street bioretention																																					
Concept Description: Capture road and driveway runoff and send to a 20' x 30' bioretention, if soils don't conflict. If infeasible, create water features for water quality and incorporate park elements.																																					
Notes/Feasibility: Determine ownership of the field – Town informed us on 7/5 that this is privately owned land. Also stated that soils may have low infiltration capacity, despite what was provided in the soil survey.																																					
GENERAL SITE INFORMATION																																					
Site Contact Info: Town of Richford	Project Candidate: Yes																																				
Ownership: Private	New BMP / Retrofit Existing: New BMP																																				
Land Use Type: Single Family Residential (< 1 ac. lots), Transport-Related (roadway or ROW)	Proposed Retrofit Practice(s): Bioretention																																				
Land Use Detail:	Non-Structural Controls: Educational signage																																				
Existing BMP on Site? No	Non-Structural Other:																																				
Is site a hotspot? No	Maintenance Burden: Medium																																				
Sources/pollutants: Sediment																																					
Soils: Missisquoi (MsD), A; WT 'L'	<table border="1"> <tr> <td>Benefits:</td> <td></td> <td>Conflicts:</td> <td></td> </tr> <tr> <td>Storage: Yes</td> <td></td> <td>Soils: TBD</td> <td></td> </tr> <tr> <td>Water Quality: Yes</td> <td></td> <td>Access: No</td> <td></td> </tr> <tr> <td>Recharge: TBD</td> <td></td> <td>Land Use: No</td> <td></td> </tr> <tr> <td>Demonstration: Yes</td> <td></td> <td>Utilities:</td> <td></td> </tr> <tr> <td>Repair:</td> <td></td> <td>Polluted:</td> <td></td> </tr> <tr> <td>Reuse: No</td> <td></td> <td>High WT:</td> <td></td> </tr> <tr> <td>Other:</td> <td></td> <td>Wetlands:</td> <td></td> </tr> <tr> <td></td> <td></td> <td>Other:</td> <td></td> </tr> </table>	Benefits:		Conflicts:		Storage: Yes		Soils: TBD		Water Quality: Yes		Access: No		Recharge: TBD		Land Use: No		Demonstration: Yes		Utilities:		Repair:		Polluted:		Reuse: No		High WT:		Other:		Wetlands:				Other:	
Benefits:			Conflicts:																																		
Storage: Yes		Soils: TBD																																			
Water Quality: Yes		Access: No																																			
Recharge: TBD		Land Use: No																																			
Demonstration: Yes		Utilities:																																			
Repair:		Polluted:																																			
Reuse: No		High WT:																																			
Other:		Wetlands:																																			
		Other:																																			
Use in Retrofit DA: Pitched Residential Roof, Paved Parking or Driveway, Gravel or Compacted Parking or Driveway, Paved Road, Low Traffic, Lawn, Low Compaction																																					
SIZING INFORMATION																																					
Drainage Area (ac): 3.55																																					
Impervious Area (ac): 0.87																																					
Practice Area Available (ft²): 1,200																																					
Existing Head Available? ~1-2'																																					

Date: 05/01/2018 05:20 PM

Assessed by: Branden Martin

ID# 13, Image 1



ID# 13, Image 2



ID#: 14																			
Name: Center Street bump outs																			
Concept Description: Install traffic calming bump outs to infiltrate and remove runoff from the existing closed drainage network.																			
Notes/Feasibility: Confirm elevation of water table.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public	Project Candidate: Yes																		
Land Use Type: Single Family Residential (<1 ac. lots), Transport-Related (roadway or ROW)	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Bioretention, Bump-Out																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Low																		
Soils: Missisquoi (MsD), A; WT '1'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: No	Demonstration: No	Utilities:	Repair:	Polluted: No	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes		Land Use: No																	
Demonstration: No	Utilities:																		
Repair:	Polluted: No																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Use in Retrofit DA: Pitched Residential Roof, Paved Road, Moderate Traffic, Lawn, Low Compaction																			
SIZING INFORMATION																			
Drainage Area (ac): 4.95																			
Impervious Area (ac): 0.96																			
Practice Area Available (ft²): 200																			
Existing Head Available? ~1-2'																			

Date: 05/04/2018 08:43 AM

Assessed by: Branden Martin

ID# 14, Image 1





ID#: 15																			
Name: Troy St. and Main St.																			
Concept Description: Install bump out or curb cut bioretention at the park located near the intersection of Troy and Main Streets.																			
Notes/Feasibility: Utility conflicts. Electric and water utilities visible. Town informed us on 7/5 that these utilities serve only the adjacent park and should be easy to move/relocate.																			
GENERAL SITE INFORMATION	RETROFIT DETAILS																		
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Public	New BMP / Retrofit Existing: New BMP																		
Land Use Type: Park, Transport-Related (roadway or ROW)	Proposed Retrofit Practice(s): Bioretention, Curb Cut, Bump-Out																		
Land Use Detail:	Non-Structural Controls: Educational signage																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Medium																		
Sources/pollutants: Sediment	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities: Yes</td> </tr> <tr> <td>Repair:</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: No	Demonstration: Yes	Utilities: Yes	Repair:	Polluted: No	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes	Land Use: No																		
Demonstration: Yes	Utilities: Yes																		
Repair:	Polluted: No																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Soils: Windsor, (WsB) A; WT '1'																			
Use in Retrofit DA: Commercial Roof, Commercial/Industrial Parking, Paved Road, Moderate Traffic, Lawn, Compacted																			
SIZING INFORMATION																			
Drainage Area (ac): 0.75																			
Impervious Area (ac): 0.27																			
Practice Area Available (ft²): 500																			
Existing Head Available? ~1-2'																			

Date: 05/04/2018 08:43 AM

Assessed by: Branden Martin

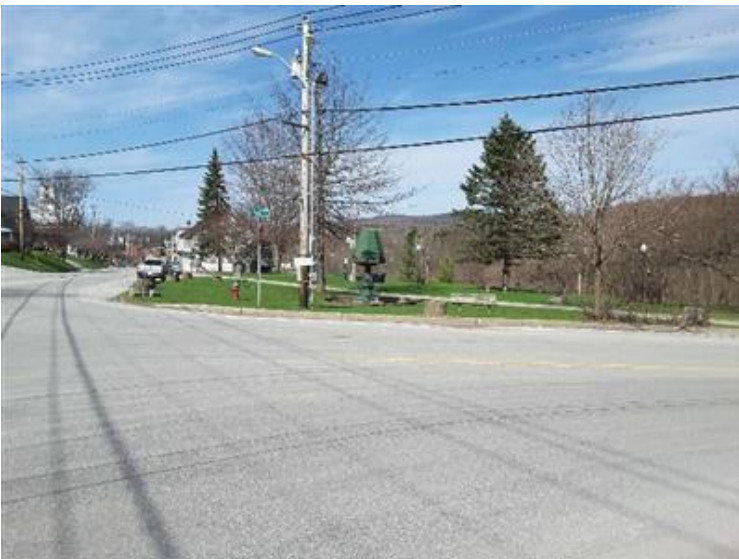
ID# 15, Image 1



ID# 15, Image 2



ID# 15, Image 3



ID#: 17																			
Name: Rt. 105 Paved Swale																			
Concept Description: Remove paved swale along western portion of roadway. Install stone and check dams within footprint of existing swale, 285' along Vermont 105. Stone line the corner at Maple Street. Also clean sediment and re-vegetate 120' of swale along Maple Street.																			
Notes/Feasibility:																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public	Project Candidate: Yes																		
Land Use Type: Single Family Residential (< 1 ac. lots), Transport-Related (roadway or ROW), Medium Traffic	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Ditch stabilized with stone lining (<8% slope), Check Dam																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Medium																		
Soils: Munson (MuB), C/D; WT 0.5-2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: No</td> <td>Soils: Yes</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: Yes</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: No	Soils: Yes	Water Quality: Yes	Access: No	Recharge: No	Land Use: Yes	Demonstration: No	Utilities:	Repair:	Polluted:	Reuse: No	High WT: Yes	Other:	Wetlands:		Other:
Benefits:		Conflicts:																	
Storage: No		Soils: Yes																	
Water Quality: Yes		Access: No																	
Recharge: No		Land Use: Yes																	
Demonstration: No	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT: Yes																		
Other:	Wetlands:																		
	Other:																		
Use in Retrofit DA: Pitched Residential Roof																			
SIZING INFORMATION																			
Drainage Area (ac): 1.63																			
Impervious Area (ac): 0.42																			
Practice Area Available (ft²): 2,500																			
Existing Head Available? N/A																			

Date: 05/04/2018 08:43 AM

Assessed by: Branden Martin

ID# 17, Image 1



ID# 17, Image 2



ID# 17, Image 3



ID# 17, Image 4



ID# 17, Image 5



ID# 17, Image 6



ID#: 18																			
Name: Maple Street Swale																			
Concept Description: Homeowner saying swale floods both adjacent properties often. Enlarge swale, stabilize with stone and vegetation. Improve channel geometry at outlet (around Mobil parking lot) to promote better flow through system.																			
Notes/Feasibility: Swale is ~130' straight shot to Mobil property boundary, then curves around parking lot to wetlands, another ~100'.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Private	Project Candidate: Yes																		
Land Use Type: Single Family Residential (< 1 ac. lots), Transport-Related (roadway or ROW), Commercial	New BMP / Retrofit Existing: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Ditch stabilized with vegetation (< 5% slope)																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Low																		
Soils: Munson (MuB), C/D; WT 0.5-2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: Yes</td> </tr> <tr> <td>Recharge: No</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: Yes</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: Yes	Recharge: No	Land Use: Yes	Demonstration: No	Utilities:	Repair:	Polluted:	Reuse: No	High WT: Yes	Other:	Wetlands:		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: Yes																	
Recharge: No	Land Use: Yes																		
Demonstration: No	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT: Yes																		
Other:	Wetlands:																		
	Other:																		
Use in Retrofit DA: Pitched Residential Roof, Commercial/Industrial Parking, Paved Road, Low Traffic, Lawn, Low Compaction																			
SIZING INFORMATION																			
Drainage Area (ac): 3.12																			
Impervious Area (ac): 0.55																			
Practice Area Available (ft²): 2,000																			
Existing Head Available? N/A																			

Date: 05/01/2018 05:19 PM

Assessed by: Gabe Bolin

ID# 18, Image 1



ID# 18, Image 2



ID# 18, Image 3






ID#: 31																			
Name: Main St. Bumpout # 2																			
Concept Description: Additional Main St. bump outs.																			
Notes/Feasibility: This project is south of ID# 10 (Town Hall Bumpout) but north of ID# 32.																			
GENERAL SITE INFORMATION	RETROFIT DETAILS																		
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Public	New BMP / Retrofit Existing: New BMP																		
Land Use Type: Transport-Related (roadway or ROW), commercial	Proposed Retrofit Practice(s): Bioretention, Bump-Out																		
Land Use Detail:	Non-Structural Controls: Educational signage																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Medium																		
Sources/pollutants: Sediment	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted:	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes	Land Use: No																		
Demonstration: Yes	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Soils: Windsor, (WsB) A; WT 'L'																			
Use in Retrofit DA: Commercial Roof, Commercial/Industrial Parking, Paved Road, Moderate Traffic, Lawn, Compacted																			
SIZING INFORMATION																			
Drainage Area (ac): 0.83																			
Impervious Area (ac): 0.15																			
Practice Area Available (ft²): 125																			
Existing Head Available? ~2'																			

Date: 05/29/2018 09:19 AM

Assessed by: Gabe Bolin

ID#: 32																			
Name: Main Street Bumpout #3																			
Concept Description: Additional Main St. bump outs.																			
Notes/Feasibility: This project is south of both ID# 10 (Town Hall Bumpout) and ID# 31.																			
GENERAL SITE INFORMATION	RETROFIT DETAILS																		
Site Contact Info: Town of Richford	Project Candidate: Yes																		
Ownership: Public	New BMP / Retrofit Existing: New BMP																		
Land Use Type: Transport-Related (roadway or ROW), commercial	Proposed Retrofit Practice(s): Bioretention, Bump-Out																		
Land Use Detail:	Non-Structural Controls: Educational signage																		
Existing BMP on Site? No	Non-Structural Other:																		
Is site a hotspot? No	Maintenance Burden: Medium																		
Sources/pollutants: Sediment	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: No</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT:</td> </tr> <tr> <td>Other:</td> <td>Wetlands: No</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: No	Demonstration: Yes	Utilities:	Repair:	Polluted:	Reuse: No	High WT:	Other:	Wetlands: No		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: No																	
Recharge: Yes	Land Use: No																		
Demonstration: Yes	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT:																		
Other:	Wetlands: No																		
	Other:																		
Soils: Windsor, (WSB) A; WT '1'																			
Use in Retrofit DA: Commercial Roof , Commercial/Industrial Parking , Paved Road, Moderate Traffic , Lawn, Compacted																			
SIZING INFORMATION																			
Drainage Area (ac): 0.75																			
Impervious Area (ac): 0.30																			
Practice Area Available (ft²): 125																			
Existing Head Available? ~2'																			

Date: 05/29/2018 09:22 AM

Assessed by: Gabe Bolin

ID#: 33																			
Name: Missisquoi Trib																			
Concept Description: Moderate to severe active bank erosion on right bank of unnamed stream, tributary to Missisquoi River; left bank and floodplain are stable. Design - stabilize bank and channel with river stone and plantings. Widen channel where needed to accommodate increased watershed flows.																			
Notes/Feasibility: Have to access private property to get to site. Note that project ID# 2 flows directly into this site (it is tributary to this site).																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public/Private	Project Candidate: Yes																		
Land Use Type: Single Family Residential (< 1 ac. lots)	New BMP / Retrofit: New BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Ditch stabilized with stone (>5-8% slope), Gully erosion repair (12"+ erosion), Stream Steps, Plunge Pool																		
Existing BMP on Site? No	Non-Structural Controls:																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment, potential fertilizer inputs (e.g., athletic fields, golf courses, farms)	Maintenance Burden: Low																		
Soils: Munson, (MuB) C/D; WT 0.5 - 2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: No</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: Yes</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: No</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted:</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: No</td> </tr> <tr> <td>Other:</td> <td>Wetlands: Yes</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: No	Water Quality: Yes	Access: Yes	Recharge: Yes	Land Use: Yes	Demonstration: No	Utilities:	Repair:	Polluted:	Reuse: No	High WT: No	Other:	Wetlands: Yes		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: No																	
Water Quality: Yes		Access: Yes																	
Recharge: Yes	Land Use: Yes																		
Demonstration: No	Utilities:																		
Repair:	Polluted:																		
Reuse: No	High WT: No																		
Other:	Wetlands: Yes																		
	Other:																		
Use in Retrofit DA: Paved Road, Low Traffic, Urban Roof, Lawn, Urbanized, Multi-Family Roof																			
SIZING INFORMATION																			
Drainage Area (ac): 31.83																			
Impervious Area (ac): 5.51																			
Practice Area Avail. (ft²): 3,000																			
Existing Head Available? N/A																			

Date: 06/04/2018 04:46 PM

Assessed by: Gabe Bolin

ID# 33, Image 1



ID# 33, Image 2



ID# 33, Image 3



ID# 33, Image 4



ID# 33, Image 5



ID# 33, Image 6

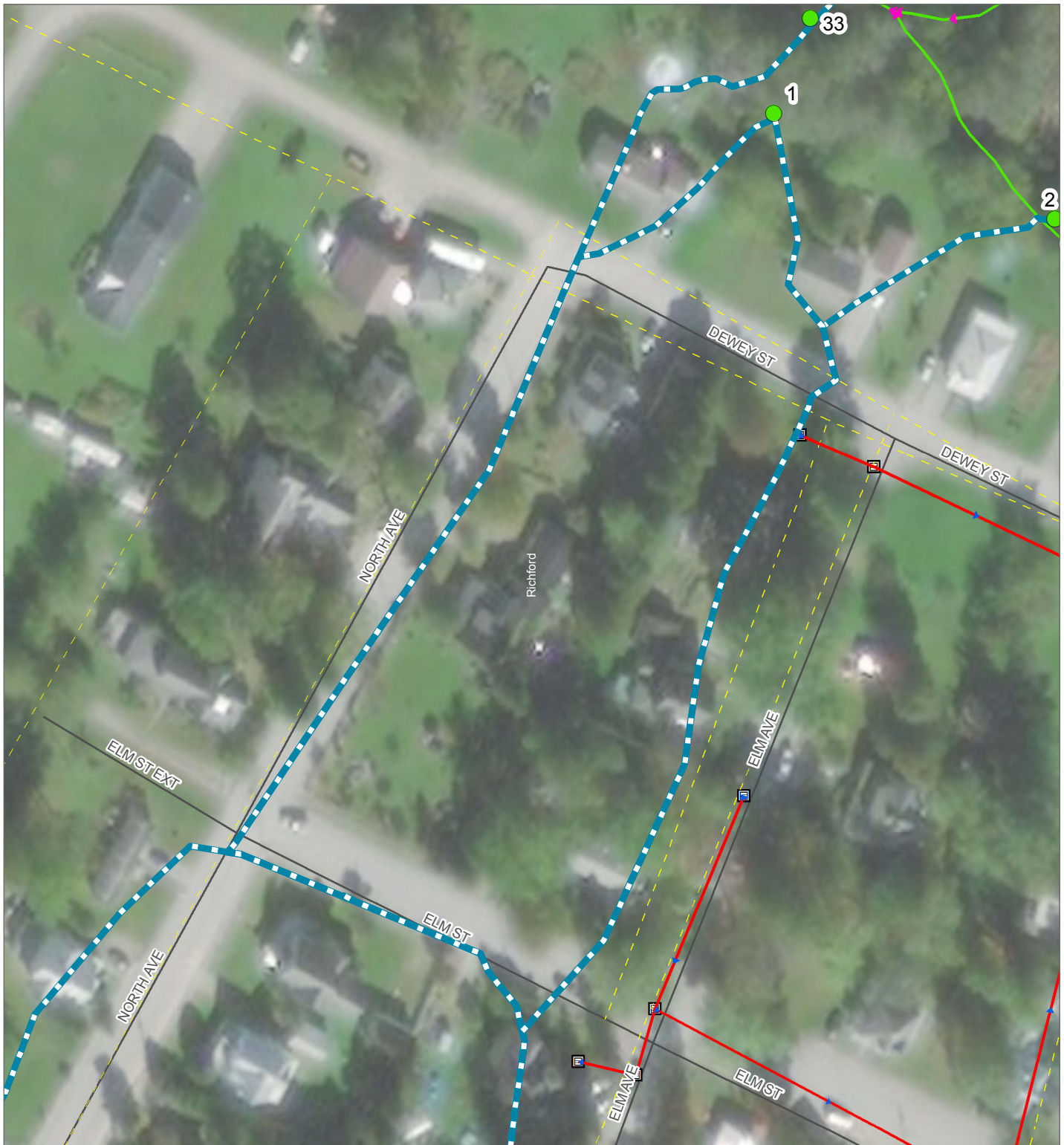


ID#: 34																			
Name: Richford Elementary Project #2																			
Concept Description: Retrofit existing swale that receives runoff from front parking lot with gravel wetland to increase storage, water quality and recharge benefits.																			
Notes/Feasibility: Project could either stand alone or be combined with ID# 11 (Richford Elementary Bioswale) as demonstration projects. Both offer substantial opportunity for infiltration and water quality benefits to 2 different streams that are within close proximity to the Missisquoi River.																			
GENERAL SITE INFORMATION																			
Site Contact Info: Town of Richford	RETROFIT DETAILS																		
Ownership: Public	Project Candidate: Yes																		
Land Use Type: Educational, Transport-Related (roadway or ROW), Parking Lot	New BMP / Retrofit Existing: Retrofit Existing BMP																		
Land Use Detail:	Proposed Retrofit Practice(s): Bioretention																		
Existing BMP on Site? No	Non-Structural Controls: Educational signage																		
Is site a hotspot? No	Non-Structural Other:																		
Sources/pollutants: Sediment	Maintenance Burden: Medium																		
Soils: Rumney, (Ru) B/D; WT 1.5-2'	<table border="1"> <tr> <td>Benefits:</td> <td>Conflicts:</td> </tr> <tr> <td>Storage: Yes</td> <td>Soils: Yes</td> </tr> <tr> <td>Water Quality: Yes</td> <td>Access: No</td> </tr> <tr> <td>Recharge: Yes</td> <td>Land Use: Yes</td> </tr> <tr> <td>Demonstration: Yes</td> <td>Utilities:</td> </tr> <tr> <td>Repair:</td> <td>Polluted: No</td> </tr> <tr> <td>Reuse: No</td> <td>High WT: Yes</td> </tr> <tr> <td>Other:</td> <td>Wetlands:</td> </tr> <tr> <td></td> <td>Other:</td> </tr> </table>	Benefits:	Conflicts:	Storage: Yes	Soils: Yes	Water Quality: Yes	Access: No	Recharge: Yes	Land Use: Yes	Demonstration: Yes	Utilities:	Repair:	Polluted: No	Reuse: No	High WT: Yes	Other:	Wetlands:		Other:
Benefits:		Conflicts:																	
Storage: Yes		Soils: Yes																	
Water Quality: Yes		Access: No																	
Recharge: Yes		Land Use: Yes																	
Demonstration: Yes		Utilities:																	
Repair:	Polluted: No																		
Reuse: No	High WT: Yes																		
Other:	Wetlands:																		
	Other:																		
Use in Retrofit DA: Paved Parking or Driveway, Lawn, School or Institutional Campus																			
SIZING INFORMATION																			
Drainage Area (ac): 2.46																			
Impervious Area (ac): 0.84																			
Practice Area Available (ft²): 2,000																			
Existing Head Available? ~1-2'																			

Date: 07/21/2018 09:00 AM

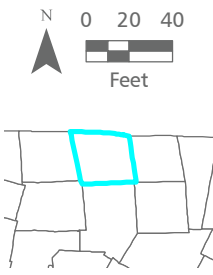
Assessed by: Gabe Bolin

Appendix D. Drainage Area Maps for Identified Problem Areas



LEGEND

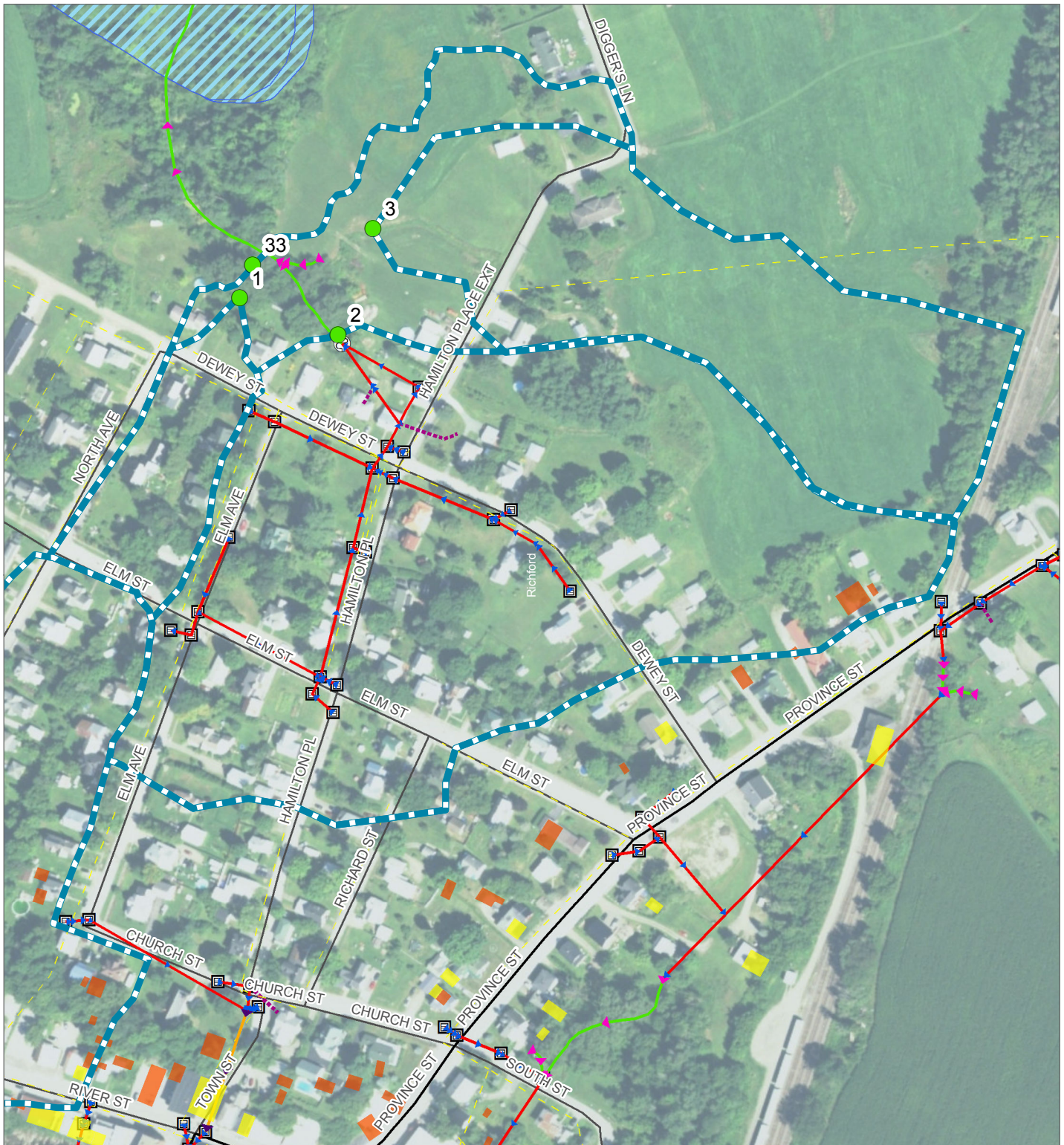
- Retrofit Opportunity Location
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Area 1
North Avenue and Dewey Street
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

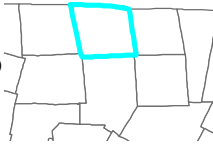
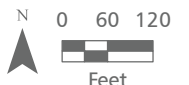
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Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.
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 Saved: 12/18/2018 by AmyM



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Storm line (old Sanitary line)
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Wetlands (VSWI)
- National Boundary (VCGI)
- Retrofit Drainage Area



**Area 2
Upstream Tributary**

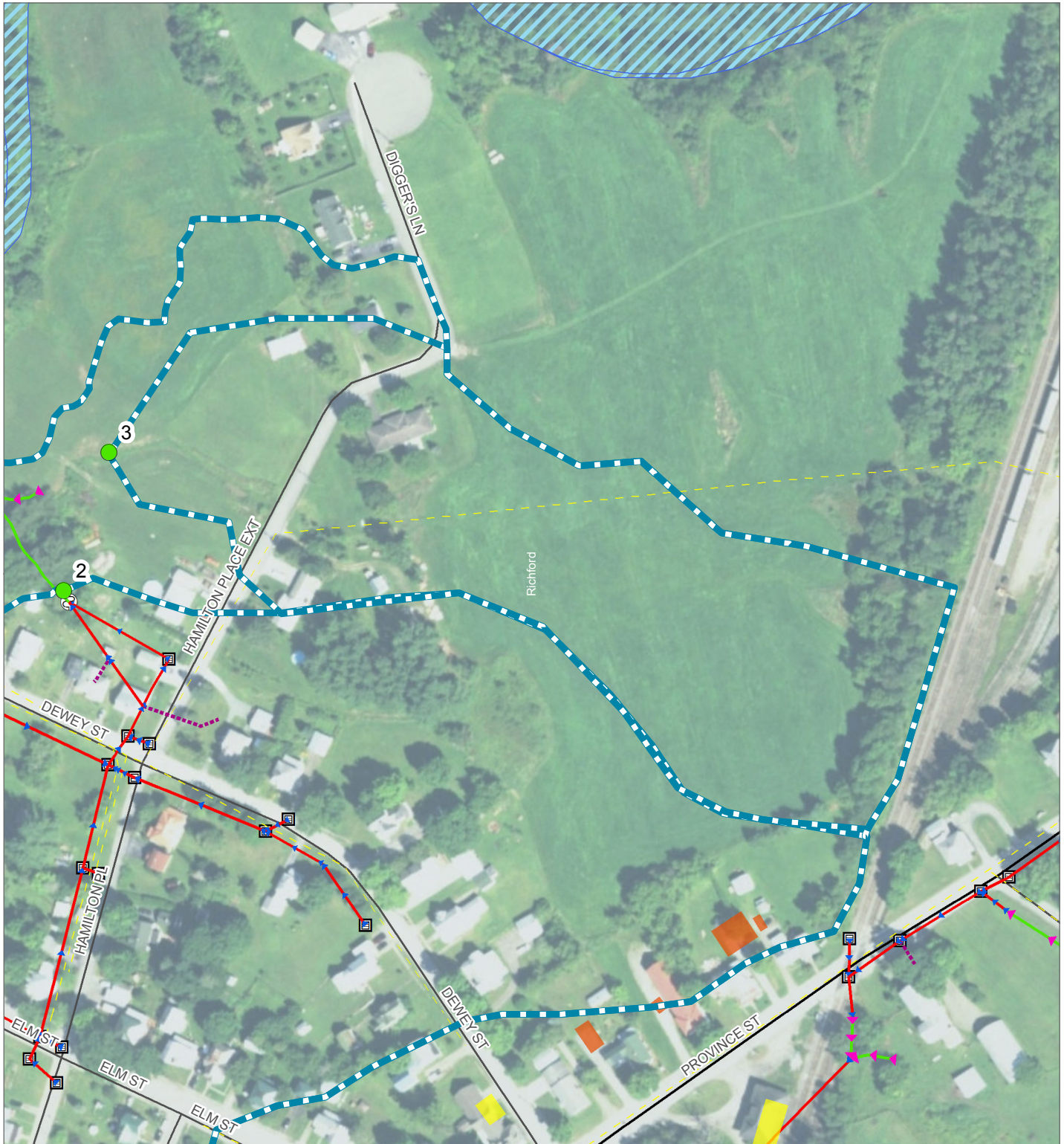
Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

STONE ENVIRONMENTAL

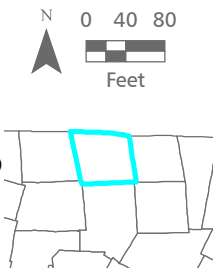
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LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Wetlands (VSWI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

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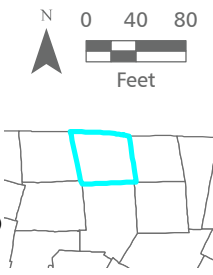
Area 3
Private Farm Culvert on
Hamilton Place Ext.
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Storm line (old Sanitary line)
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Rivers (VCGI)
- Streams (VCGI)
- Wetlands (VSWI)
- National Boundary (VCGI)
- Retrofit Drainage Area

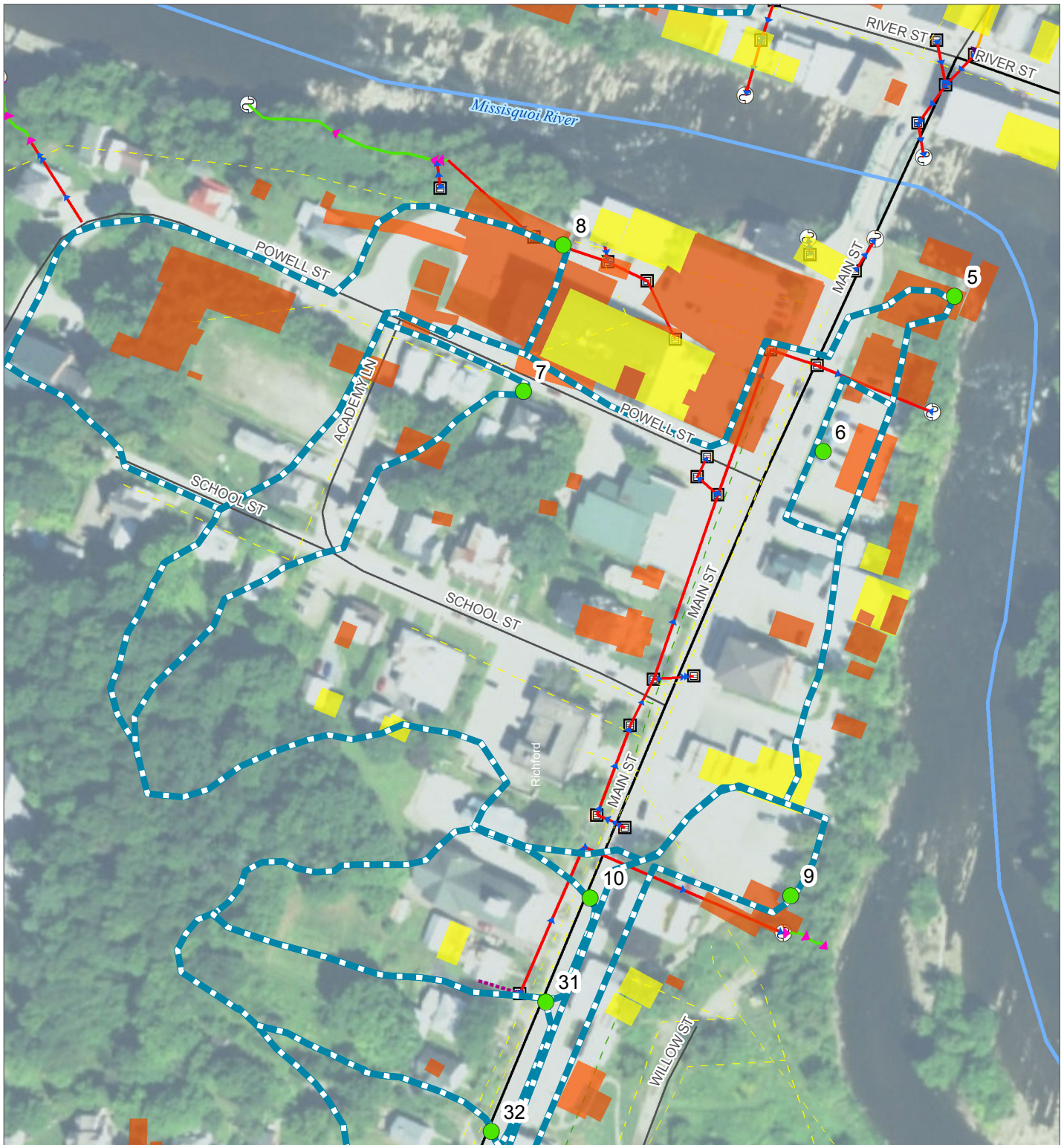


Area 4
North Ave and River St. @
Missisquoi River
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL

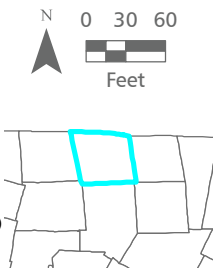
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LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Storm line (old Sanitary line)
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Rivers (VCGI)
- Streams (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

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**Area 5
Vista Park**

Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

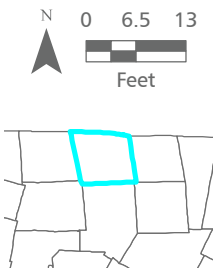
STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Sanitary line
- Existing, Storm line
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

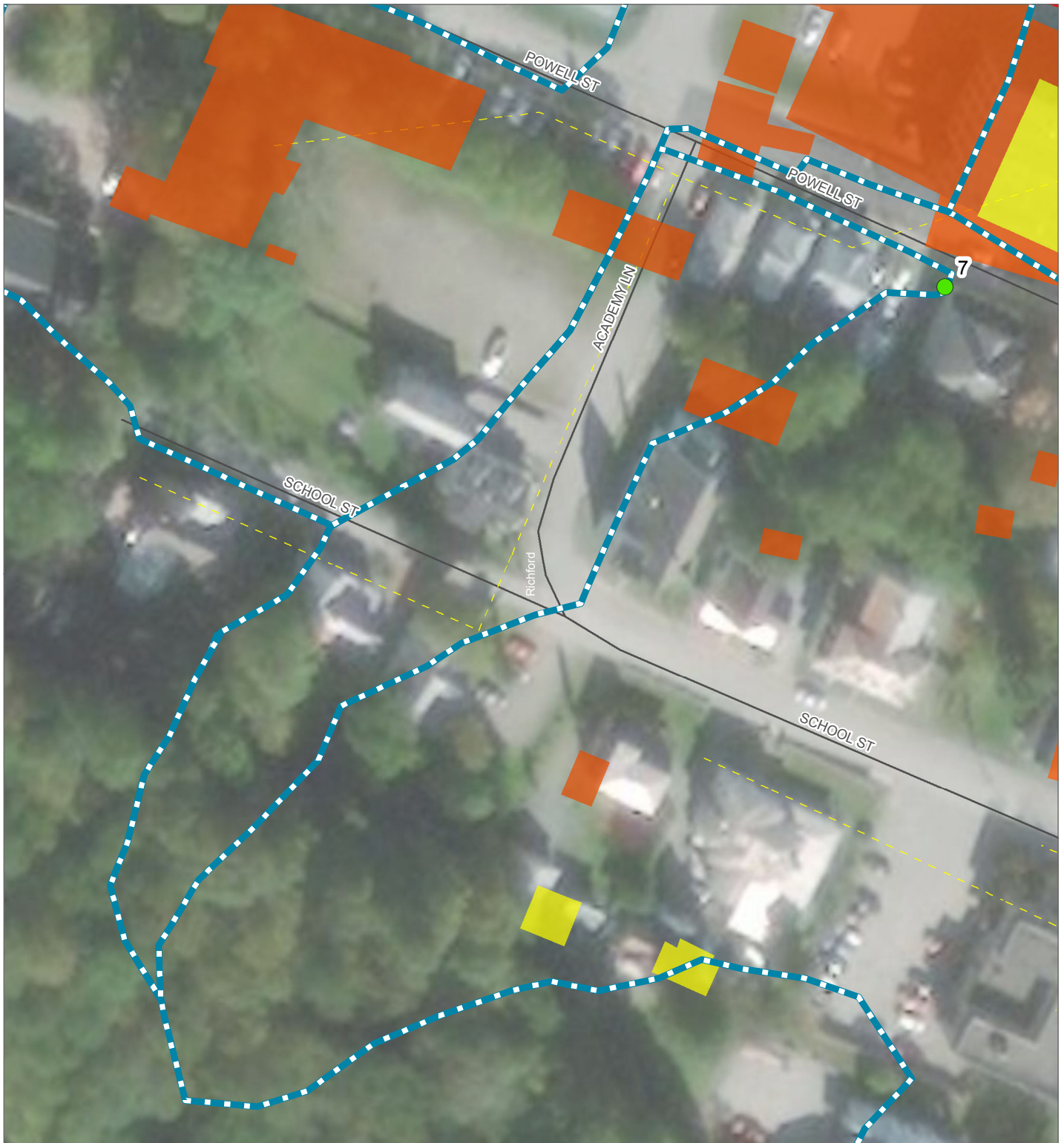
Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.



Area 6
Bioswale Across From Vista Supermarket
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL

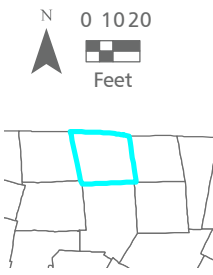
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LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Existing, Sanitary line
- Existing, Storm line
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.



Area 7
Powell St. Bump-Out

Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

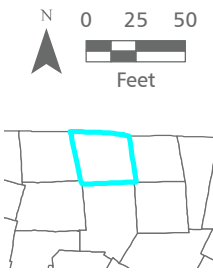
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Saved: 12/18/2018 by AmyM



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- Roads - Local level
- Town Boundary (VCGI)
- Rivers (VCGI)
- Streams (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Area 8
Vista Supermarket Back
Parking Lot
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

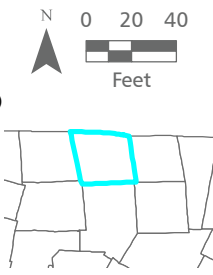
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LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

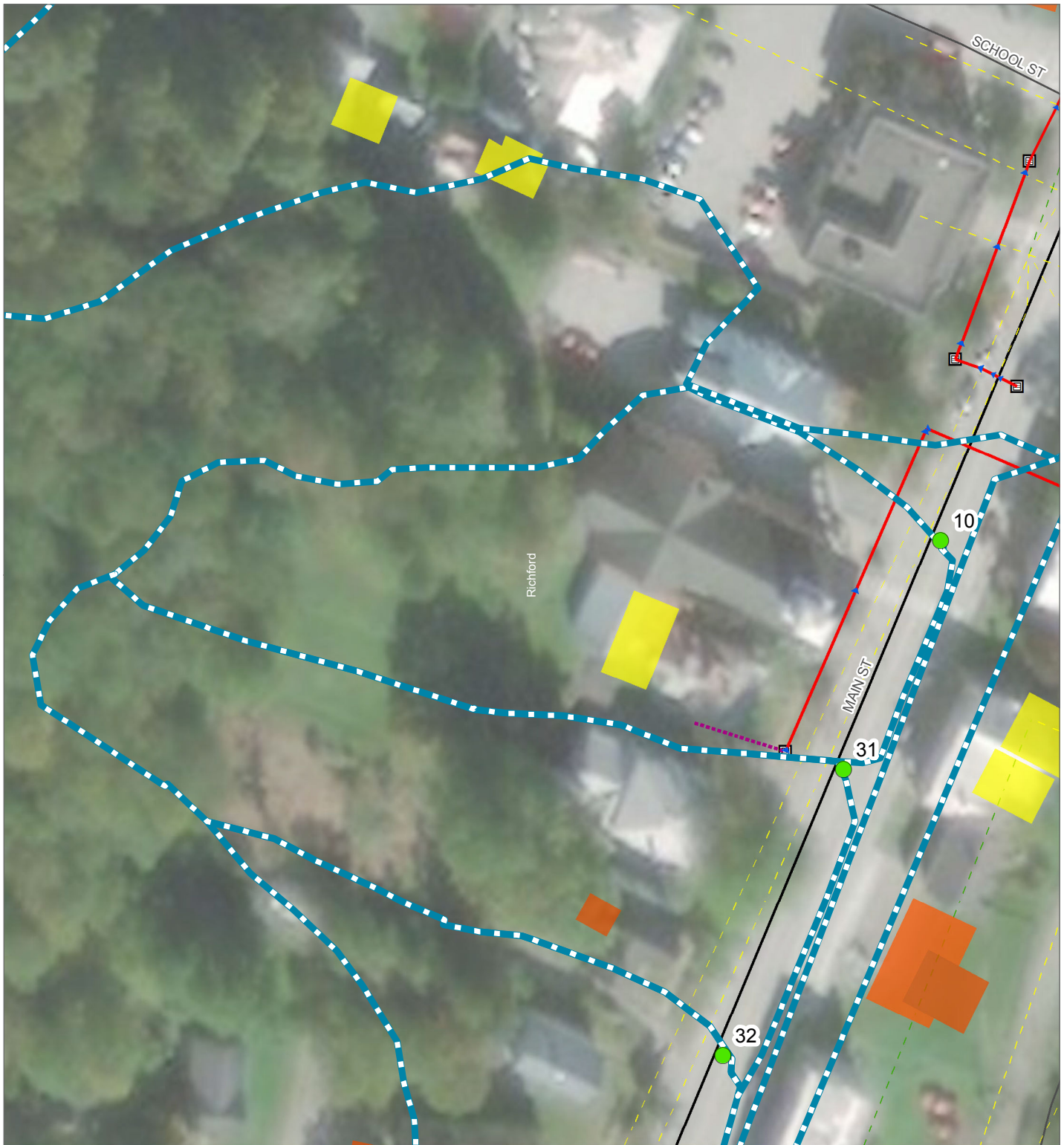
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Area 9
TD Bank Bioretention

Richford Stormwater Master Plan

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 Northwest Regional Planning Commission
 Town of Richford

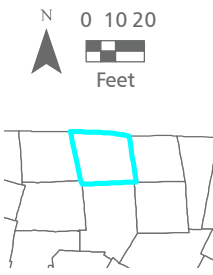
STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Catchbasin
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

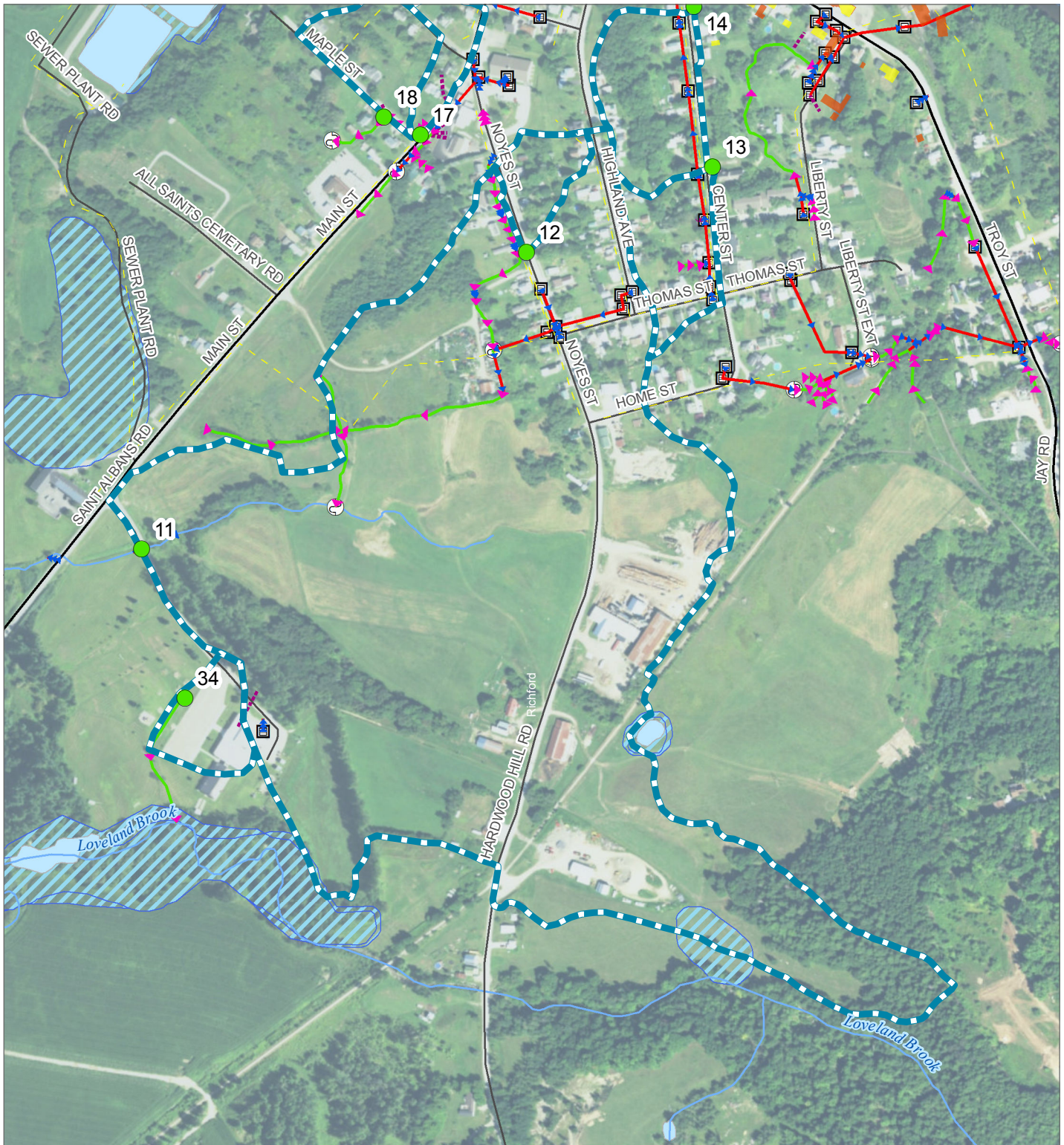


Area 10
Town Hall Bump-Out

Richford Stormwater Master Plan

Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

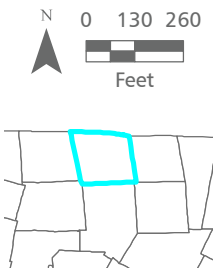
STONE ENVIRONMENTAL



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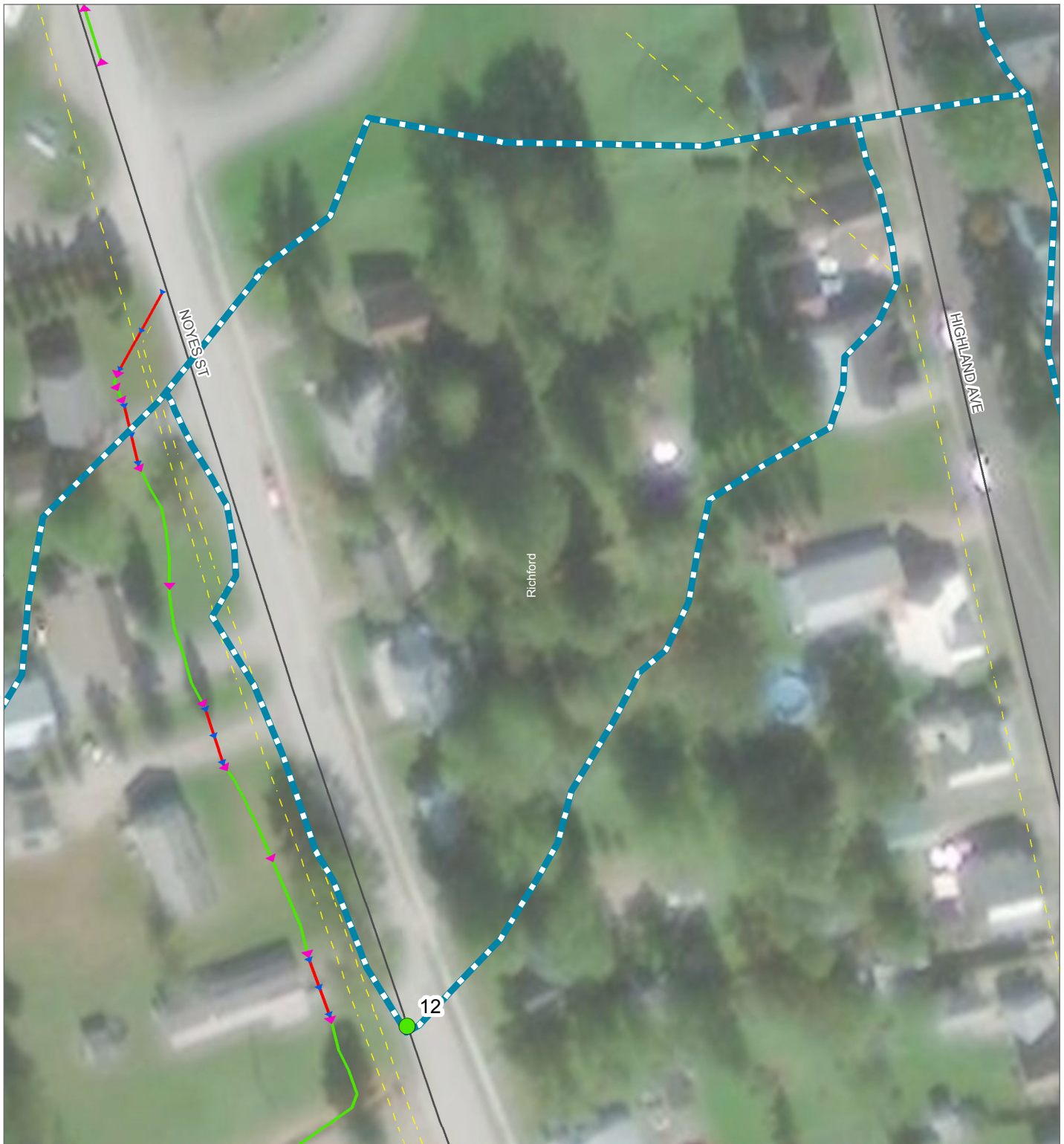
- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- ☐ Existing, Catchbasin
- ☐ Existing, Outfall
- VT State highway
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Rivers (VCGI)
- Streams (VCGI)
- NHD Waterbody
- Wetlands (VSWI)
- National Boundary (VCGI)
- Retrofit Drainage Area

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.



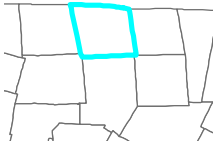
Area 11
Richford Elementary Project
No. 1
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- Existing, Sanitary line
- Existing, Storm line
- ▶▶ Existing, Swale
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Area 12
Noyes Street Swale

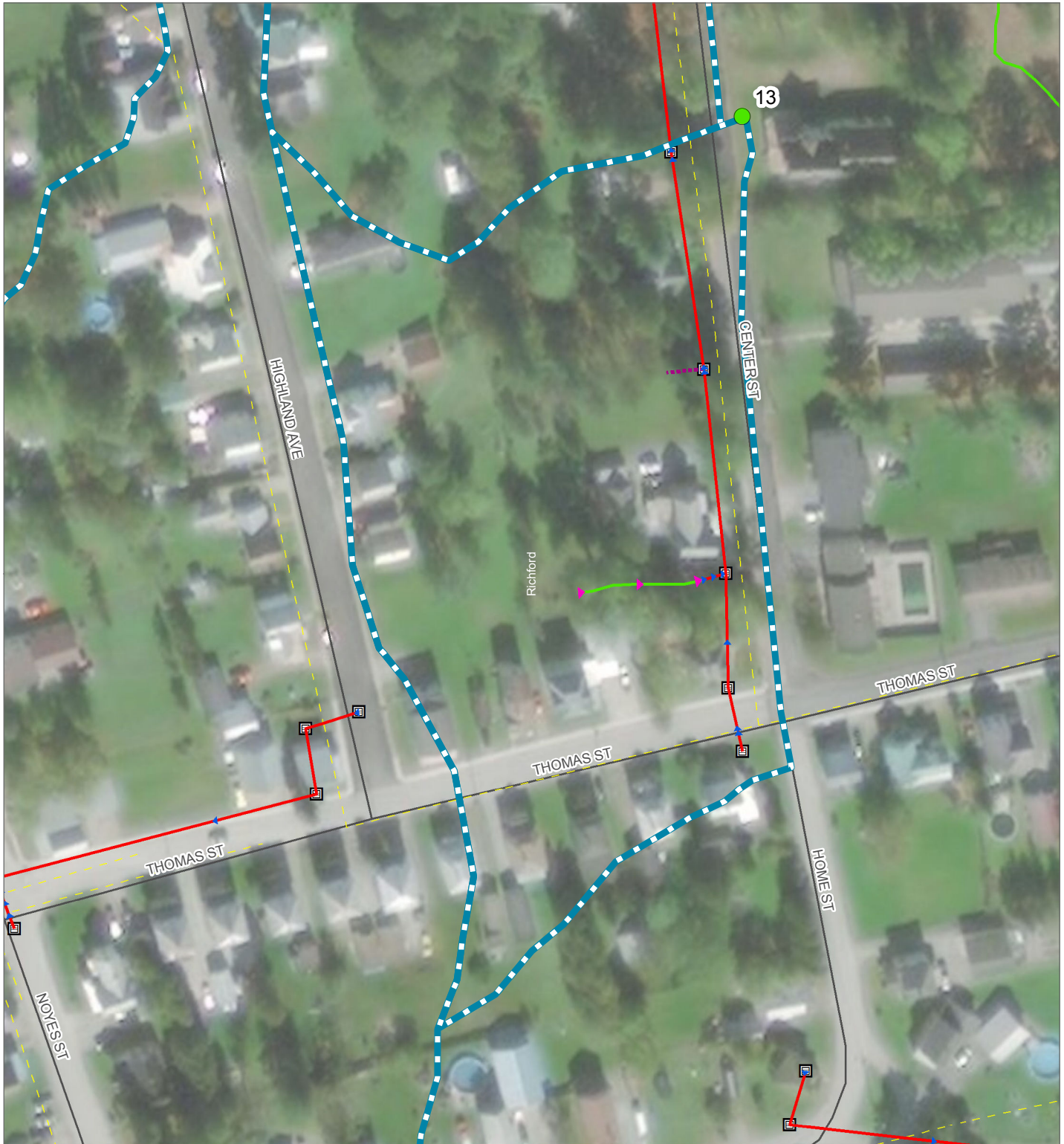
Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

STONE ENVIRONMENTAL

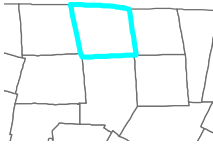
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LEGEND

- Retrofit Opportunity Location
- - - Existing, Footing drain
- - - Existing, Sanitary line
- - - Existing, Storm line
- >>> Existing, Swale
- Existing, Catchbasin
- Roads - Local level
- Town Boundary (VCGI)
- - - National Boundary (VCGI)
- Retrofit Drainage Area



Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

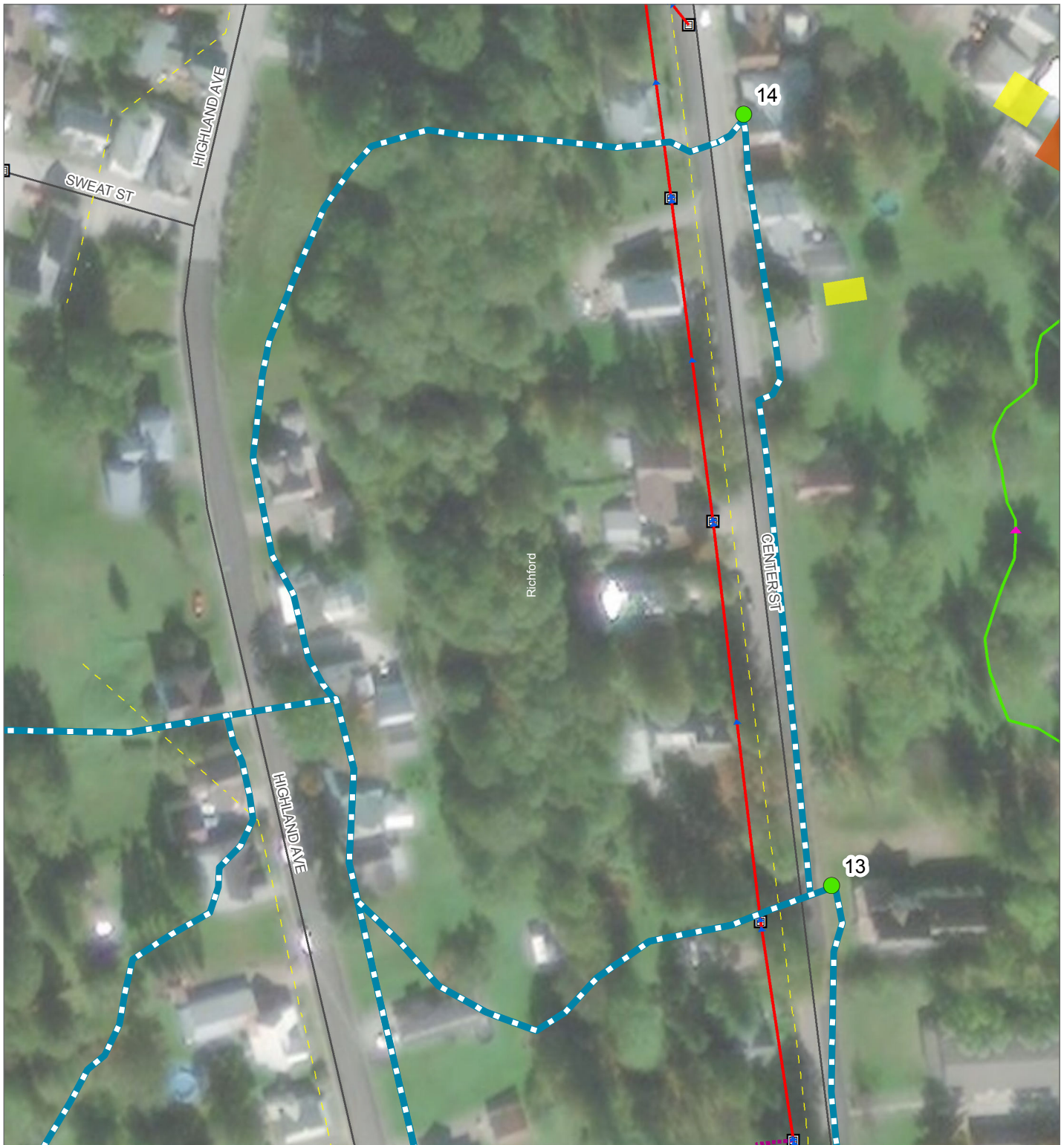
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 Saved: 12/18/2018 by AmyM

Area 13
Center Street Bioretention

Richford Stormwater Master Plan

Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

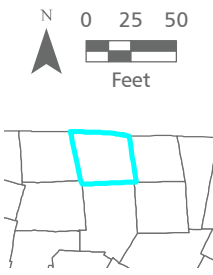
STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- - - Existing, Footing drain
- - - Existing, Sanitary line
- - - Existing, Storm line
- - - Existing, Swale
- Existing, Catchbasin
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.



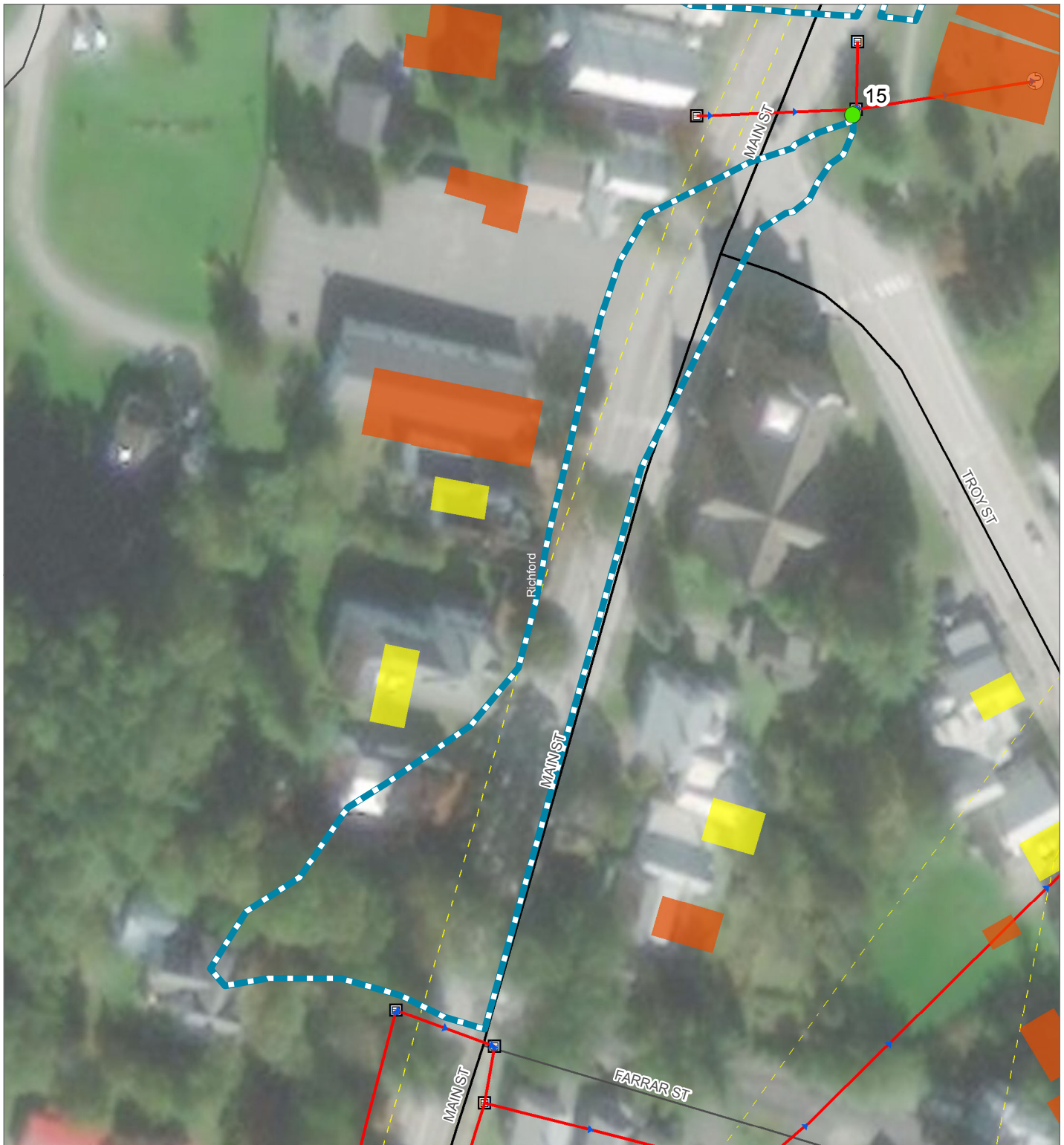
Area 14
Center Street Bump-Outs

Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

STONE ENVIRONMENTAL

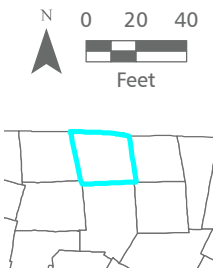
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Saved: 12/18/2018 by AmyM



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Sanitary line
- Existing, Storm line
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

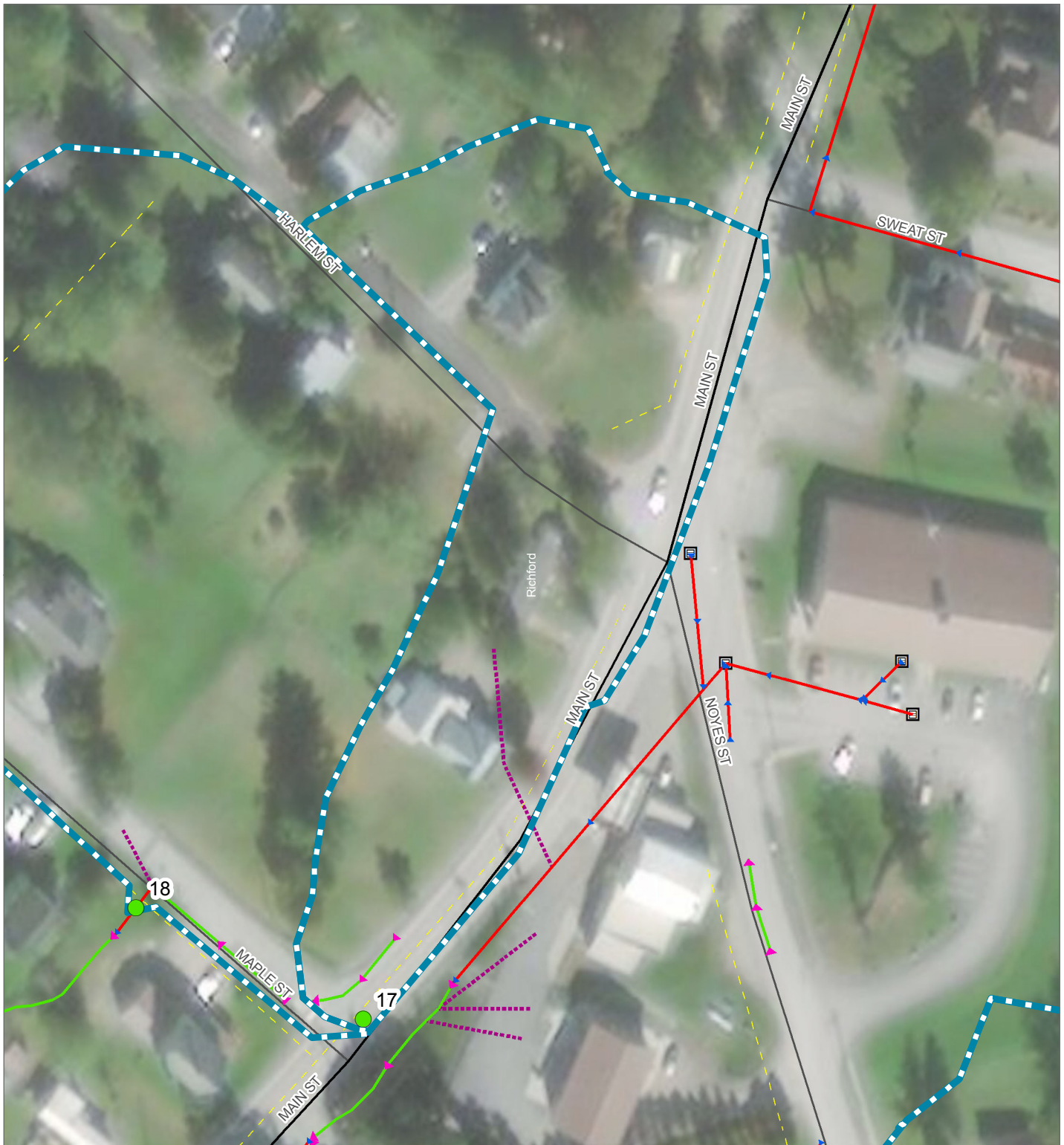
Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.



Area 15
Troy St. and Main St. Bump Out
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

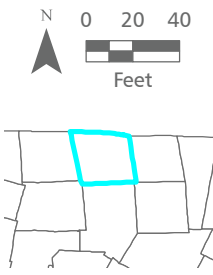
STONE ENVIRONMENTAL

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LEGEND

- Retrofit Opportunity Location
- - - Existing, Footing drain
- - - Existing, Sanitary line
- - - Existing, Storm line
- - - Existing, Swale
- Existing, Catchbasin
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

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 Saved: 12/18/2018 by AmyM

Area 17
VT Rte. 105 Paved Swale

Richford Stormwater Master Plan

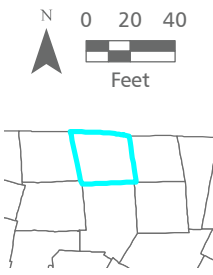
Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- ⋯ Existing, Footing drain
- - - Existing, Sanitary line
- Existing, Storm line
- Existing, Swale
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



Area 18
Maple Street Swale

Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

STONE ENVIRONMENTAL

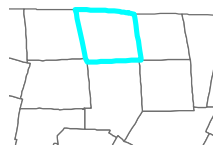
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LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Catchbasin
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

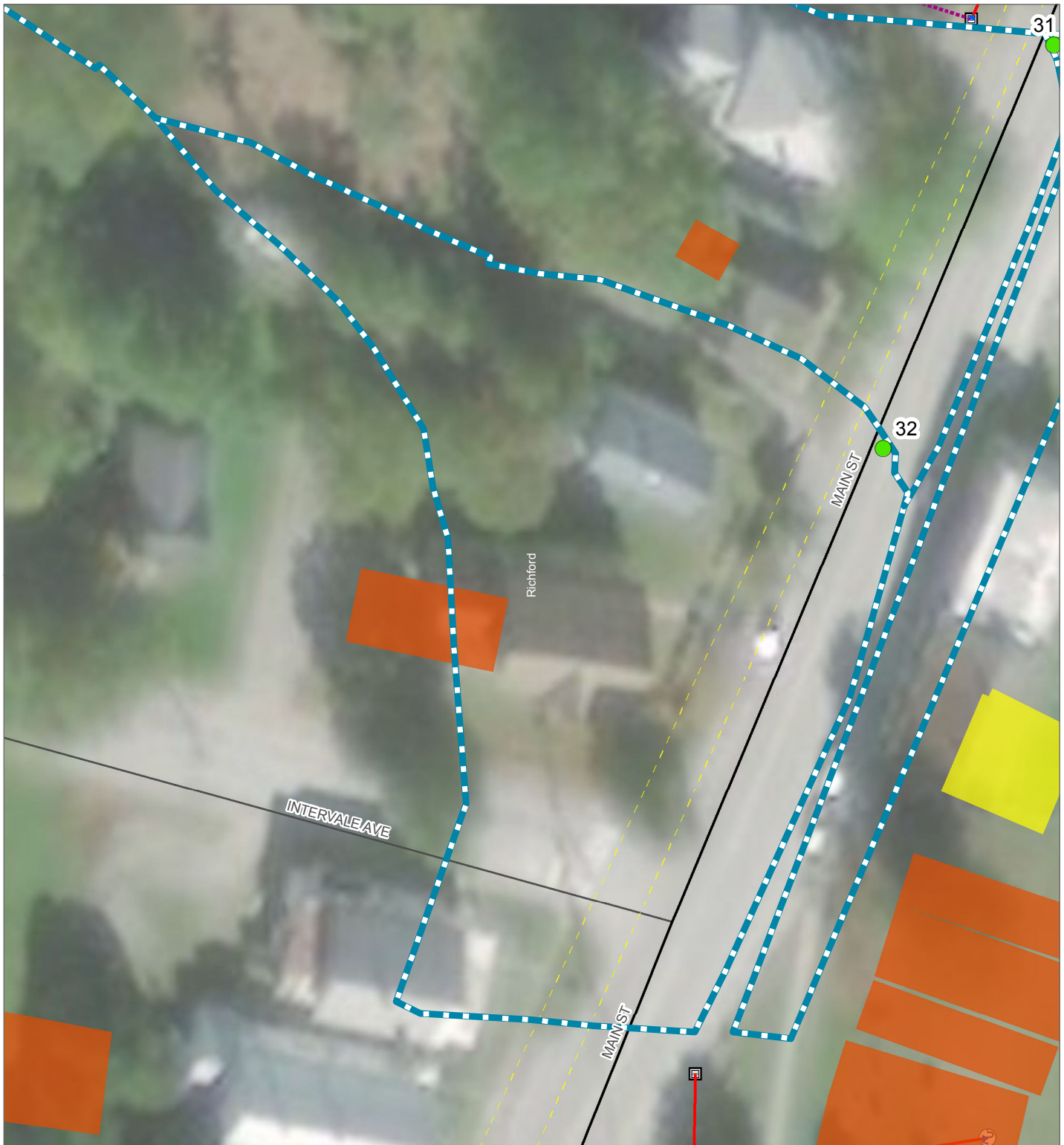


Area 31
Main Street Bump-Out No.2

Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

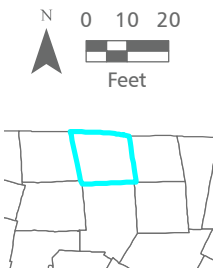
STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Historic Structure
- - - Existing, Footing drain
- - - Existing, Sanitary line
- - - Existing, Storm line
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.



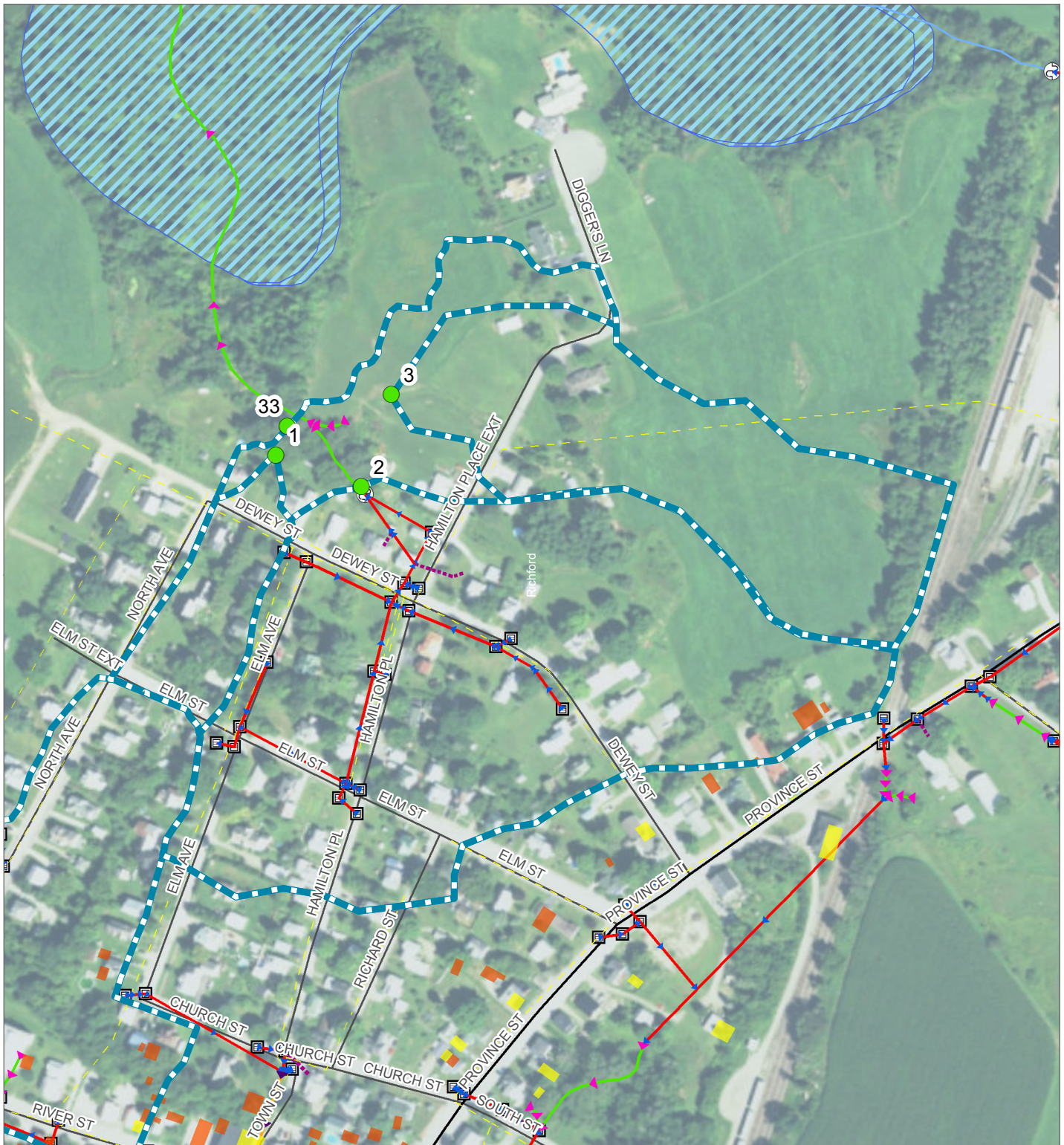
Area 32
Main Street Bump-Out No. 3

Richford Stormwater Master Plan

Prepared for:
Northwest Regional Planning Commission
Town of Richford

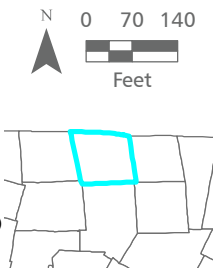
STONE ENVIRONMENTAL

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SWMP\GIS\MapDocuments\PpresentationsAndReports\RichfordSWMP_AppD_RetrofitDrainageAreas.mxd
Saved: 12/18/2018 by AmyM



LEGEND

- Retrofit Opportunity Location
- Potential Contamination, Current Structure
- Potential Contamination, Historic Structure
- Abandoned, Sanitary line
- Existing, Footing drain
- Existing, Sanitary line
- Existing, Storm line
- Existing, Storm line (old Sanitary line)
- Existing, Swale
- Existing, Catchbasin
- Existing, Outfall
- US/State highway - City
- Roads - Local level
- Town Boundary (VCGI)
- Streams (VCGI)
- Wetlands (VSWI)
- National Boundary (VCGI)
- Retrofit Drainage Area

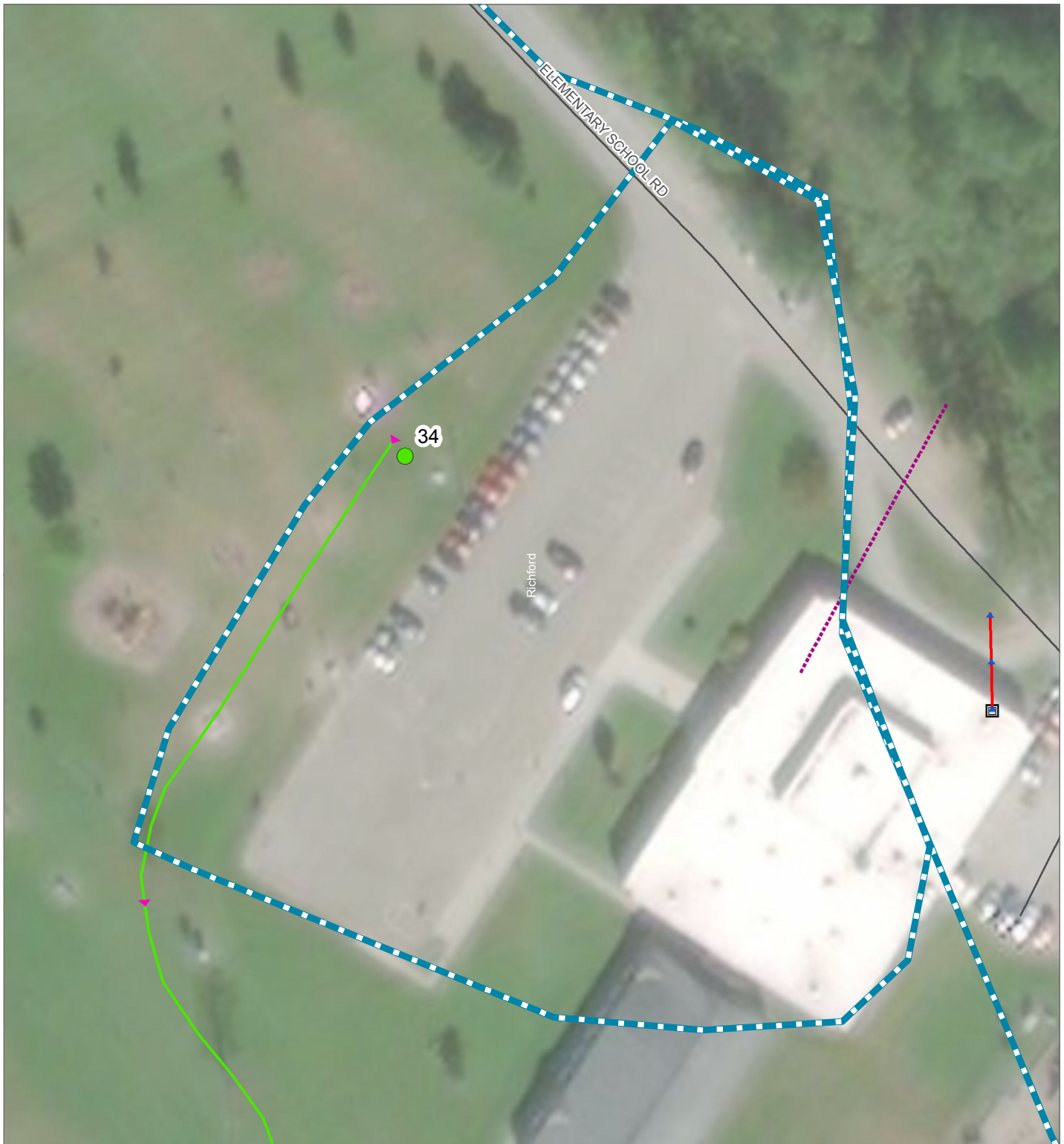


Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.

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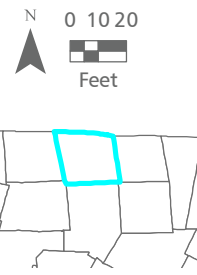
Area 33
Missisquoi Tributary
 Richford Stormwater Master Plan
 Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL



LEGEND

- Retrofit Opportunity Location
- ⋯ Existing, Footing drain
- - - Existing, Storm line
- - - Existing, Swale
- Existing, Catchbasin
- Roads - Local level
- Town Boundary (VCGI)
- National Boundary (VCGI)
- Retrofit Drainage Area



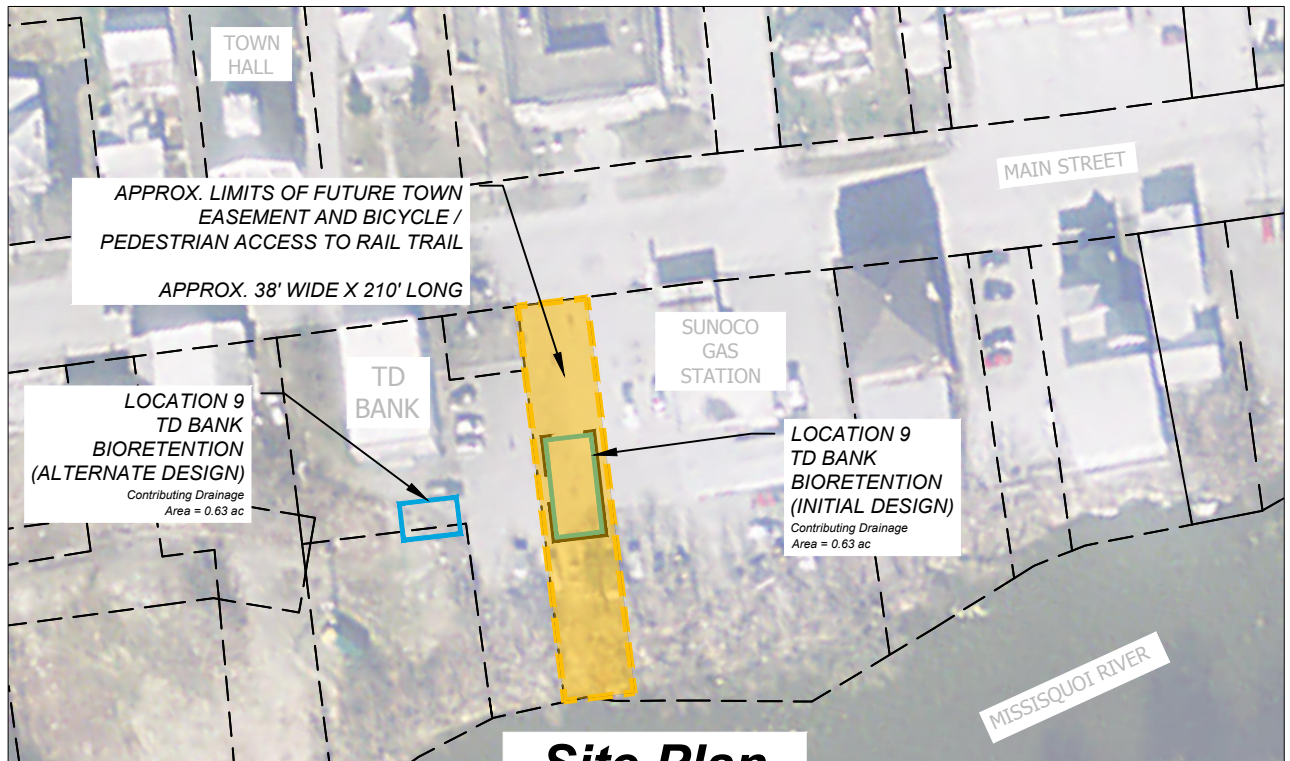
Area 34
**Richford Elementary School
 Project No. 2**
 Richford Stormwater Master Plan

Prepared for:
 Northwest Regional Planning Commission
 Town of Richford

STONE ENVIRONMENTAL

Source: Esri World Imagery; VCGI; VT ANR; Stone Environmental.
 Path: O:\PROJ-17\WRM\17-079-B Richford
 SWMP\GIS\MapDocuments\PpresentationsAndReports\RichfordSWMP_AppD_RetrofitDrainageAreas.mxd
 Saved: 12/18/2018 by AmyM

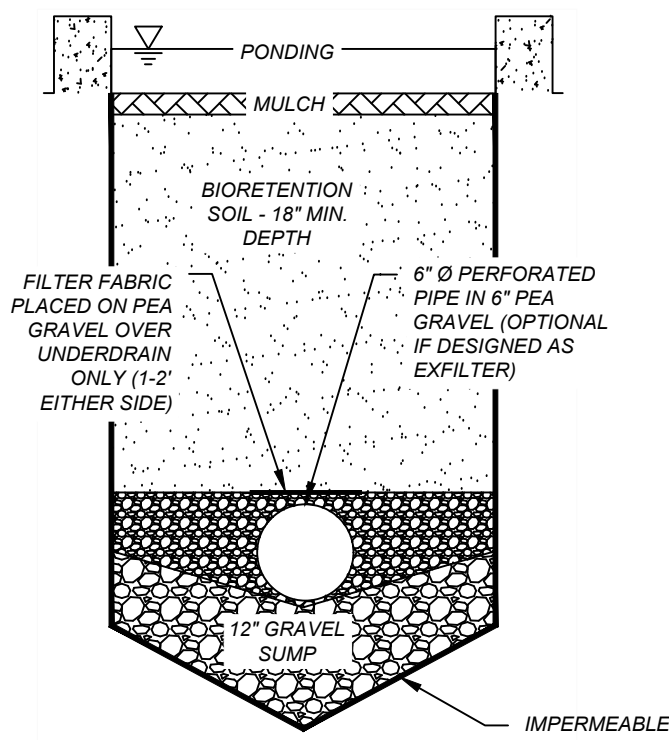
Appendix E. Concept Designs for Priority Stormwater Problem Areas



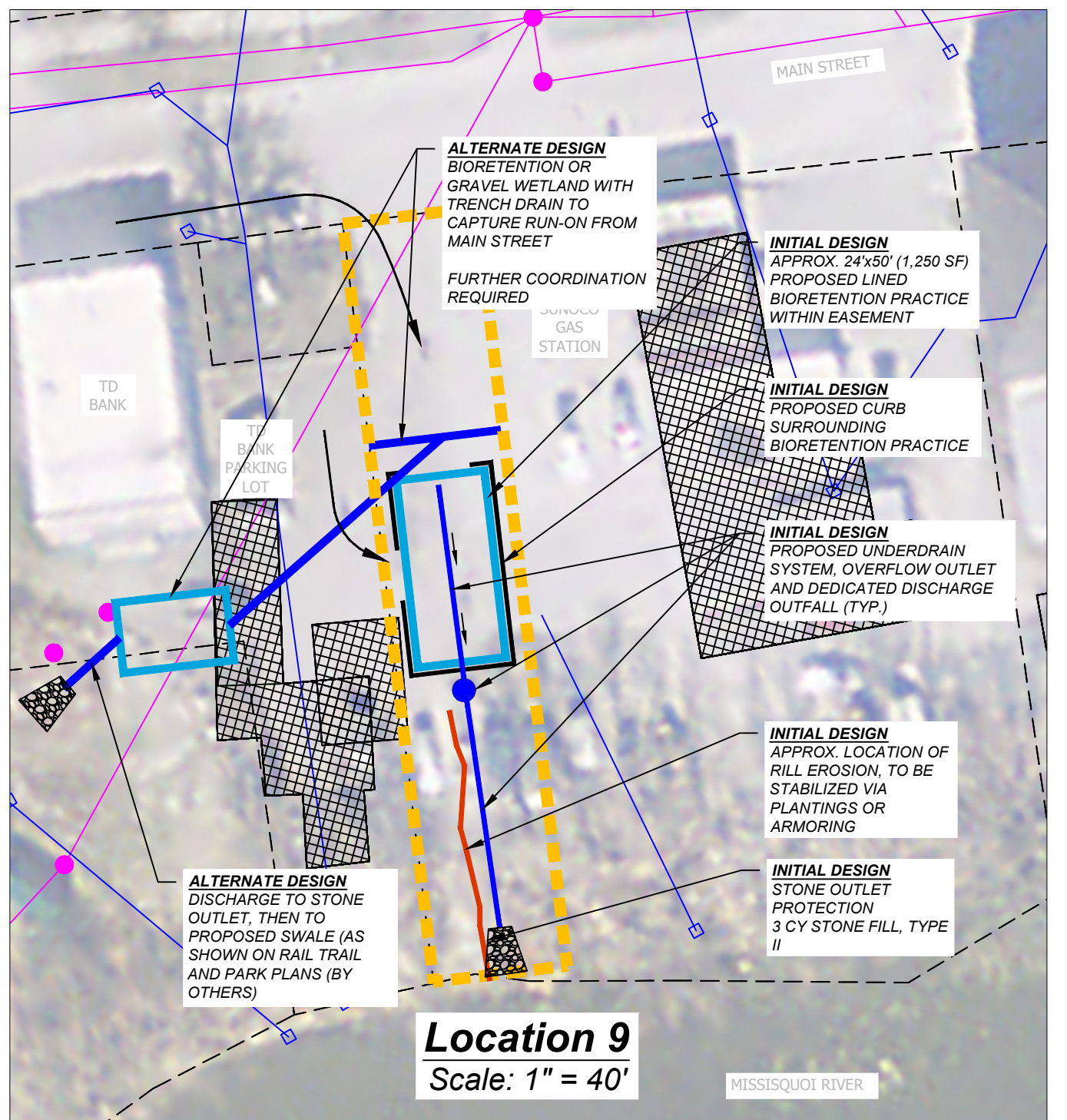
Site Plan
Scale: 1" = 100'

Notes:

1. This practice will collect and treat runoff that flows from Main Street into the Town easement, and off the TD Bank parking lot, using bioretention principles.
2. Basis of design: To provide water quality treatment and removal of sediment and phosphorus from stormwater runoff via collection of the WQv. Volume reduction is a secondary concern as the receiving water (Missisquoi River) is large. An underdrain is proposed and collected flow will be routed to the river following treatment. Details of underdrain design will be refined in future design phases.
3. Historical contamination is adjacent to the practice (see legend). An impermeable geotextile liner is proposed to prevent infiltration of water that may mobilize existing contamination, and to prevent migration of petroleum into the subsurface in the event there is a spill at the adjacent gas station.
4. Orthophoto, parcel boundaries and stormwater infrastructure obtained from the Vermont Center for Geographic Information (VCGI). Limits of contamination developed by Stone Environmental, 2010.
5. Parcel boundaries do not represent a boundary survey and should be considered approximate.
6. Limits of Town easement between TD Bank and Sunoco are based on parcel lines and should be considered approximate. Easement limits to be confirmed in future design phases.
7. Curbing around practice will consist of granite curb 6" above the adjacent pavement surface, with curb cuts allowing conveyance of runoff from Main Street and the TD Bank parking lot into the practice.



Typical Section
Scale: NTS



Location 9
Scale: 1" = 40'

Legend

- Parcels
- Existing storm line
- Existing catch basin
- Existing sanitary line
- Existing sanitary manhole
- ▨ Existing/historical contamination
- ▭ Approx. limits of future Town easement
- Approx. direction of overland stormwater flow

File: O:\PROJ\17\WRM\17-079-B Richford SWMP\CAD\BASE2.dwg

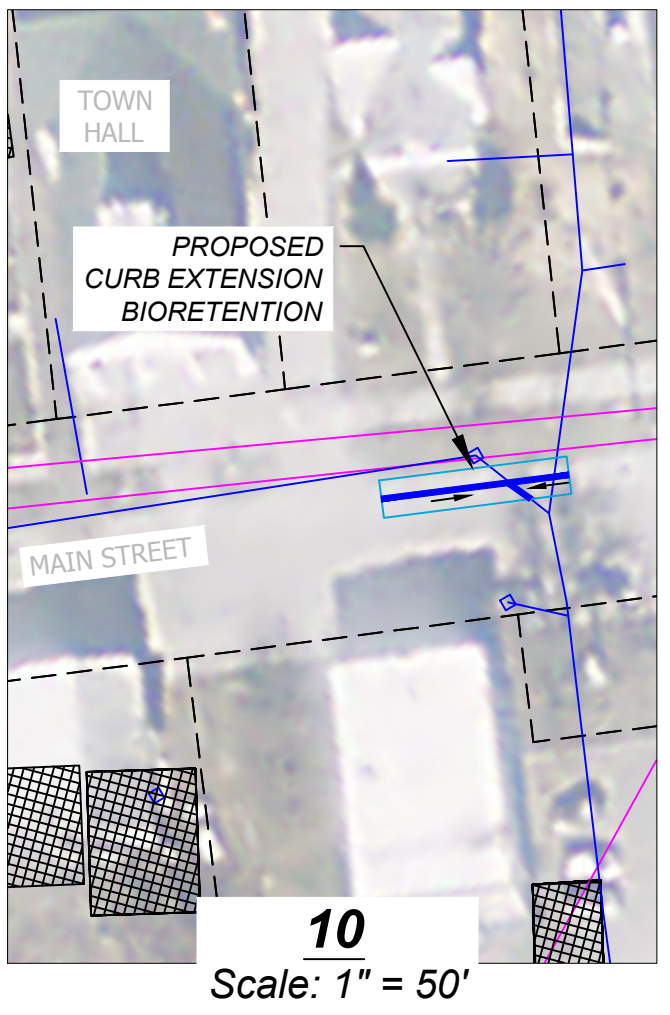
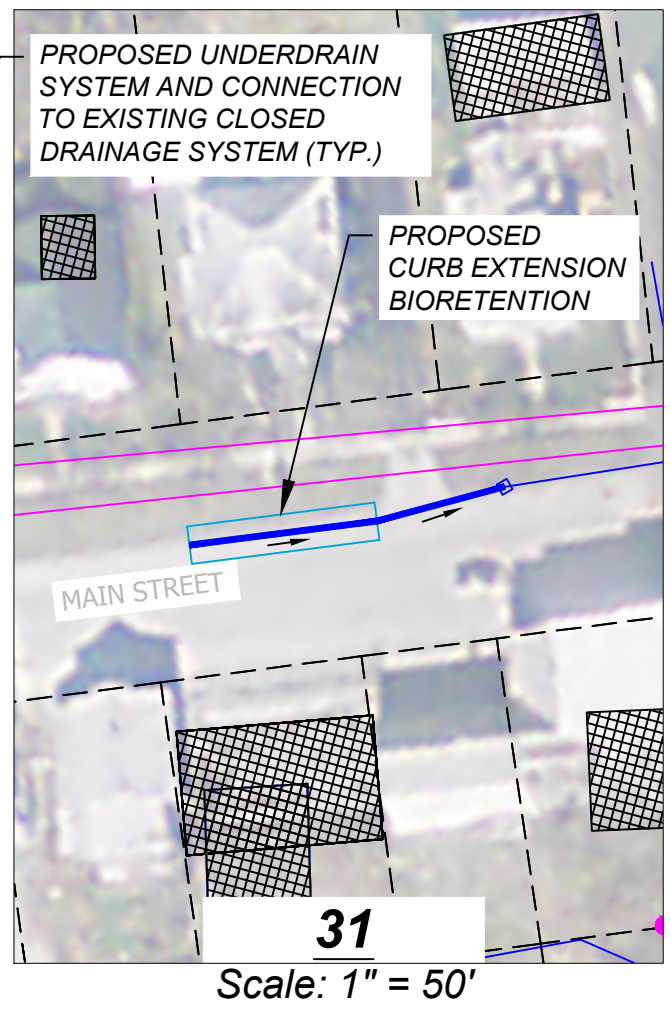
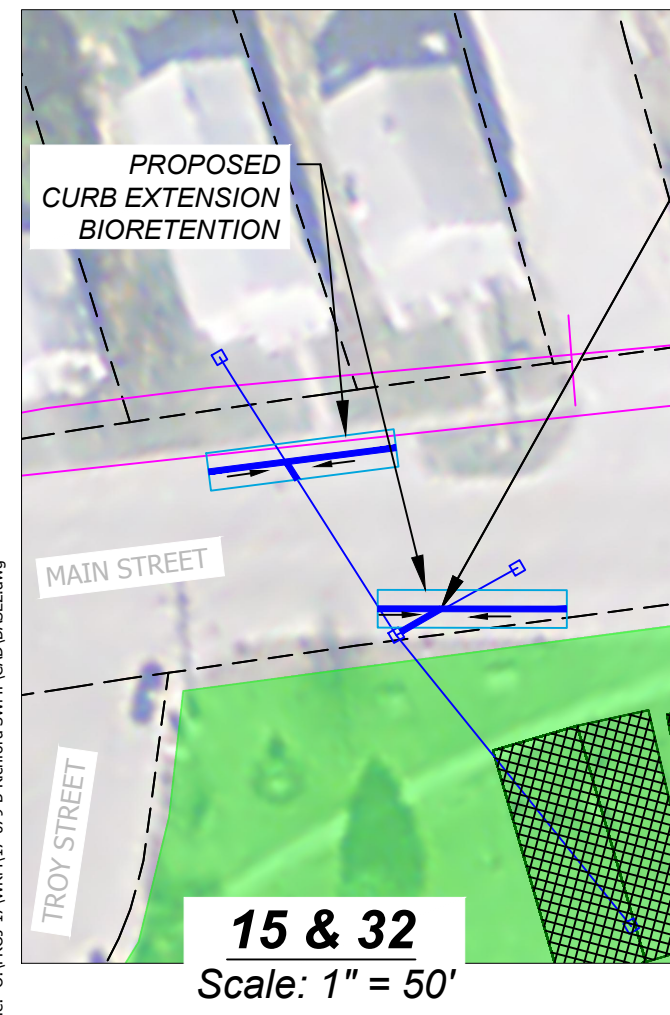
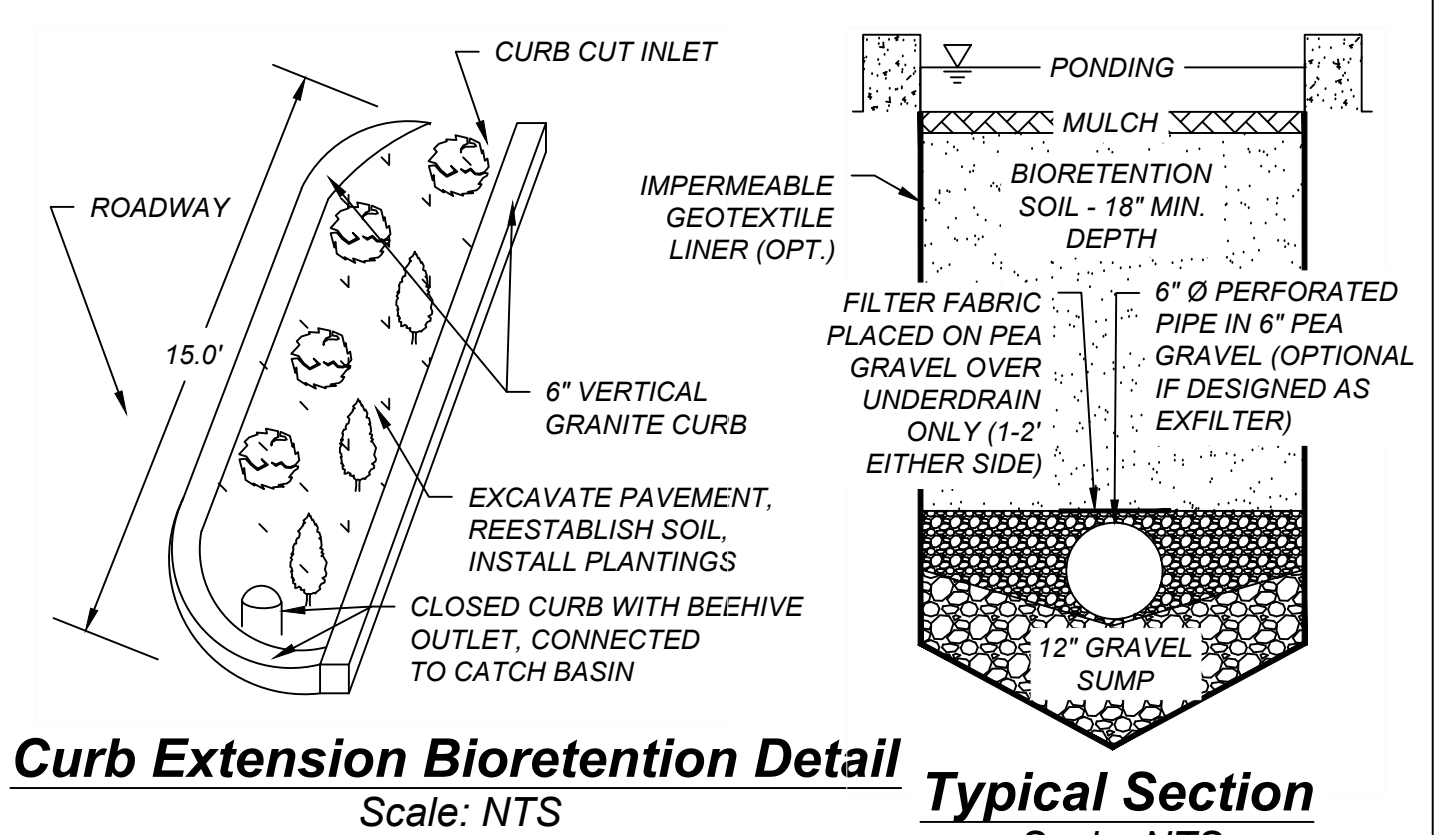
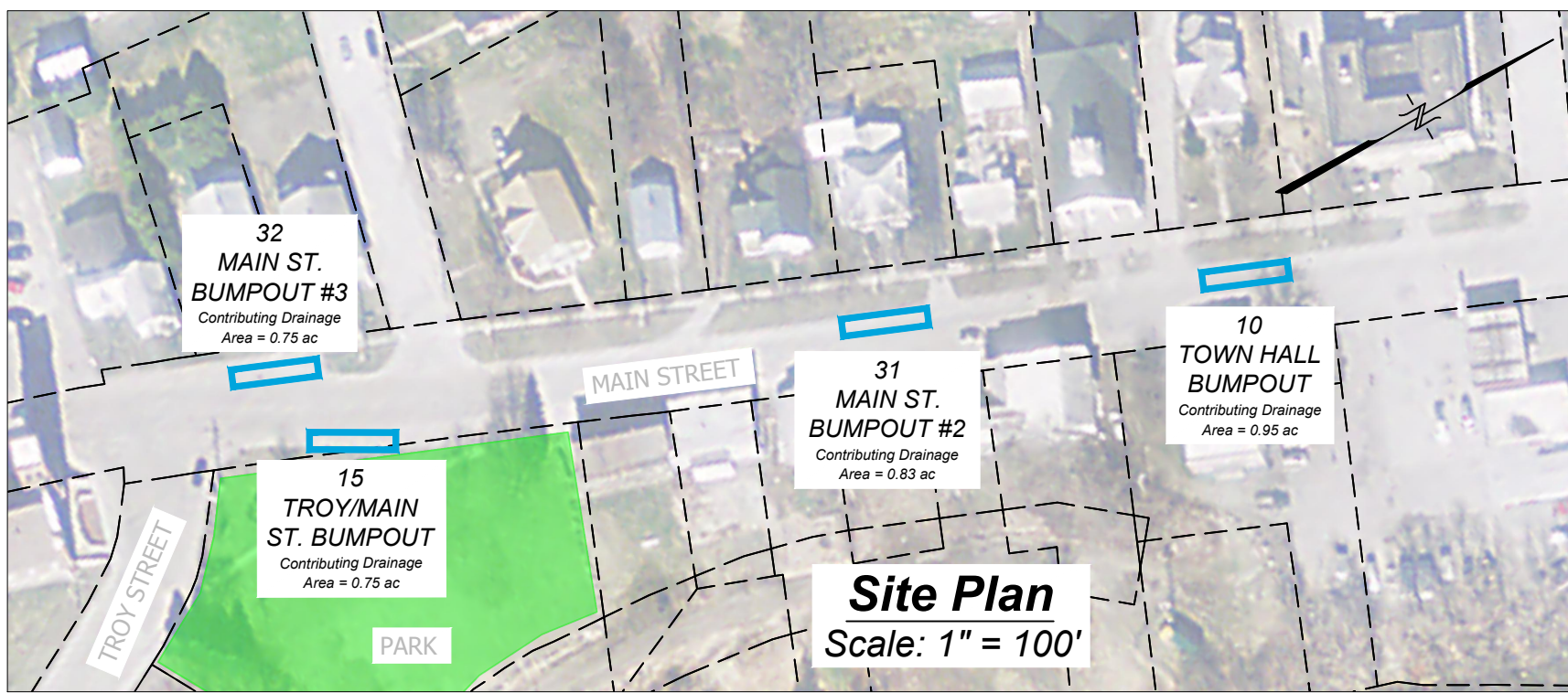
#	Date	Drwn	Chk'd	App'd	Description
1	12/19/18	GMB			Revisions to concept design to reflect requirement to not block rail trail access.
DRAWING CREDITS					
Drawn On: 10/4/2018					
Drawn By: GMB					
Checked On: 10/15/2018					
Checked By: ANM/BAM					
Project No.: 17-079-B					

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535 Stone Cutters Way / Montpelier / VT / 05602 / USA
802.229.4541 / info@stone-env.com / www.stone-env.com

TOWN OF RICHFORD
STORMWATER MASTER PLAN
TD BANK BIORETENTION
RICHFORD VERMONT

FIGURE NO.

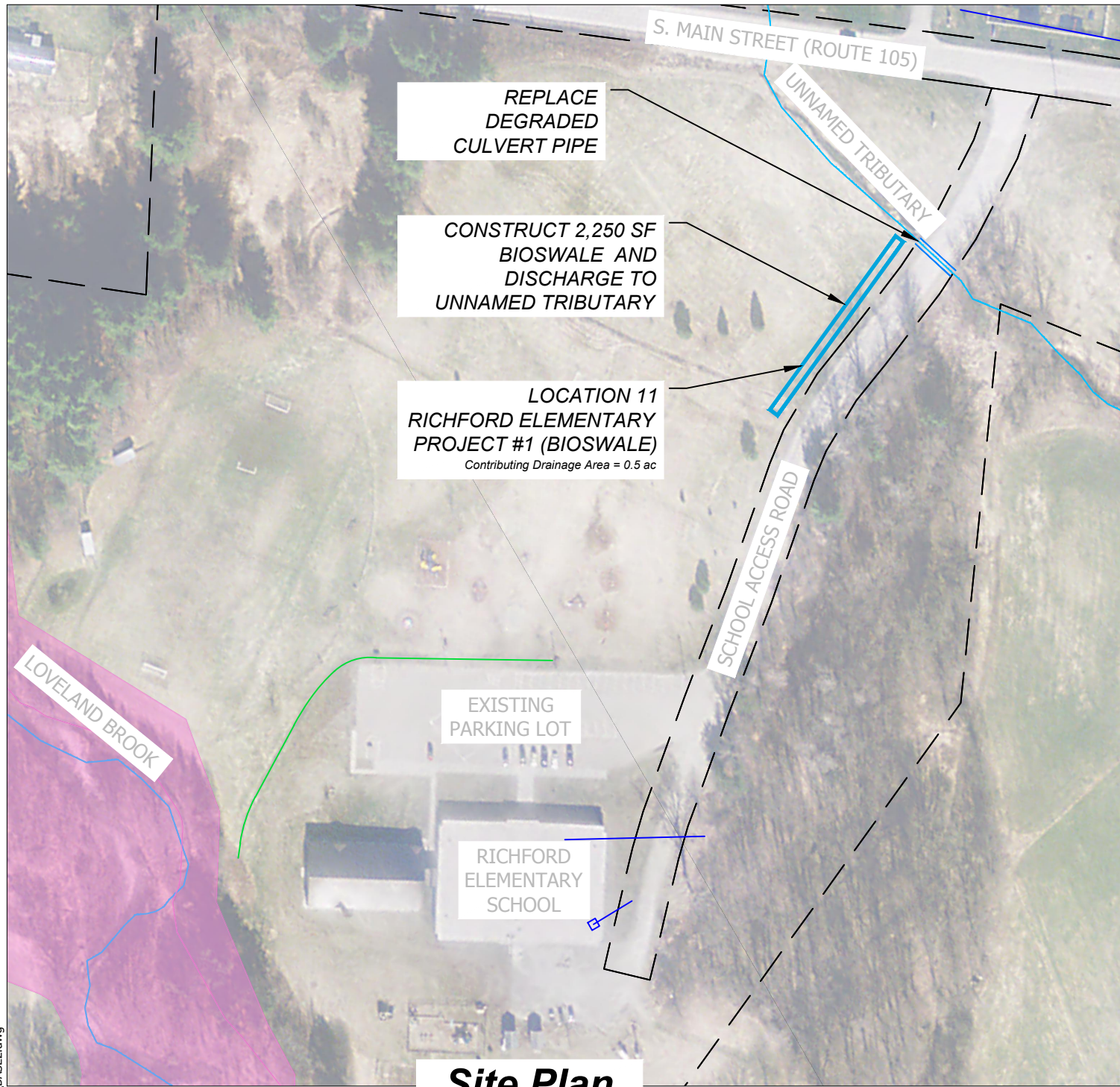
2



- Notes:**
- The purpose of these practices is to collect and treat runoff from the roadway using filtering or infiltration based bioretention practices.
 - Basis of design: To provide water quality treatment and removal of sediment and phosphorus from stormwater runoff via collection of the WQ_v at each practice. Volume reduction is a secondary concern, as the receiving water (Missisquoi River) is large. It is assumed that each practice will be underdrained such that flow can be routed to the closed drainage system.
 - Historical contamination exists adjacent to some of the practices (see legend). Impermeable liners for these practices will be explored in future design phases.
 - Orthophoto, parks, stormwater infrastructure and parcel boundaries obtained from the Vermont Center for Geographic Information (VCGI). Limits of contamination developed by Stone Environmental, 2010.
 - Parcel boundaries do not represent a boundary survey and should be considered approximate.
- Legend**
- Parcels
 - Existing storm line
 - Existing catch basin
 - Existing sanitary line
 - Existing sanitary manhole
 - Existing/historical contamination
 - Existing park/open space
 - Proposed curb extension bioretention

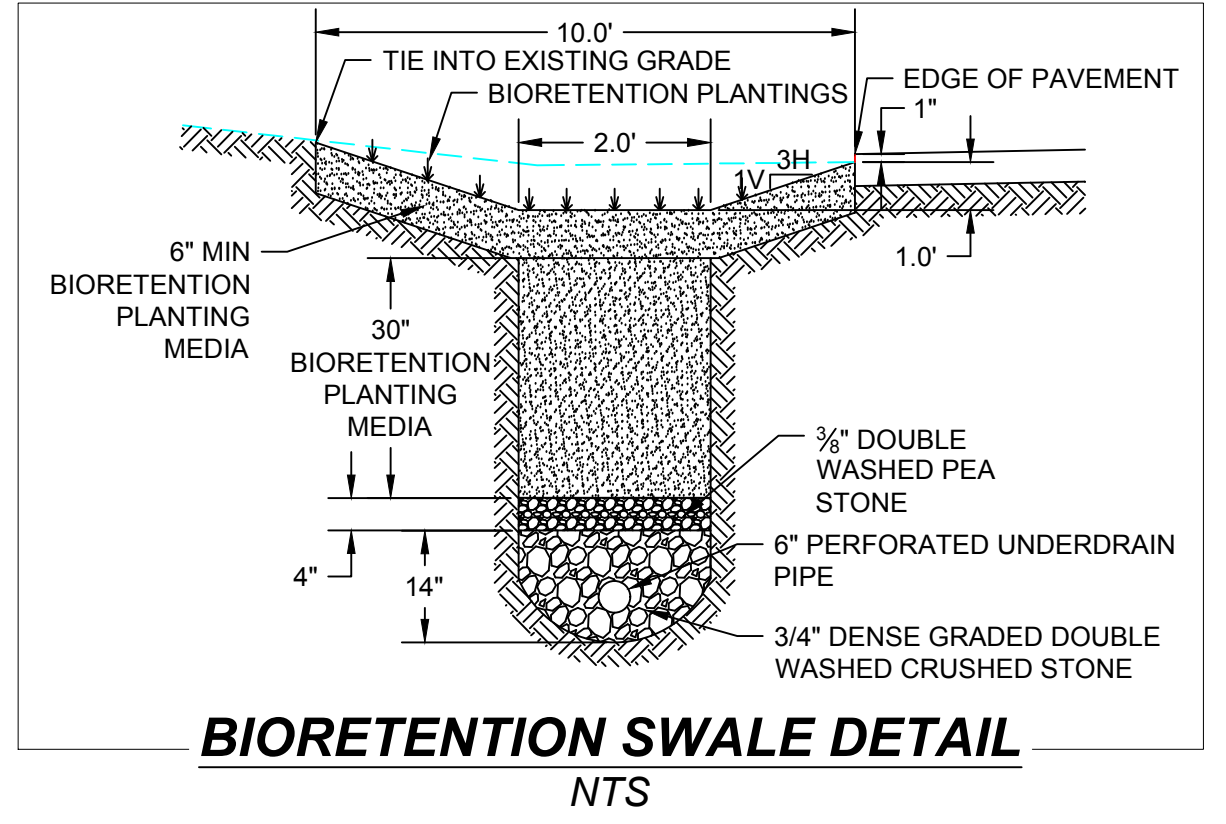
#	Date	Drwn	Chk'd	App'd	Description

Drawn On: 9/21/2018
 Drawn By: GMB
 Checked On: 10/15/2018
 Checked By: ANM/BAM
 Project No.: 17-079-B



Site Plan
Scale: 1" = 150'

- Legend**
- Parcels
 - Existing stream
 - Existing storm line
 - Existing swale
 - Existing catch basin
 - VSWI Class 2 wetlands



Notes:

1. The purpose of this practice is to collect and treat runoff from the school access road using a bioretention swale.
2. Basis of design: To provide water quality treatment and removal of sediment and phosphorus from stormwater runoff via collection of the WQv. Volume reduction is a secondary concern. The practice will discharge to the unnamed tributary shown in the Site Plan on this sheet.
3. Orthophoto, parcel boundaries, delineation of streams and stormwater infrastructure obtained from the Vermont Center for Geographic Information (VCGI).
4. Parcel line boundaries do not represent a boundary survey and should be considered approximate.

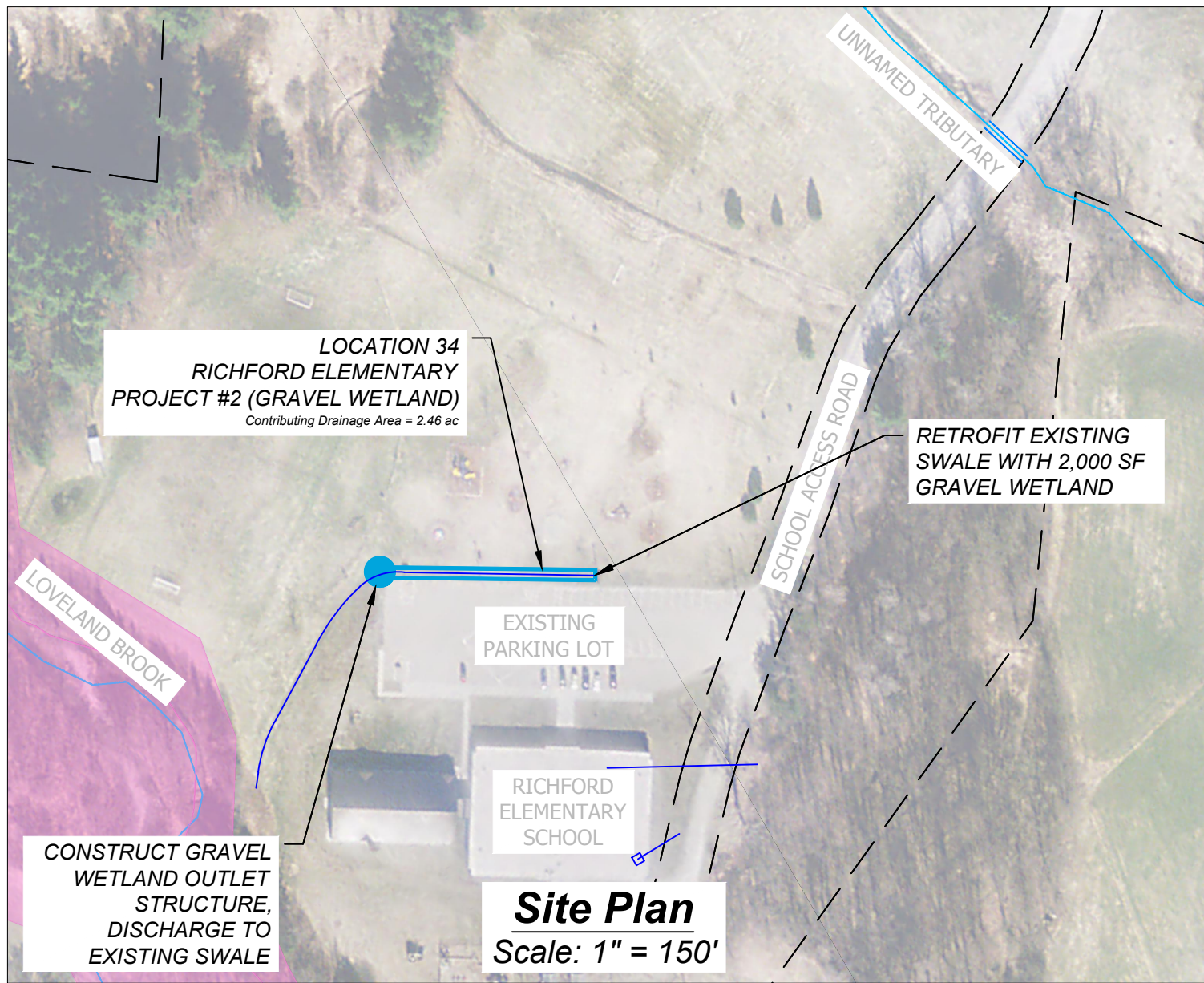
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#	Date	Drwn	Chk'd	App'd	Description
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2	10/15/2018	ANM/BAM			Checked On: 10/15/2018
3					Checked By: ANM/BAM
4					Project No.: 17-079-B

DRAWING SCALE

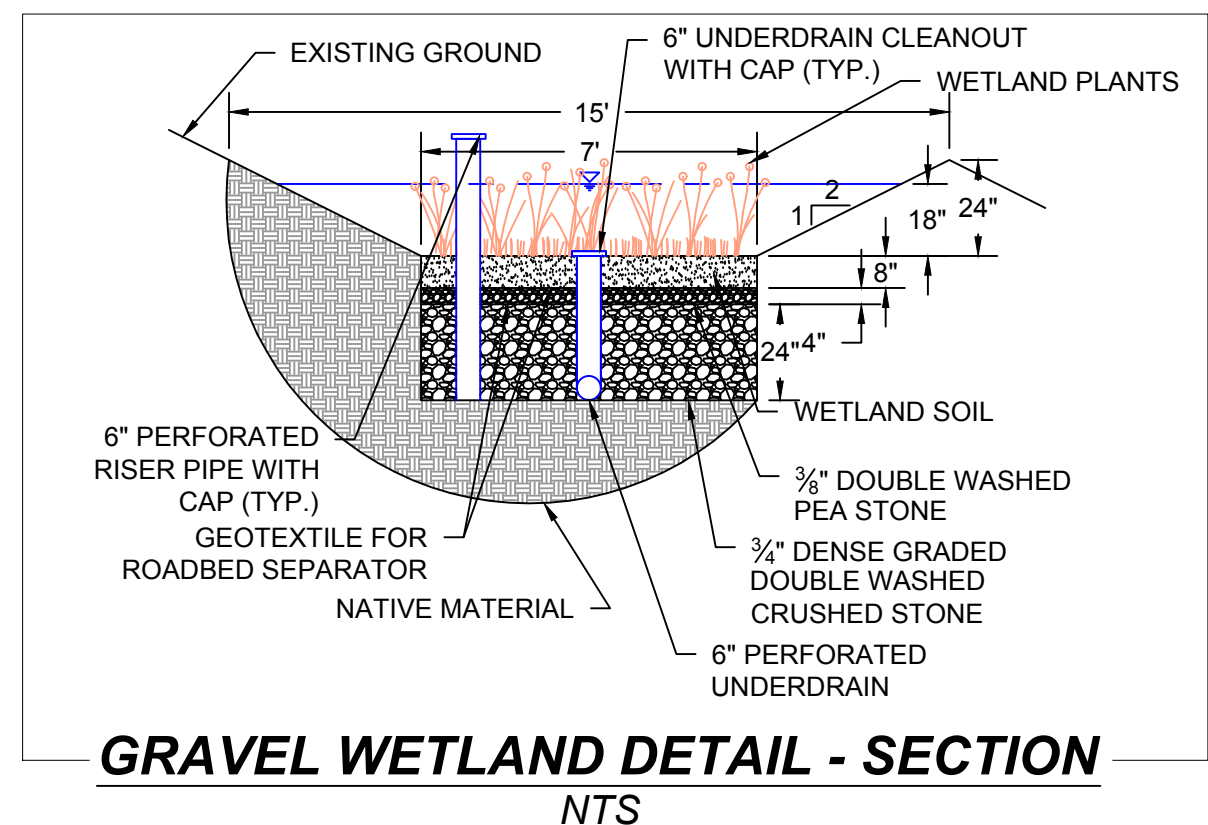
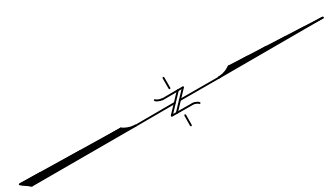
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TOWN OF RICHFORD
STORMWATER MASTER PLAN
ELEMENTARY SCHOOL BMPS - 11
RICHFORD VERMONT

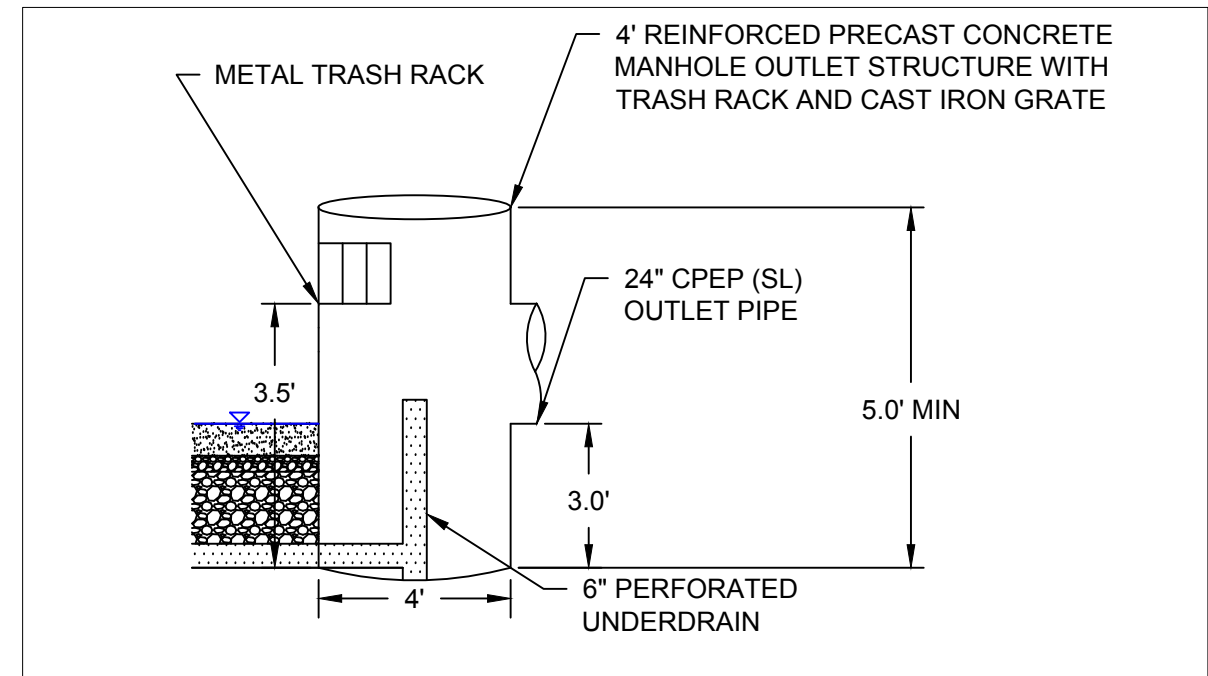


Notes:

1. The purpose of this practice is to improve the performance of the existing swale and collect and treat runoff from the school parking lot with a gravel wetland.
2. Basis of design: To provide water quality treatment and removal of sediment and phosphorus from stormwater runoff via collection of the WQ_v. Volume reduction is a secondary concern as the receiving water (Missisquoi River) is large. Flow will be routed to the existing swale following treatment via the outlet structure, followed by eventual discharge to Loveland Brook.
3. Orthophoto, parcel boundaries, delineation of streams, and stormwater infrastructure obtained from the Vermont Center for Geographic Information (VCGI).
4. Parcel boundaries do not represent a boundary survey and should be considered approximate.



GRAVEL WETLAND DETAIL - SECTION
NTS



GRAVEL WETLAND OUTLET STRUCTURE
NTS

Legend

- Parcels
- Existing stream
- Existing storm line
- Existing swale
- Existing catch basin
- VSWI Class 2 wetlands

#	Date	Drwn	Chk'd	App'd	Description
1	10/4/2018	GMB			Drawn On: 10/4/2018
2	10/15/2018	ANM/BAM			Checked On: 10/15/2018
3					Checked By: ANM/BAM
4					Project No.: 17-079-B

Appendix F. Stakeholder Meetings and Documentation

Richford SWMP

1/29/18 Kick off Meeting notes (Linda Collins/Selectboard, John Nutting/Highway Dept, Stone/Gabe, NRPC - Bethany & Amanda)

- REI vs SWMP - do not repeat projects
- DEC encouraging SWMP to focus on developed lands; acknowledge issue of runoff to roads from private lands
- Discussion of potential areas of concern
 - IDDE - Issues in Town. When upgraded sewer lines left old and used as storm drains. Homeowners sump pumps, etc are connected to this and can experience backups when there is an overflow with stormwater. Issue thought Town, most complaints from North Ave and off Dewey St. Line goes to the ag/corn field and dumps into river with an 8" clay pipe. Issue - ag equipment breaks pipe so Town has to go fix. Can't block pipe without addressing whole system or backs up into basements.
 - Private driveways (gravel mainly) in Village and runoff that comes off; cause icing in winter
 - Ex. South Main St - gravel goes right into stormdrains
 - Barry Road
 - Steep slopes
 - Drew Rd - ag fields, appropriate sized culvert, erosion of culvert now perched
 - Issues related to ag use of adjacent land (gravel and sand in these areas) - Pinnacle Road, Rte 139 end of Providence Street, Golf Course Road
 - Less issue at Magoon Road - road higher than drive - town fixed driveway to their ROW
 - Direct discharge areas - dumping into open ditches; are there end of pipe practices if applicable where could implement some pre-treatment before enters rivers
- NOTE - contract out vactoring, rotation of 2 years to reach all ~100 catchbasins in town. Extract about 60 years of gravel/year from 1/2 catchbasins and reuse it.
- Development slow, agriculture is what is changing more often
- Potential solution for agriculture access points - tracking pads and stone aprons - to address erosion and sediment. But how address existing issues. Potential for Agency of Agric funding to address these areas?
- Follow-up for NRPC
 - Brownfields - info on testing at 111-113 Main Street since areawide assessment
 - Rail Trail extension project - a 20-year old project with plans by Lameroux and Dickerson. Can review if any undersized culverts that could be upgraded. Do they have/need a stormwater permit?

Northwest Regional Planning Commission Richford Stormwater Master Plan Stone Project # 17-079-B

Location: Varied, see below
Date / Time: Meetings on 7/5/2018 (at Richford Town Hall); 9/11/2018 (via phone)
Subject: General SWMP Details and Project Prioritization/Concept Design Selection

Attendees 7/5/2018 Meeting

- ✓ Amanda Holland
- ✓ John Nutting
- ✓ Karen Bates
- ✓ Gabe Bolin
- ✓ Arthur Pond

Affiliation:

[Northwest Regional Planning Commission](#)
[Richford, VT Road Foreman](#)
[VTDEC](#)
[Stone Environmental](#)
[Resident](#)

Attendees, 9/11/2018 Meeting

- ✓ Amanda Holland
- ✓ John Nutting
- ✓ Gabe Bolin

Affiliation:

[Northwest Regional Planning Commission](#)
[Richford, VT Road Foreman](#)
[Stone Environmental](#)

Notes

The following provides a summary of meeting notes from the two meetings listed above, regarding project prioritization and selection of conceptual designs.

- **Site ID – 1, North Avenue and Dewey Street (Score 14)** – this project was not pursued as the existing soils are not expected to infiltrate water well, and a bioretention practice was thought to be most suitable for this site. The drainage area is larger because storm drains from Dewey Street are connected to this system. Surface water backs up into the property on the corner. Town stabilized outlet with rock 4-5 years ago. A site visit is recommended to confirm these details. Site questions: Can we separate out storm drains and basement drains? Where is extent of wetlands mapped in area? There is/has been development planned off end of Dewey St - is stormwater infrastructure planned? (Mark St. Pierre/Roger Gendron)
- **Site ID – 2, Upstream tributary (Score 18)** – Due to the presence of excessive stormwater runoff and severe impacts to the stream, this project was not anticipated to match well with funding programs to be pursued to obtain SWMP implementation funds.
- **Site ID – 3, Private farm culvert on Hamilton Place Ext. (No Score)** – since the project is on a farm, it was thought that NRCS programs and funding would be more appropriate to address this issue.
- **Site ID – 4, North Ave and River St. @ Missisquoi River (Score 16)** – not originally pursued since the proposed stormwater practice lies within the river corridor. Stone followed up with Rebecca Pfeiffer, the VT DEC Floodplain Manger for the region, and she stated that typically, new stormwater infrastructure in the river corridor is not something that DEC supports, however they consider this a unique site due to the USACE Richford weir ice project. Rebecca suggested that the project team, along with Staci Pomeroy, meet to

discuss the proposed practice, review any field data they might have, and talk about any channel management the Town is required to do regarding the USACE ice project at this portion of the river.

- **Site ID – 5, Vista Park (Score 11)** – this project was not pursued due to the lower score in combination with the presence of utilities running right along the curb where the curb cut would be constructed, to direct flow into this bioretention practice. Potential for winter snow storage from Site #6 parking lot here.
- **Site ID – 6, Bioswale Across from Vista Supermarket (Score 13)** – John Nutting relayed that there is infrastructure underground (historic logging tunnel and potential water line) in this area that may be encountered during construction. We also spoke about the private landowner who owns the parking lot adjacent to this proposed practice, and the potential difficulty in obtaining permission to build this practice.
 - Public Works stated the tunnel is 2-3ft from surface and about 8’ wide x 8’ high. Water Dept. wants to keep it to access water line. Tunnel entrance crosses street (River St.) at center of parking lot. Could potentially install swales along this green space and break around this line. This site captures mainly the parking lot runoff.
 - This site is owned by Peoples Trust and *Richford Renaissance Group* (only the first was noted on the PAD sheet).
- **Site ID – 7, Powell St. bump out (Score 12)** – this project was not pursued due to its proximity to an adjacent building that was formerly contaminated.
- **Site ID – 8, Vista Supermarket back parking lot (Score 14)** – this project was not pursued due to the potential presence of contaminated soils in the vicinity of the proposed project.
- **Site ID – 9, TD Bank Bioretention (Score 13)** – a conceptual design was developed for this site following information from John Nutting that this area receives a significant amount of stormwater runoff from Main Street during large storm events, is expected to convey a moderate amount of road sand and salt directly to the river during those events, and that stormwater runoff has resulted in significant rill erosion down the river bank. John also relayed that this easement is owned by the town (although recently it was clarified that the town will own it, once the rail trail construction is complete; the Sunoco gas station currently owns the easement).
- **Site ID – 10, Town Hall Bump Out (Score 12)** – although these practices (Site IDs 10, 15, 31 and 32) are small, it was agreed upon in both meetings by members of the Town, NRPC, Stone and DEC that implementing 4 total bumpouts in a small project area would collectively treat a comparable amount of stormwater runoff compared to higher scoring projects. Benefits of these being highly visible demonstration projects that could be used as public outreach tools in the future was also discussed. Since these projects are relatively simple to construct, it was thought that benefits could be realized by using the towns skills to construct the projects (John Nutting stated that they’d be able to construct the bumpouts).
- **Site ID – 11, Richford Elementary Project #1 (Score 14)** - advanced to concept design due to the higher implementation score, treatment of the majority of the school access road, discharge to a Missisquoi River tributary, and potential partnership with school.
- **Site ID – 12, Noyes Street Swale (Score 14)** – not pursued as the Town expects the landowner will not cooperate on this project, and that all runoff that runs through this swale leads to a wetland in the back of the property.
- **Site ID – 13, Center Street bioretention (Score 13)** – this project was not pursued following information received that the fill placed in this small parcel was thought to be fine material

that would not infiltrate water well. The Town noted that there was a tennis court with clay soils on this site; soil testing would be needed.

- **Site ID – 14, Center Street bump outs (Score 13)** – this project was not pursued due to an expected issue with basements flooding in the area. The Town noted houses in the area have sump pumps. Would need to test infiltration and seasonal water table.
- **Site ID – 15, Troy St. Main St. Bumpout (Score 11)** – see explanation for Site ID 10.
- **Site ID – 16, 10' Culvert at Guilmette (No Score)** – project not anticipated to match well with funding programs to be pursued to obtain SWMP implementation funds.
- **Site ID – 17, Rt. 105 Paved Swale (Score 16)** – not pursued since the town intends to address this project in the future. Town agrees with practice and noted the municipality could install the practice.
- **Site ID – 18, Maple Street Swale (Score 14)** – not pursued as it was thought that this project would only benefit the adjacent homeowner. Flow through this system eventually leads to the wetland adjacent to the gas station.
- **Site ID – 31, Main Street Bumpout #2 (Score 11)** – see explanation for Site ID 10.
- **Site ID – 32, Main Street Bumpout #3 (Score 11)** – see explanation for Site ID 10.
- **Site ID – 33, Missisquoi Trib (Score 19)** – see explanation for Site ID 2.
- **Site ID – 34, Richford Elementary Project #2 (Score 15)** – advanced to concept design due to the higher implementation score, treatment of the majority of the school parking lot, discharge to a Missisquoi River tributary, and potential partnership with school.

December 19, 2018

To: Amanda Holland, NRPC

From: Daniel Voisin, Amy Macrellis

MEMO

Stone Project No. 17-079-B

Subject: Site Considerations for Richford Rail Trail Extension and Riverwalk Projects

We have reviewed the concept plans recently circulated for the Richford Riverwalk Park, as well as the Town of Richford Transportation Path (STP Bike (36)S), as well as files available through the VTDEC Hazardous Sites FTP site related to the Camisa properties (111-113 Main Street). The DEC folder appears to be incomplete, as there are no files that are after some correspondence in 2016. There is no report from Weston & Sampson that corresponds to the site plan included in the e-mail received from Amanda on Dec. 17.

We offer a few initial thoughts:

1. Our work with the Richford AWA indicates that the area proposed for the Riverwalk Park historically included some amount of rail transport with a large saw mill / plywood manufacturing plant just to the southeast. There was a rail spur that terminated roughly in the area behind 111-113 Main Street that is indicated (approximately) on Weston and Sampson's Figure 2.
2. Weston and Sampson's preliminary work indicates that soils east of the Main Street area contain PAHs at concentrations that exceed the industrial regional screening levels (RSLs). Note: DEC uses the residential RSL as the default relevant regulatory criteria, but also need to consider its Urban-n
 - a. The hot spot of PAHs contamination does not line up well with the rail spur. It's almost random but could be attributed to this area being a lay down area for the rail, or a convenient place to dump coal ash.
 - b. Data are limited to the assessment of the 113 Main Street property, but we should expect to find similar soils in just about any portion of the project area.

Since the file appeared to be incomplete, we contacted Sarah Bartlett in the VTDEC Hazardous Sites Section. She reported that W&S was engaged in 2017 through the VTDEC Brownfield Assessment Contract to prepare a CAP. They conducted additional sampling in the back portion of 113 Main, but VTDEC does not have these data. Also, the CAP would only cover the 111-113 parcels. Sarah reported that the proposed recreation area project is in flux. Greta indicated to Sarah that changes were likely for the concept drawing, which resulted in DEC putting the brakes on W&S finalizing the CAP.

Due to the nature of the redevelopment and the challenges related to the natural resource issues (wetland, flood plain, etc.) it looks like any “capping” for remedy will be problematic. The project may be required to remove equal amounts of soil to allow for installation of a barrier without adding to the grade. This may be problematic in the area of hydric soils.

We recommend the following next steps:

1. Engage all stakeholders at the same time in a working meeting, reviewing issues and intended outcomes. This would need to include DEC Wetlands, Rivers, Sites Management, etc. as well as key NRPC staff (Amanda and Greta), Stone, and W&S.
2. Consider a quantitative risk assessment for the project prior to proceeding with the CAP to establish a site-specific cleanup value. Given the short, recreation-based exposure, they may be able to leave many more portions of the site as-is without remedial action than they otherwise would using generic values.
3. In any area that is proposed to have an infiltration-based SW treatment, SPLP analyses should be performed to ensure groundwater would not be adversely affected.

Richford SWMP – Final Stakeholder Meeting

December 20, 2018

Attendees:

John Nutting, Linda Collins & Arthur Pond (Town of Richford)

NRPC: Amanda Holland

Stone: Gabe Bolin (by phone)

Notes (Compiled by Gabe and Amanda)

- Gabe walking group through the report layout and sections. Overall goal: trying to treat for sediment and P related to Missisquoi impairments; less so for infiltration due to Brownfields/contamination issues. Areas that were focused on were existing development; private property impacting municipal ROW; and localized erosion.
- Section 4, prioritization criteria – added criteria to account for existing contamination in village
- Walking through how cost estimates were developed
 - Estimates are conservative at this 30% design level to ensure we have enough funding to build the projects
 - Estimates were developed assuming they would be bid on by contractors, and that the town would not do the construction – again, to be conservative and make sure there was enough funding if the town was too busy.
 - Bump out example: cost of 4 bump-outs \$78,100; conservative figures and includes a 20% contingency; includes cost to tie into existing drainage system \$4,000 each, to account for any other utilities we may find/encounter and problems associated with that. Items like traffic control and mob/demob would go away if the town performed the work.
 - **Action Item: Table 1 or 2 in report - add a small note under tables that states these costs are all assuming they're contractor completed, and costs could be reduced if completed by municipality.**
 - Note that the costs provided in Table 1 are at the 10% design level; costs for projects advanced to 30% design are more refined and at the 30% design level.
 - For projects 2 and 33, Ann Smith partnering with Lindsey Wright from Missisquoi River Basin Association, is pursuing funding to develop these projects. DEC initially told us those projects were not a priority for ERP and therefore were not selected for further development under this contract.
- Projects advanced to 30% design
 - Gabe provided summary of school projects and conversation with principal. Came up with 3.1 acres of impervious at the school, so expect that school will have to comply with 3-acre permit. Principal O'Brien was on board with projects when she learned this. Will need to review once permit comes out if these practices will cover them completely/put them in compliance.
 - TD Bank – proposed practice receives water from Main Street, and possibly flows from TD Bank parking and gas station. Point of practice is to filter out P and contaminants prior to discharge to river.
 - Width of easement about 38 feet.
 - Water then goes over river bank (rill erosion present during survey). We were initially under the impression that town owned the easement between Sunoco and TD Bank. However plans changed when we learned the easement will be access to the rail trail. Presented initial design, and also presented changes to accommodate rail trail access. Art shared that flows from behind the gas station also lead to our

proposed practice area. For final design, let's look at flow coming from gas station. Does flow come from TD Bank area? Roofs? John stated there's a grade break behind gas station.

- The current practice was proposed to be within the municipal ROW but during final design could engage adjacent property owners to discuss solutions that could extend onto adjacent properties.
- Town not able to commit to any construction in 2019, has too many other commitments. But they would be willing to move school and bumpout projects towards final design. Wait on TD Bank project until after rail trail is constructed (2019). Still have to negotiate with landowners.
- Is all of this effort regarding stormwater helping Town to be in compliance? Response: There's actually nothing in place right now that is requiring compliance. As of now, funding is available. So it's good to keep pursuing and moving the projects forward. Glad stream projects are being pursued, LCBP funding available for those.

Appendix G. Batch Input File for VTDEC Tracking

Grant number	Project Name	O&M Responsible Party	Latitude	Longitude	Drainage area	Watershed Projects Database number	BMP Type (See BMP definitions Tab)	Impervious area treated (acres)	Impervious land use	Pervious area treated (acres)	Pervious land use	Storage volume (cuft)	Infiltration rate (in/h)	Is this an upgrade to an existing BMP?	If upgrade, enter previous storage volume (cuft)	Enter previous BMP type if changed	If the drainage area changed, what is the previous drainage area?	BMP status	Date of Planned Construction	Notes if applicable
2018-CWF-S-1-02	1-North Avenue and Dewey Street	Town of Richford	45.00123	-72.67141	12-MISSISSQUOI RIVER		Gravel Wetland	0.51	Developed Impervious	1.60	Developed Pervious	2,400		No				Planned		
2018-CWF-S-1-02	2-Upstream tributary		45.00105	-72.67073	12-MISSISSQUOI RIVER		Regenerative Conveyance	4.24	Developed Impervious	14.19	Developed Pervious	8,000		No				Planned		
2018-CWF-S-1-02	3-Private farm culvert on Hamilton Place Ext.		45.00157	-72.67050	12-MISSISSQUOI RIVER		No New BMP Proposed	0.49	Developed Impervious	7.74	Developed Pervious	0		No						
2018-CWF-S-1-02	4-North Ave and River St. @ Missi	Town of Richford	44.99769	-72.67451	12-MISSISSQUOI RIVER		Gravel Wetland	3.10	Developed Impervious	5.63	Developed Pervious	4,000		No				Planned		
2018-CWF-S-1-02	5-Vista Park		44.99648	-72.67171	12-MISSISSQUOI RIVER		Bioretention	3.81	Developed Impervious	2.65	Developed Pervious	7,500		No				Planned		
2018-CWF-S-1-02	6-Bioswale Across From Vista Supermarket		44.99605	-72.67223	12-MISSISSQUOI RIVER		Bioretention	0.17	Developed Impervious	0.03	Developed Pervious	600		No				Planned		
2018-CWF-S-1-02	7-Powell St. Bump Out	Town of Richford	44.99621	-72.67340	12-MISSISSQUOI RIVER		Bioretention	0.40	Developed Impervious	0.54	Developed Pervious	100		No				Planned		
2018-CWF-S-1-02	8-Vista Supermarket back parking lot		44.99662	-72.67325	12-MISSISSQUOI RIVER		Deep Sump Catch Basin	0.55	Developed Impervious	1.57	Developed Pervious	1,800		No				Planned		
2018-CWF-S-1-02	9-TD Bank Bioretention	Town of Richford	44.99481	-72.67235	12-MISSISSQUOI RIVER		Bioretention	0.52	Developed Impervious	0.11	Developed Pervious	2,500		No				Preliminary Design	2020	Possible coordination with construction of Rail Trail Extension, anticipated 2019-2020.
2018-CWF-S-1-02	10-Town Hall Bump Out	Town of Richford	44.99480	-72.67314	12-MISSISSQUOI RIVER		Bioretention	0.48	Developed Impervious	0.47	Developed Pervious	250		No				Preliminary Design		Concept plan includes bump-outs at locations 10, 15, 31, and 32
2018-CWF-S-1-02	11-Richford Elementary Project N	Franklin Northeast S	44.98550	-72.67988	12-MISSISSQUOI RIVER		Bioretention	0.45	Developed Impervious	0.05	Developed Pervious	2,250		No				Preliminary Design		
2018-CWF-S-1-02	12-Noyes Street Swale	Town of Richford	44.98843	-72.67455	12-MISSISSQUOI RIVER		Bioretention	0.47	Developed Impervious	1.51	Developed Pervious	2,000		No				Planned		
2018-CWF-S-1-02	13-Center Street bioretention	Town of Richford	44.98928	-72.67197	12-MISSISSQUOI RIVER		Bioretention	0.87	Developed Impervious	2.68	Developed Pervious	2,400		No				Planned		
2018-CWF-S-1-02	14-Center Street Bump Outs	Town of Richford	44.99086	-72.67223	12-MISSISSQUOI RIVER		Bioretention	0.96	Developed Impervious	3.99	Developed Pervious	200		No				Planned		
2018-CWF-S-1-02	15-Troy St. - Main St. Bump Out	Town of Richford	44.99348	-72.67377	12-MISSISSQUOI RIVER		Bioretention	0.27	Developed Impervious	0.48	Developed Pervious	500		No				Preliminary Design		Concept plan includes bump-outs at locations 10, 15, 31, and 32
2018-CWF-S-1-02	16-10' culvert at Guilmette		44.97352	-72.65637	12-MISSISSQUOI RIVER		No New BMP Proposed	17.86	Developed Impervious	1767.74	Developed Pervious	0		No						
2018-CWF-S-1-02	17-Rt. 105 Paved Swale	Town of Richford	44.98959	-72.67603	12-MISSISSQUOI RIVER		Grass Swale	0.42	Developed Impervious	1.22	Developed Pervious	3,750		No				Planned		
2018-CWF-S-1-02	18-Maple Street Swale	Town of Richford	44.98976	-72.67654	12-MISSISSQUOI RIVER		Grass Swale	0.55	Developed Impervious	2.58	Developed Pervious	4,000		No				Planned		
2018-CWF-S-1-02	31-Main Street Bump Out No. 2	Town of Richford	44.99451	-72.67331	12-MISSISSQUOI RIVER		Bioretention	0.15	Developed Impervious	0.68	Developed Pervious	125		No				Preliminary Design		Concept plan includes bump-outs at locations 10, 15, 31, and 32
2018-CWF-S-1-02	32-Main Street Bump Out No. 3	Town of Richford	44.99415	-72.67352	12-MISSISSQUOI RIVER		Bioretention	0.30	Developed Impervious	0.45	Developed Pervious	125		No				Preliminary Design		Concept plan includes bump-outs at locations 10, 15, 31, and 32
2018-CWF-S-1-02	33-Missisquoi Trib		45.00153	-72.67120	12-MISSISSQUOI RIVER		Regenerative Conveyance	5.51	Developed Impervious	26.32	Developed Pervious	12,000		No				Planned		
2018-CWF-S-1-02	34-Richford Elementary Project #	Franklin Northeast S	44.98463	-72.67939	12-MISSISSQUOI RIVER		Gravel Wetland	0.84	Developed Impervious	1.62	Developed Pervious	4,000		No				Preliminary Design		

Source file: DEC WPC Bulk Upload Table_2018-CWF-S-1-02.xlsx

