STORMWATER MANAGEMENT PLAN FOR SHELDON

FINAL REPORT

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Prepared for:

Friends of Northern Lake Champlain
P.O. Box 58
Swanton, VT 05488
Tel. / 802.355.0694
E-Mail / denisefnlc@gmail.com
Friends of Northern Lake Champlain

Prepared by:

Stone Environmental, Inc.
535 Stone Cutters Way
Montpelier, VT 05602
Tel. / 802.229.4541
E-Mail / sei@stone-env.com

STONE ENVIRONMENTAL INC

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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 Town-wide Stormwater Management 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., town-wide) to determine their relative contributions, and aid in setting priorities for addressing challenges related to stormwater runoff. As adjoining towns 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 Background

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 waters. 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.

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.

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 degradation of water quality (NRC 2009).

Watershed management practices have direct impacts on water quality in local creeks and streams (e.g., Black Creek, Missisquoi River), as well as downstream waterbodies (e.g., Lake Champlain). Any decisions that affect land use have stormwater management ramifications and, in turn, impact all downstream water resources. The findings of one study (Troy et al. 2007) suggest that “land-use changes in the Basin have increased phosphorus levels in Lake Champlain, especially conversion of agricultural areas and forests to developed uses.”

Vermont's streams, rivers, and Lake Champlain are vital economic resources. As such, the quality of local receiving waters affects both economic interests and quality of life in the surrounding areas. Throughout the Champlain Valley, 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.

1.2. Goals of this Project

The Sheldon Town Plan states: *Since Sheldon has no major lakes or ponds, the Missisquoi River is the Town's principal surface water feature... Maintaining the quality of the river is of extreme importance. Not only does it affect the Town, but also it has the potential to directly affect the Missisquoi River Delta and consequently, Lake Champlain* (Town of Sheldon 2010).

In order to protect the quality of the Missisquoi River, the quality and quantity of stormwater runoff from existing development must be well-managed. The ultimate goal of this project is to provide the Town of Sheldon with a list of high priority water resource concerns, including conceptual solutions for each, which will inform and support the development and implementation of restoration projects in an efficient and targeted manner. The Stormwater Management Plan first, however, incorporates information from existing plans and datasets to create a single, town-specific resource to guide future stormwater management activities. This Stormwater Management Planning Library, included as Appendix B, is a valuable resource for the future regarding any water quality-related work in Sheldon.

This Stormwater Management Plan also:

- Identifies stormwater-related areas of active erosion or other sources of sediment that are being delivered directly to water bodies in the Town of Sheldon;
- Develops recommendations to address stormwater problems, including:
    - A list of problem areas that can assist stakeholders in directing resources to high priority projects;
    - Conceptual solutions for high-priority problem areas (Section 4.3); and
    - Potential revisions to town ordinances to encourage location-specific management activities.

2. GENERAL DESCRIPTION OF THE STUDY AREAS

The Town of Sheldon is located in Franklin County in northwest Vermont, and is bordered by five towns (Highgate, Swanton, Fairfield, Enosburgh, and Franklin). The town has a total area of 38.8 square miles, most of which is farmland and woodland. Development in the area is primarily concentrated in Sheldon and Sheldon Springs. As of the 2010 US Census, the population of the town was 2,190.

Sheldon lies fully within the Lake Champlain basin, and has a number of rivers and streams within its borders, including portions of Hungerford Brook, Missisquoi River, McGowan Brook, Black Creek, Morrow Brook, Goodsell Brook and Tyler Branch (see Figure 1, Appendix A for a map of watershed boundaries).

2.1. Missisquoi River

The Missisquoi River is the largest tributary to Lake Champlain's Missisquoi Bay. From its headwaters in Lowell, Vermont, the Missisquoi River flows north into Quebec where the Missisquoi Nord joins the main stem at Highwater, Quebec. The river returns to Vermont at East Richford and flows south through the heart of Sheldon and ultimately west, through the southern and western portions of Highgate, to Missisquoi Bay—for a total length of approximately 88 miles. The majority of the Town of Sheldon, including Sheldon Springs and the surrounding development, drains directly to the main stem of the Missisquoi River. The whole length of the Missisquoi River is considered by the State of Vermont to be stressed from high sediment loads, turbidity, nutrient enrichment, and increased water temperature; the State attributes the stressors to agricultural land uses, loss of riparian vegetation, and streambank erosion (VTDEC, 2012). No specific impairment or remedial action plan, however, has been identified by the State.

2.2. Black Creek

Black Creek is one of the largest tributaries to the Missisquoi River and drains 122 square miles, including Sheldon Village and the south-central portion of town. The Black Creek watershed also includes most of Fairfield and sections of the surrounding towns to the southeast. Its mainstem begins at Metcalf Pond in Fletcher before flowing southeast through Cambridge and bending northwest through the heart of Fairfield. It enters Sheldon at the southern town line and joins the Missisquoi River just north of Sheldon Village. Along its length, the creek flows through a variety of landscapes including wetland, hay and corn fields, pastureland, forest, and developed areas and village centers. There are a number of natural and manmade obstructions altering Black Creek's flow including beaver dams, manmade dams, and road crossings. Twelve miles of the stream's channel, from the creek's terminus extending upstream through Sheldon to East Fairfield, have been classified by the state as stressed due to nutrient enrichment, turbidity, thermal changes, sedimentation, and the loss of riparian buffers (VTDEC, 2012).

2.3. The Tyler Branch

The Tyler Branch is another major tributary to the Missisquoi River and drains approximately 58 square miles. The main stem is 11 miles long, and flows northeast through Bakersfield and Enosburgh before joining the Missisquoi in eastern Sheldon. Most of the watershed is forested, and less than a fifth is used for agriculture. The State has classified Tyler Branch as a body of "water in need of further assessment," meaning that additional data is needed to confirm whether the Tyler Branch fully complies with the Vermont Water Quality Standards (VTDEC, 2012). As such, the Tyler Branch is considered high priority for State-led assessment and monitoring activities.

2.4. Hungerford Brook

Hungerford Brook drains a small portion of western Sheldon, flowing northwest into the Missisquoi main stem and eventually into Lake Champlain. It flows northward from St Albans Town into Swanton before passing briefly through the western corner of Sheldon and entering Highgate, where it ultimately empties into the Missisquoi River. Watershed impacts such as direct cattle access to the stream, close cropping with small or absent buffers, channel alteration, and direct inputs of stormwater runoff have been repeatedly observed during numerous studies of the brook (VTANR, 2013).

2.5. McGowan Brook

McGowan Brook has a 6.4 mile long main channel which passes through primarily forested land along its length. It forms in Franklin, flows south through the eastern corner of Highgate, and enters north-central Sheldon before bending west to its confluence with the Missisquoi River.

2.6. Other Watersheds in Sheldon

Two small watersheds, Morrow Brook and Goodsell Brook, drain the southeastern portion of Sheldon directly into the Missisquoi River. The Morrow Brook watershed, draining approximately 6.4 square miles, is characterized by a near equal mix of forest and agriculture. Goodsell Brook, drains about 9.6 square miles, it’s watershed is dominated by farmland.

3. EXISTING PLANS AND DATA

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Sheldon's water resources, and the important interface between water resources and local land use decisions. At times these evaluations have followed watershed boundaries and other times they have followed political boundaries. The following sections identify evaluations that have been done to date and pull out the pieces that are most relevant to Sheldon and to future efforts to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Sheldon.

3.1. Watershed-Based Assessments

The watershed-based assessments summarized below and presented in more detail in Appendix B of this report are generally led by the Agency of Natural Resources. These include:

- Basin planning, completed primarily to guide VTANR 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 draft *Missisquoi River Basin Water Quality Management Plan* (VTANR, 2013) covers the entire Town of Sheldon. In addition, in 2008, USDA's Natural Resource Conservation Service (NRCS) completed the *Missisquoi Areawide Plan*, a watershed-based plan specifically structured to inform and help guide the conservation efforts of partner agencies and cooperating farmers.
- Critical source area (CSA) evaluation, to identify areas of the landscape that, absent proper management, are likely to produce disproportionate amount of phosphorus loading to adjacent waterways. In 2011, detailed data about the distribution of potential CSAs of phosphorus pollution in the Missisquoi River watershed were developed using a Soil and Water Assessment (SWAT) model.
- Stream geomorphic assessments (SGA), undertaken to understand the natural tendencies of a particular reach of stream or river, its current condition, and what changes may be anticipated in the future. Stream geomorphic assessments have been completed for Black Creek, Hungerford Brook, and the Tyler Branch in Sheldon. Although a stream geomorphic assessment has also been completed for the Missisquoi River between the Black Creek and Hungerford Brook, the report is currently unavailable through DEC's stream geomorphic assessment website.
- Water quality monitoring and biological assessments. Since 2005, water samples have been collected by the Missisquoi River Basin Association at four sites in Sheldon for one or more years. Water samples have also been collected on the Missisquoi River (two sites), on Black Creek (one site), and on an unnamed tributary to Hungerford Brook (one site).
- Stormwater infrastructure mapping and illicit discharge survey work (VTDEC 2009). Vermont DEC developed up-to-date municipal drainage maps for six communities in the Missisquoi River Basin. The drainage maps show stormwater infrastructure, including features like pipes, manholes, catchbasins, and swales within a municipality. Data sources include data collected from field work, available state permit plans, record drawings, town plans, existing GIS data from contractors, and the input and guidance of knowledgeable members of the municipalities. As part of the project, Vermont DEC also identified potential locations for Best Management Practice (BMP) stormwater retrofit sites. Three high-priority sites were identified in Sheldon

Springs. These are sites where stormwater treatment structures could be cost-effectively added or improved.

- TMDL development, to establish the maximum amount of a pollutant (e.g., bacteria, nutrients, excess stormwater flows) that a waterbody can assimilate and still meet state-established water quality standards. TMDLs are based on the relationship between pollution sources and in-stream water quality conditions, and a TMDL addresses a single pollutant or stressor for each waterbody. The previously approved Lake Champlain phosphorus TMDL is currently under review by EPA Region 1 (VTDEC, 2012).

3.2. Town-Wide Assessments and Programs

In addition to the watershed-based assessments, a number of data sources are developed on a municipality-by-municipality basis. These are important to fold into any effort to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Sheldon. These include direct feedback from the Town, work by the Vermont Agency of Transportation, and past and current planning initiatives.

- In meetings with Stone Environmental, Town officials identified 14 areas of concern and priority projects throughout Sheldon, ranging from areas of active stream erosion to road flooding during high-water events. See Figure 15 and Table 2 in Appendix B (pages 50-51) for a map and table of concern areas and priority projects.
- VTrans-sponsored programs, including routine inspections of bridges and culverts and grant opportunities provided by the Better Backroads Program, have identified a number of potential projects to protect existing infrastructure whose implementation would also improve stormwater management.
- Sheldon's Town Plan recognizes both the important recreational opportunities that the Town's surface water resources provide, and that problems of pollution continue. Provisions are in place to limit development in sensitive areas in order to safeguard vital water resources against degradation.
- Sheldon's zoning regulations include standards for development on land with a slope in excess of 20 percent, but these standards do not apply to development on less sensitive parcels. The regulations also do not contain specific support for low impact development (LID) stormwater management strategies.

4. STORMWATER PROBLEM AREAS

One of the goals of this Plan is to "develop a comprehensive list of stormwater problems". To achieve this goal, a thorough effort was made to identify existing problem areas, and then to evaluate existing conditions and potential solutions.

4.1. Identification of Problem Areas

The first task was to identify the location and nature of existing drainage problems, and where appropriate, to gather field data for further analysis. The approach to identifying potential problem areas included the following elements:

- Reviewing existing plans and data, as described in Section 3 above, and noting the locations of any concerns related to stormwater
- Engagement with local officials, including:
  - May 3rd, kick-off meeting with the Road Foreman
  - May 23rd, meeting with the Road Foreman and another equipment operator
- Targeted site visits to verify problems areas (June and July 2013)
- Documentation (with photos) of existing problem areas

A "problem area data sheet" was developed and used as a guide to ensure consistent information was collected as site visits were completed. More than 20 potential problem areas were identified and geo-located. The data sheets for all of the problem areas identified in the Town of Sheldon are provided in Appendix C of this report.

4.2. Evaluation of Problem Areas

Working from the list of potential problem areas, the Consultant Team visited each potential problem area to directly observe the site. Where an unresolved problem was found, photos were taken of any areas of active erosion, as well as observations about the source or cause.

Each problem area was given a score, with the intent of generally assessing the severity of existing problems, removing low priority problem areas from the dataset, and providing general guidance on the relative order in which the problems should be addressed when considered town-wide (Appendix C). Scores were assigned as follows:

Level	Classification
1	Outside of project scope or infeasible to remedy due to project size.
2	Stable, but problem could escalate with future change in surrounding land use.
3	Small to moderate erosion and/or drainage problems are present; issues could be readily addressed.
4	Significant erosion and/or drainage problems are present; issues may be readily addressed.

4.3. Conceptual Solutions to High Priority Problem Areas

In Sheldon, nine problem areas were assigned a Level 3 or 4 classification; these areas were subject to more detailed investigation. The first phase of the detailed investigation involved desktop analysis to determine:

- Drainage area contributing to the known problem,

- Underlying soils, with particular attention to the presence of highly erodible soils (e.g., $k > 0.17$),
- Location of any existing stormwater infrastructure,
- Proximity to the nearest surface water feature,
- Whether the Town identified the area for planned future growth, and
- Potential location or locations most suitable for stormwater treatment practices, taking into account topography and existing development (if any).

A map of each high-priority problem area including all of these features was prepared (Appendix D). These sites were revisited to further investigate treatment potential and gather information for conceptual solutions, including more detailed information on the contributing drainage area, soil conditions, and traffic and pedestrian flow. These data were collected in order to better evaluate anticipated water quality benefits and constructability. In some locations, several areas were grouped together because of the inter-related nature of the stormwater management needs. In other locations, conceptual solutions were not developed for one of the following reasons:

- The stormwater concerns involve issues where it would be not be appropriate for the Town to assume a leadership role (e.g., private property);
- The stormwater concern did not rise to the level of demanding immediate action.

In total, nine conceptual solutions were developed to address problem areas that were assigned a Level 3 or 4 classification; each is described in the following sections.

4.3.1. Sheldon Springs (Problem Area ID: MR-7)

Significant amounts of impervious cover, outdated stormwater infrastructure, and heavy truck traffic have led to a variety of erosion and drainage issues in Sheldon Springs near the RockTenn facility. Several potential stormwater improvement projects have been identified, but a comprehensive engineering study is required to fully characterize the drainage and sediment transport problems.

Soils in the Sheldon Springs area around the RockTenn facility appear to be well-drained sandy loams, but are very rocky. The topography is terraced and quite steep in many areas. The impervious surfaces in the area are expansive and include several large, gravel parking areas. Stormwater impacts could be greatly reduced by grading gravel surfaces in a manner to direct drainage towards stormwater treatment practices and/or paving them. Pervious pavement in select areas may also be an option to reduce stormwater runoff.

The locations of potential stormwater improvement opportunities are shown in Figure 1.

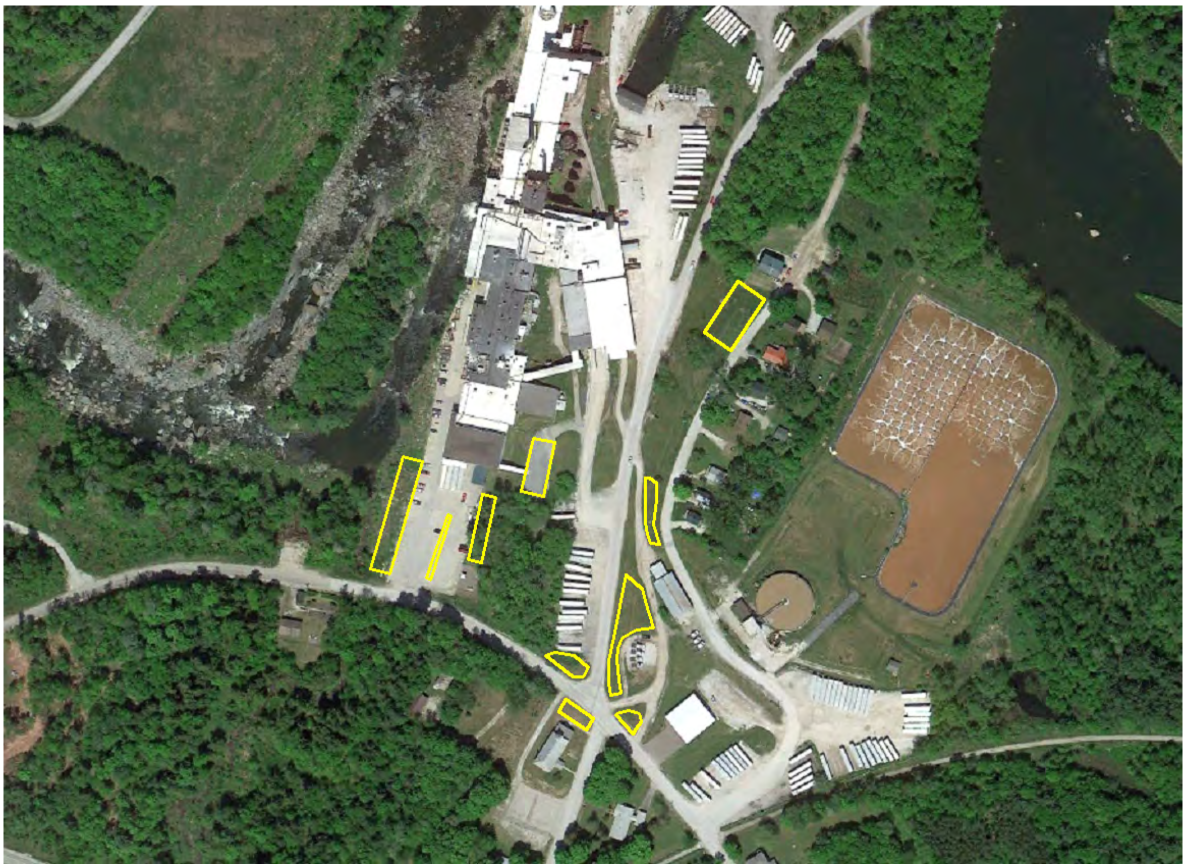

Figure 1. Several stormwater treatment opportunities (highlighted) exist in Sheldon Springs near the RockTenn facility.

4.3.2. Church Street (Problem Area ID: BC-5)

Church Street is a narrow paved road serving three buildings, with a paved parking lot along the east side of a church and a steep bank leading down the rail trail to the west. The culvert that drains a large portion of this area is crushed and clogged with debris. The culvert outlets onto the steep bank, approximately 150 feet from the Black Creek. Due to the condition of the culvert, most of the runoff from the area appears to run over the road, and is eroding the top of the bank. The guard-posts along the top of the bank have begun to fall over the edge.

While there is not enough space in this narrow section of road to provide adequate ditching, there is an opportunity to install a bioretention practice at the church. Such a practice could capture, slow, and treat the runoff from a significant portion of the area's impervious surface. Since the existing culvert is crushed and clogged, it should be replaced with one that meets current standards.

The locations of potential improvement opportunities are illustrated in Figure 2.

Figure 2. The location of a potential bioretention practice location on Church Street is highlighted in green; a culvert replacement opportunity is highlighted in yellow.

4.3.3. Swamp Road (Problem Area ID: GB-1)

A culvert that conveys Goodsell Brook under Swamp Road is too short for the current width of the road. The resulting over-steepened slope, coupled with unmanaged stormwater runoff from the road surface, has created unstable conditions at both the inlet and outlet of the culvert. Generally, vegetated slopes should be limited to 2:1 (horizontal to vertical) to maintain stable conditions. Erosion of this slope will likely soon lead to deteriorating road conditions. In addition, the existing culvert pipe is undersized (approximately one-half bankfull width), and a large scour pool has formed on the downstream side of the culvert. The location of the culvert is indicated in Figure 3.

Given the deteriorating condition of the culvert and surrounding banks, it is a good candidate for replacement. The replacement culvert should be long enough to accommodate 2:1 (H:V) slopes at the inlet and outlet, and sized such that it matches the stream's bankfull width, and so that $1/6^{th}$ of the culvert can be buried at bankfull stream width to provide a natural bottom.

Figure 3. The location of a culvert replacement opportunity on Swamp Road.

4.3.4. Kittell Road (Problem Area ID: GB-2)

A section of an unnamed tributary to Goodsell Brook on the south side of Kittell Road, just west of Riley Road, is actively eroding (Figure 4). Several sections of the bank have sloughed into the stream channel. Vegetation on the banks is mowed to less than an inch and only a single tree is left along the bank in this section. The planting of woody, deep-rooted vegetation should be an important component of any solution to address the bank erosion.

Additionally, a gravel stockpile sits at the southeast corner of Kittell Road and Riley Road. Sediment from the gravel pile appears to be washing into the unnamed tributary, about 10 feet away. The pile should be moved or covered to prevent further loss of material.

Figure 4. At left, eroding stream banks are sloughing into the stream. Vegetation is mowed up to the edge of the banks. At right, a large gravel stockpile sits 10 feet from the stream.

4.3.5. Dutton Road (Problem Area ID: MR-3)

As with many of the roads in Sheldon, sections of Dunton Road have a shoulder lip, which prevents runoff from leaving the road surface and entering the ditches as sheetflow. In this case, the excess water has caused a secondary swale on the road surface, leading to accelerated erosion near the edge of the road and, where water does break through, large deposits of road sediment in local ditches (Figure 5). Measures to prevent this type of erosion include:

- Crowning the roadway so water does not remain on the road surface. For roadways that are not super-elevated, this generally means a 2-4% (1/4” - 1/2” per ft) crown for gravel roads and a 1-2% (1/8” - 1/4” per ft) crown for paved roads to promote sheeting of water.
- Avoiding creation of a ridge or berm between the crown and the ditch when grading gravel roadways. Any berm along the roadway shoulder that prevents the proper sheeting of water should be removed.
- Roadways should have at least a 15-inch thick processed gravel subbase, with the top 3 inches (minimum) as crushed gravel.

The Federal Highway Administration’s *Gravel Roads: Maintenance and Design Manual* is a good reference guide.

Figure 5. Road grading and crowning improvement opportunity on Dunton Road.

4.3.6. Maple Glen Road (Problem Area ID: MR-4)

Sections of Maple Glen Road near the intersection with Poor Farm Road (Figure 6) have a ridge between the road crown and the ditch, which prevents runoff from leaving the road surface and entering the ditches as sheetflow. Similar to Dutton Road, the excess water has formed a "secondary swale" in the roadway near the edge of the travel surface, leading to increased sediment transport and accelerated erosion. Again, this is an opportunity where additional road maintenance could vastly reduce the erosive conditions and have a dramatic impact on water quality.

Figure 6. Road grading and crowning improvement opportunity on Maple Glen Road.

4.3.7. East Sheldon Road (Problem Area ID: MR-11)

The culvert conveying Morrow Brook under East Sheldon Road is significantly undersized (approximately 1/8th bank-full width), and the bank above the culvert inlet is over-steepened (approximately 1:1 slope). As a result, stormwater runoff from East Sheldon Road has eroded large portions of the bank around the culvert. The inlet portion of the culvert has broken and water is beginning to wash around and below the exterior of the pipe. It appears that the culvert has begun to settle and will soon affect the road. Further, there is a large scour pool at the culvert's outlet. The culvert outlets into a pasture where farm animals have direct access to the stream. The banks downstream from the culvert are vertical and unstable (see Figure 7).

In general terms, the replacement culvert should be long enough to accommodate 2:1 slopes at the inlet and outlet, and sized such that it matches the stream's bankfull width and can be buried at 1/6th bankfull stream width to provide a natural bottom. Additionally, animal access to the stream should be addressed (e.g., restricted to a stabilized crossing).

Figure 7. A large scour pool has formed at the outlet of an undersized culvert. Additionally, animals are grazed in this pasture and have direct access to the stream.

4.3.8. Morey Road (Problem Area ID: HB-1)

The section of Morey Road between Woodshill Road and Heald Road has four culverts (Figure 8) that are too short for the current width of the road, resulting in unstable conditions at both the inlets and outlets. Erosion of the over-steepened slopes surrounding the culvert by stormwater runoff from the road surface will lead to deteriorating road shoulder conditions in the near- to medium-term. A replacement culvert should be long enough to accommodate vegetated slopes which are at least 2:1 (H:V) to maintain stable conditions. Another option may be to construct headwalls at the inlets and outlets of each culvert in order to stabilize and protect the banks from further erosion.

Figure 8. The locations of four undersized culverts along Morey Road.

4.3.9. Bushey Road (Problem Area ID: HB-2)

A culvert that conveys an unnamed tributary of the Hungerford Brook under Bushey Road is too short for the current width of the road. The resulting embankment slope, coupled with stormwater runoff from the road surface, has created unstable conditions on the banks. Generally, vegetated slopes should be limited to 2:1 (horizontal to vertical) to maintain stable conditions. The erosion of this over-steepened slope will likely soon lead to deteriorating road conditions. The existing culvert pipe is undersized (approximately one-half bankfull width), resulting in a large scour pool on the downstream side (Figure 9).

Any replacement culvert should be long enough to accommodate 2:1 slopes at the inlet and outlet, and sized such that it matches the stream's bankfull width and can be buried at 1/6th of the bankfull stream width to provide a natural bottom.

Figure 9. A large scour pool immediately downstream from the undersized culvert beneath Bushey Road.

5. NEXT STEPS

This document represents an extensive effort to identify and evaluate potential stormwater problem areas throughout the town of Sheldon. Several high priority potential stormwater improvement projects were identified in Section 4 that the Town could pursue directly, or could work with partners to pursue funding to address.

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 project. 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.

In addition to exploring opportunities to address current stormwater management needs, Sheldon can also take steps to prevent future stormwater problems by expanding how stormwater management is addressed in zoning regulations. Specifically, Sheldon could consider incorporating one or more of the following elements into the zoning regulations:

- Require that a certain amount of stormwater runoff be treated as part of all development and redevelopment projects; and.
- Articulate a clear preference for low impact development practices that seek to infiltrate and soak away, as opposed to store and release, stormwater runoff into the land use and development regulations. Soils within the Missisquoi River floodplain, especially those in Sheldon Springs, are well suited for infiltration, and the Town should take advantage of this beneficial characteristic.

Some specific examples of how this might be accomplished include:

- Modifying access requirements to minimize impervious surfaces. Thoughtful siting and design of streets helps achieve stormwater control "at the source," which means less runoff requiring management and less impact on downstream waterbodies. Further, reducing paving lowers development and maintenance costs.
    - Mobile home parks and two-way campground roads are required to have "…a minimum right-of-way width of 33 feet…".
        - Consider reducing the minimum width for mobile home park roads and campground roads to more closely reflect actual traffic volumes.
- Revising parking standards to encourage minimal use of impervious surface. For example:
    - Define a parking space with the more typical dimensions of 9' by 18' (162 square feet), instead of the current 300 square foot suggestion per parking space.
    - Recommend or require smaller stalls for compact cars, up to 30% of the total number of parking spaces.

- Re-evaluate specified parking requirements to prevent the creation of surplus amounts of parking. For example, consider reducing the required minimum number of parking spaces for residential and mobile homes from 2 to 1.
- Require that the pads provided for mobile home lots be porous rather than non-porous.

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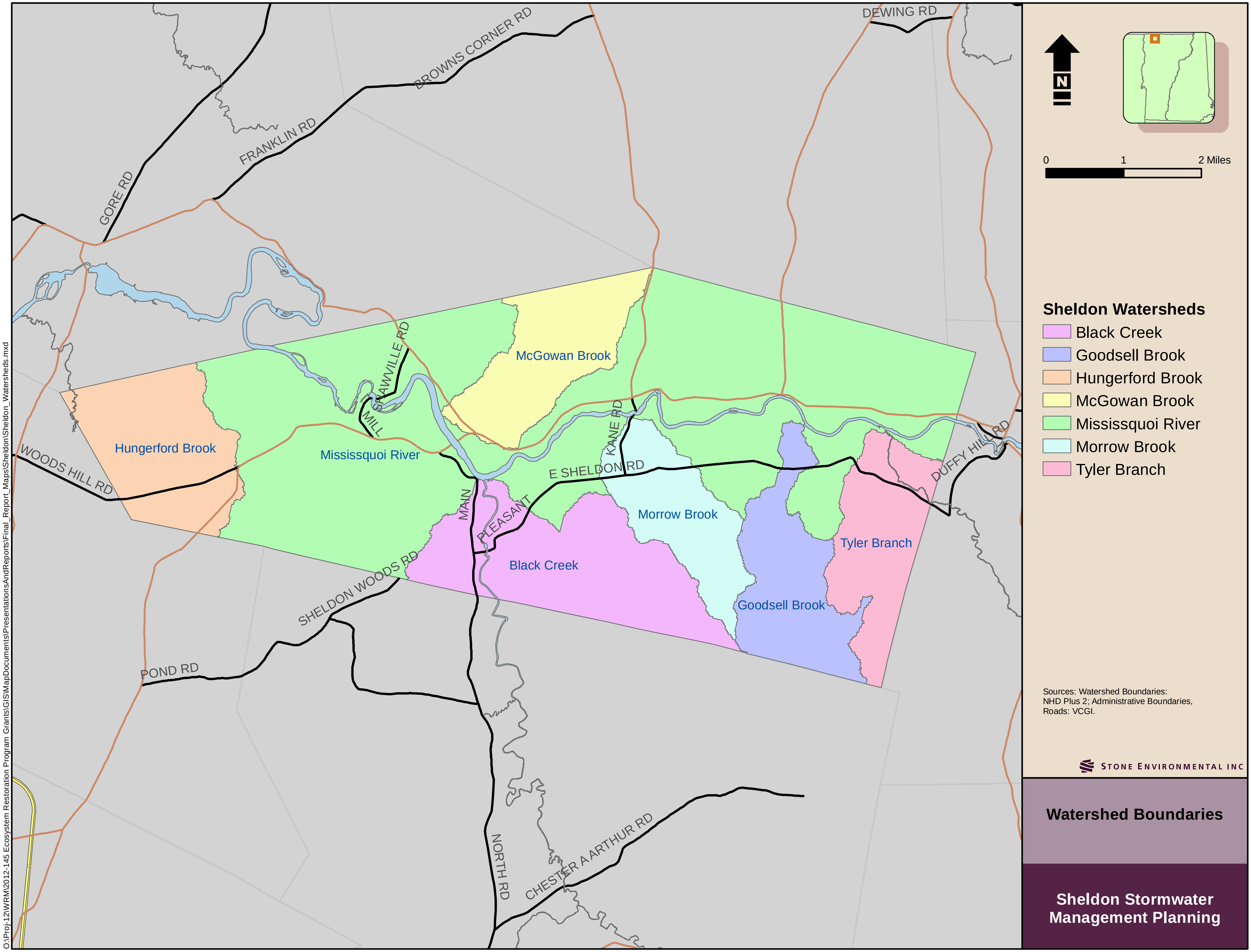
APPENDICES

APPENDIX A: WATERSHED MAP


DEWING RD
BROWNS CORNER RD
FRANKLIN RD
GORE RD
McGowan Brook
SHAWVILLE RD
MILL
Hungerford Brook
Mississquoi River
WOODS HILL RD
KANE RD
E SHELDON RD
DUFFY HILL RD
MAIN
PLEASANT
Morrow Brook
Tyler Branch
Black Creek
Goodsell Brook
SHELDON WOODS RD
POND RD
NORTH RD
CHESTER A ARTHUR RD
N
0
1
2 Miles
Sheldon Watersheds
Black Creek
Goodsell Brook
Hungerford Brook
McGowan Brook
Mississquoi River
Morrow Brook
Tyler Branch
Sources: Watershed Boundaries: NHD Plus 2; Administrative Boundaries, Roads: VCGI.
STONE ENVIRONMENTAL INC
Watershed Boundaries
Sheldon Stormwater Management Planning
O:\Proj-12\WRM\2012-145 Ecosystem Restoration Program Grants\GIS\MapDocuments\PresentationsAndReports\Final_Report_Maps\Sheldon\Sheldon_Watersheds.mxd

APPENDIX B: STORMWATER MANAGEMENT PLANNING LIBRARY

STORMWATER MANAGEMENT PLANNING LIBRARY

TOWN OF SHELDON

June 26, 2013

Prepared for:

Friends of Northern Lake Champlain
P.O. Box 58
Swanton, VT 05488
Tel. / 802.933.6677
E-Mail / info2FNLC@gmail.com

Prepared by:

Stone Environmental, Inc.
535 Stone Cutters Way
Montpelier, VT 05602
Tel. / 802.229.4541
E-Mail / info@stone-env.com
Stone Project ID / 12-145

STONE ENVIRONMENTAL INC

Table of Contents

1. BACKGROUND

Water has no political boundaries. As such, evaluations of water quality tend to be undertaken along watershed boundaries and to involve land areas in multiple municipalities, counties, and, in the case of the Lake Champlain, countries. For example, the Missisquoi River watershed area includes part or all of twenty northern Vermont communities in three counties. Although from a strict water quality perspective it would be ideal to manage our water resources along watershed lines, the reality is that many decisions, in particular decisions about land use, are made at the local level. This report is designed to summarize the information currently available from the suite of reports that speak to water quality in the various rivers, lakes, and streams that pass through or are located wholly within the Town of Sheldon, Vermont. Although water quality assessment data dating back to the early 1970s is available for the Missisquoi River watershed, this summary focuses on assessments and reports that have been prepared in the past twenty years. This report will serve as the basis for developing a Sheldon-specific list of strategic, prioritized projects that could be undertaken to improve water quality.

2. INTRODUCTION

The Town of Sheldon is located in Franklin County in northwest Vermont. The town has a total area of 38.8 square miles. As of the 2010 census the population of the town was 2,190.[1] Sheldon has a number of rivers, streams and ponds within its borders, including portions of the Hungerford Brook, Missisquoi River, McGowan Brook, Black Creek, Morrow Brook, Goodsell Brook and Tyler Branch (See Figure 1 for a map of watershed boundaries). Development in the area is primarily concentrated in Sheldon and Sheldon Springs.

The majority of the western 1/3 of the Town of Sheldon, including Sheldon Springs and the surrounding development, drains directly to the main stem of the Missisquoi River. The remainder of the town is also in the Missisquoi watershed, but drains through various tributaries to the river. The Hungerford Brook drains a small portion of the western 1/3 of town, draining northwest into the Missisquoi main branch and eventually Lake Champlain. The Black Creek drains downtown Sheldon and the surrounding southern portion of town. The Morrow Brook, Goodsell Brook, and Tyler Branch drain the southeastern most section of town, while the main branch of the Missisquoi drains the northeastern 1/3 of town.

Numerous and varied groups and individuals have invested considerable effort in evaluating different components of Sheldon's water resources, and the important interface between water resources and local land use decisions. At times these evaluations have followed watershed boundaries and other times they have followed political boundaries. The following sections identify evaluations that have been done to date and pull out the pieces 1) most relevant to Sheldon and 2) most relevant to future efforts to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Sheldon.

[1] Derived from US Census data, hosted by VT Center for Geographic Information: http://vcgi.org/

3. 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, whose main purpose 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 Sheldon is within the Missisquoi Basin, last updated in March of 2013.[2]
- Stream geomorphic assessment work, undertaken to understand the natural tendencies of a particular reach of stream or river, its current condition, and what changes may be anticipated in the future. Stream geomorphic assessments have been completed for three stream/river segments within Sheldon: the Hungerford Brook, Black Creek, and Tyler Branch.
- In-stream water quality assessment work, including water chemistry and biological assessments.

3.1. Missisquoi Bay Watershed Phosphorous Load Monitoring Program[3]

This document locates river flow gages and phosphorus sampling areas on the Missisquoi River. While there are no sampling stations in Sheldon, the document also includes information on wastewater treatment plants. The specifications for the Sheldon Springs's wastewater treatment facility from the time of this document (2005) are described below:

- Permit Flow Limit: 0.054 mgd (204 m^3/d)
- Permit Phosphorus Concentration Limit: N/A
- Waste Load Allocation: 0.373 mt/yr
- 2003 Actual Load: 0.056 mt/yr

3.2. Missisquoi River Watershed Water Quality Management Plan[4]

The Missisquoi River Basin Water Quality Management Plan, most recently revised in March of 2013, overviews water resources, and identifies concerns and threats to water quality within the more than 619 square miles of Vermont that drain to the Missisquoi River. Utilizing recommendations from a broad array of stakeholders, the Plan summarizes strategies and specific actions to guide efforts to sustain and improve water quality and aquatic habitat over the next five years.

The Plan's high priority strategies include the following:

- Implement projects to meet the phosphorus reduction targets for Lake Champlain and Lake Carmi, and to meet the bacteria reduction targets for Berry, Godin and Samsonville Brooks.

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[2] http://www.vtwaterquality.org/mapp/docs/mp_Basin06Plan.pdf

[3] http://plan.lcbp.org/assets/files/task-comment-files/Missisquoi%20P%20Load%20Monitoring%20Plan.pdf

[4] http://www.vtwaterquality.org/mapp/docs/mp_Basin06Plan.pdf

- Evaluate the feasibility of removing the Swanton Dam.
- Augment stormwater system mapping and address 13 suspected illicit discharges identified in the town of Enosburg Falls, North Troy, Richford, and Swanton.
- Support stormwater master planning and plan implementation in Swanton, Highgate, Enosburg Village and Falls, and Richford.
- Assist road town foremen with the identification and remediation of erosion from town roads by promoting Better Backroads inventories and projects in Lowell, Albany, Troy, Jay, Westfield, Berkshire, and Highgate.
- Work with towns, VTrans and private landowners to use existing culvert assessments to identify appropriate replacement size and placement to improve fish passage and the geomorphic stability of the stream.
- Use the Critical Source Area study to direct technical and financial agricultural resources to identified critical sources.
- Work with towns to protect river corridors and promote flood resiliency by establishing Fluvial Erosion Hazard zones and buffer zones in local zoning.
- Identify wetlands on agricultural lands for phosphorus retention, and in the river corridor for sediment attenuation, and then prioritize and conserve and/or restore.
- Encourage use of the basin's rivers and lakes to increase people's appreciation of the water resources.
- Assist the towns in addressing specific wastewater treatment infrastructure upgrade needs identified in the Clean Water Fund's forthcoming Water Survey.

More specifically, the Plan identifies the following concerns for the Mid Missisquoi River, as described below:

- Missisquoi River (whole length), is considered to be stressed from high sediment loads, turbidity, nutrient enrichment, and increased water temperature, likely from agricultural land uses, loss of riparian vegetation, and stream-bank erosion.
- The Tyler Branch has been identified as a body of "water in need of further assessment" due to agricultural runoff and morphological instability.
- The Black Creek, from its mouth to East Fairfield, has also been identified as a body of "water in need of further assessment" due to agricultural runoff.

3.3. Links between Geomorphic Condition, Water Quality, and Phosphorus Loading in Hungerford Brook, Vermont (Dani Newcomb)[5]

A 2007 Master's thesis developed by a University of Vermont Rubenstein School student examined the links between geomorphic condition, water quality, and phosphorus loading in Hungerford Brook. The Hungerford

[5] http://www.lcbp.org/PDFs/IJC_MBBP/P_loading_Hungerford_Brook.pdf

Brook drains approximately .28 square miles, or .7% of Sheldon's total area. Specifically, the thesis focuses on:

- The impacts of land use at the watershed and near-stream scales on total suspended solids, total phosphorus, and soluble reactive phosphorus.
- The link between geomorphic condition and phosphorus and sediments in the Hungerford Brook watershed as the spatial scale varies.
- The contribution of soil phosphorus in stream banks to the total phosphorus load in Hungerford Brook.

The results of the study found that in Hungerford Brook:

- Phosphorus and sediment transport happens mainly during storm events and that concentrations greatly exceed the state standards.
- Phosphorus concentrations are significantly lower at the mouth of Hungerford Brook than upstream in the subwatershed, indicating that deposition is occurring in the downstream subwatersheds.
- Agricultural land use is closely associated with stream instability.

3.4. Missisquoi Areawide Plan[6]

In 2008, the NRCS completed the Missisquoi Areawide Plan, a watershed-based plan designed to reduce the phosphorus load delivered to Missisquoi Bay. The document was structured to inform and help partner agencies and cooperating farmers. The Areawide Plan consists of a series of water quality improvement strategies that target efforts to specific priority areas. The strategies were developed in consultation with local stakeholders and representatives of various state and federal agencies. The Areawide Plan was designed to help move conservation implementation actions away from a "first come, first served basis" in order to target financial and technical resources to the areas of the watershed with the greatest conservation need. The plan includes a considerable amount of geospatial data, including information on farmstead location, annual crop and hay lands, and the adjacency of cropland to areas with steep slopes.

3.5. Identification of Critical Source Areas of Phosphorus in the Vermont Sector of the Missisquoi Bay Basin[7]

Critical Source Areas are areas of the landscape that, absent proper management, are likely to produce disproportionate amount of phosphorus loading to adjacent waterways. Detailed data about the distribution of potential Critical Source Areas (CSAs) of phosphorus to Missisquoi Bay were developed using a Soil and Water Assessment (SWAT) model. The areas identified using this modeling approach were selected primarily by their soils, landscape features, proximity and connectivity to streams, and the land use or farm crop practices that are in place or are likely to be in place. To view this data in an interactive map, visit lcbp.stone-env.com.

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[6] Missisquoi Areawide Plan

[7] http://www.lcbp.org/wp-content/uploads/2013/04/63_Missisquoi_CSA.pdf

From a stormwater management standpoint, phosphorous critical source areas are areas of development (including roads) with a high potential for stormwater runoff. In general, roads with steep grades are particularly vulnerable to runoff and likely to be identified as CSAs. In Sheldon the CSAs identified by the model include:

- Sheldon Woods Road (west of Main Street)
- Route 236 (intersection with Gilman Road and north)
- Sheldon Road (East of Bouchard Road)

3.6. Stream Geomorphic Assessment Final Reports[8]

Stream geomorphic assessments have been completed for three stream/river segments within Sheldon: Hungerford Brook, Black Creek and Tyler Branch. The assessment results are designed to direct future stream corridor restoration and protection measures. See Appendix A, Figures 3 – 8 for stream geomorphic assessment maps of Sheldon-area rivers and streams. Although a stream geomorphic assessment has also been completed for the Missisquoi River between the Black Creek and Hungerford Brook, as indicated in Figures 4-6, the report is currently unavailable through DEC’s stream geomorphic assessment website.

3.6.1. Hungerford Brook Phase 2 SGA[9]

This document outlines Phase 2 geomorphic assessment for twelve reaches in the Hungerford watershed. The goal of this study was to identify stream conditions, including sediment and nutrient inputs, channel constrictions, and other features. Common stressors found in the watershed were:

- Lack of woody buffers
- Accelerated erosion due to increased hydrologic pressure
- Undersized culverts
- Straightened channels
- Drainage of wetlands

Two of the reaches assessed fell within the Sheldon town boundary. The report found that both reaches were in stable condition and “are reference stream types for this type of stream.”

3.6.2. Hungerford Brook Corridor Plan[10]

This document summarizes the stressors found during Phase 1 and 2 assessments and to identify and prioritize conservation and restoration projects within the Hungerford Brook watershed. The Corridor Plan identified projects along three reaches within Sheldon, below is a summary of the project recommendations.

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[8] https://anrnode.anr.state.vt.us/SGA/finalReports.aspx

[9] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=28_P2A&option=download

[10] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=28_CPA&option=download

M3.T1.01: Plant cattle exclusion buffers downstream of Cook road and replace an undersized culvert on Cook Road.

Project Location: From Highgate/Sheldon boundary to approximately 2000 feet upstream of Heald Road.

M3.T1.02: Replace two undersized culverts and one bridge and plant cattle exclusion buffers in Wood Hill Road area.

Project Location: From south of Heald Road to ½ mile south of Woods Hill Road.

M3.T1.03: Plant cattle exclusion buffers and replace two undersized bridges (both bridges and a majority of the un-buffered segment of this reach are located in Swanton).

Project Location: From ½ mile south of Woods Hill Road to just south of Route 105 (Swanton).

3.6.3. Black Creek Corridor Plan[11]

This document utilizes the Phase 2 stream geomorphic assessment data for 17 reaches of the Black Creek to identify primary concerns and prioritize restoration projects. Although the Corridor Plan generally finds that the Black Creek Watershed is in good condition, it does identify areas of stream channel adjustment and opportunities for restoration through establishment of buffers, removal of floodplain encroachments, and replacement of undersized infrastructure (bridges and culverts). Below are specific project recommendations for reaches assessed that fell within the boundaries of Sheldon:

M01: Protect river corridor. Plant cattle exclusion buffers in areas with less than 25 foot riparian buffers (despite the 50 foot buffer along streams required by Sheldon's zoning regulations) and remove berm along left bank near Missisquoi confluence.

Project Location: From the confluence with the Missisquoi River to 3 miles upstream (includes the entirety of the segment of the Black Creek that runs through Sheldon).

3.6.4. Tyler Branch Corridor Plan[12]

This document uses past Phase 2 stream geomorphic assessments of the Tyler Branch to create possible project packets in sensitive or restorable areas. The report identifies one potential project within Sheldon:

M01/M02: Increase sediment/nutrient storage and attenuation and to re-establish geomorphic stability.

Project Location: From confluence with Missisquoi River in Sheldon upstream to just beyond Sheldon/Enosburgh town line.

[11] https://anrnode.anr.state.vt.us/SGA/report.aspx?rpid=56_CPA&option=download

[12] http://www.anr.state.vt.us/dec//waterq/rivers/docs/FinalReports/rv_CP_TylerBranch.pdf

3.7. LaRosa Volunteer Data[13] (2005 – 2010)

Since 2005, water samples have been collected by the Missisquoi River Basin Association at four sites in Sheldon for one or more years; two on the Missisquoi River, one on the Black Creek, and one on an unnamed tributary to Hungerford Brook. Of the two Missisquoi sites, one was sampled for only a year and therefore will not be considered here. The other three sites provided at least two contiguous years of data. Between 2005 and 2007 data were collected for the Missisquoi River and Black Creek. Between 2008 and 2010 data were collected for the Black Creek and the Hungerford Brook tributary. Samples were analyzed by the VT DEC's LaRosa laboratory for total nitrogen, total phosphorous, and turbidity. All sample results are available online at the source listed below.

In 2005 data analysis suggests that average total nitrogen, total phosphorous, and turbidity levels were higher in the Missisquoi River than in the Black Creek. Between 2006 and 2007 average pollutant levels were higher in the Black Creek than in the Missisquoi River. Between 2008 and 2010 data analysis suggests higher average pollutant loads, with the exception of turbidity (across all three years), in the Hungerford Brook tributary than in the Black Creek. See Table 2 for a tabulated summary of pollutant concentration averages.

In both periods, 2005-2007 and 2008-2010, average total nitrogen, total phosphorous, and turbidity levels between the two water bodies often followed similar trends. That said, pollutant concentrations did differ occasionally between the two bodies of water. In August 2006, the total phosphorus concentration spiked substantially in the Black Creek. In June of the same year the turbidity concentration spiked substantially in the Missisquoi River. In 2007, pollutant concentrations fluctuated substantially for both bodies of water, but especially total phosphorus concentrations in the Black Creek in June, August, and September. In October of 2008, the total phosphorus concentrations spiked in the Hungerford Brook tributary and in July the turbidity concentration in the Black Creek spiked. Throughout 2009, pollutant concentrations trended similarly. In 2010 all the Hungerford Brook tributary pollutant concentrations fluctuated more than Black Creek concentrations.

Unfortunately, it is not possible to determine what portion of the measured pollutant load is attributable to stormwater runoff as compared to other sources (such as agriculture).

4. MUNICIPALITY-SPECIFIC ASSESSMENTS

In addition to the watershed-based assessments, a number of pieces of data are developed on a municipality-by-municipality basis. These are important to fold into any effort to develop a list of strategic, prioritized projects that could be undertaken to improve water quality in and around Sheldon. These include direct feedback from the Town, work by the Vermont Agency of Transportation, as well as past and current planning initiatives.

4.1. Town Feedback

In meetings with Stone Environmental, Town officials identified 14 areas of concern and priority projects throughout Sheldon, ranging from areas of shoulder erosion to undersized culverts. See Figure 9 and Table 3

[13] http://www.vtwaterquality.org/cfm/larosavm/mp_larosavolmon.cfm

for a map and table of concern areas and priority projects; Figure 9 and Table 3 also include the locations of concerns identified in the stream geomorphic assessments as described in Section 3.6.

4.2. Vermont Agency of Transportation-Sponsored Programs

4.2.1. Vermont Online Bridge and Culvert Inventory Data[14]

Vermont has 2,699 long structures (bridges and culverts) greater than 20 feet on interstate, state, and town routes and another 1,276 short structures between 6 and 20 feet on the state system that the state Agency of Transportation (VTrans) inspects. Inspections are conducted every 24 months on long structures and every 60 months on short structures unless conditions warrant more frequent inspections. Data collected as part of these inspections can help identify not only bridges and culverts with structural deficiencies but also structures that may be adversely impacting water quality. The system contains a detailed accounting of the 9 bridges and 221 culverts in Sheldon.

4.2.2. Stream Geomorphic Assessment, Failure Modes Data[15]

Failure Modes- Problems and Causes

This document records the failure modes of a select group of bridges and culverts along the Missisquoi River through Sheldon. The tables provide a structure number and a road name for the structure. Typical problems with structures are scouring of the bank, other erosion issues, and poor structure placement.

Structure Failure Modes

This document is similar to the Failure Modes Problems and Causes, but includes issues such as sediment deposits, obstructed structures, floodplain problems, and beaver dams.

4.2.3. Better Backroads Program[16]

The Town of Sheldon has been successful in obtaining grants from the Agency of Natural Resources and the Better Backroads Program to address some of the most pressing erosion issues that threaten public roads and bridges.

Starting in the summer of 2013, the Better Backroads Program will help fund, using municipal grants, work on gravel roads to alleviate erosion issues and improve water quality under the leadership of VTrans and VANR. In response to federal funding requirements and program needs, VTrans and VANR are making a variety of changes, including use of state (rather than federal) funding, and movement of administrative and technical assistance from the Northern Vermont Resource Conservation and Development Council to VTrans.

[14] http://apps.vtrans.vermont.gov/BridgeAndCulvert/Login.aspx?ReturnUrl=%2fBridgeAndCulvert%2fDefault.aspx

[15] https://anrnode.anr.state.vt.us/SGA/datasets/selectReport.aspx?sortType=Town&bid=06&bnm=Missisquoi

[16] http://www.vtwaterquality.org/erp/htm/backroads.htm

4.2.4. Ecosystem Restoration Program Projects[17]

Sheldon has 15 listed Ecosystem Restoration Program (ERP) projects. Below is a brief description of each project and its status:

Project	ERP Program	Description	Start Year	Status
Missisquoi River	River Management	Missisquoi River and tributaries project identification (Phase 1 SGA)	2005	Ongoing
Kane Road	Better Backroads	Replace culvert and install stone lined ditch	2007	Complete
St. Marie's Hill	Better Backroads	Install stone lined ditch	2007	Complete
Kittell Road – Phase 1	Better Backroads	Install stone lined ditch	2008	Complete
Kittell Road – Phase 2	Better Backroads	Install stone lined ditch	2009	Under Review
TH #17	Better Backroads	Erosion Control	2012	Completed by 12/15/13

4.3. Vermont DEC Stormwater Permitting Program

4.3.1. State Stormwater Permits

Currently, Vermont DEC requires that a stormwater permit be obtained when any construction, new development, or redevelopment results in impervious or disturbed area equal to or greater than one acre, with stricter requirements in watersheds that are classified as stormwater impaired. The State has developed a suite of technical standards for stormwater-related mitigation that are outlined in the Vermont Storm Water Management Manual, Volumes I and II. For example, the goal of a stormwater management program during construction is to mitigate sediment loss during storm events—while during and after construction, the objective is to maintain as much of the pre-developed hydrology as possible.

4.3.2. Environmental Research Tool[18]

ANR's Environmental Research Tool allows the user to look up the location of stormwater permits that have been issued by ANR, as well as hazardous waste sites, brownfields, and spills. There are seven stormwater permits that have been issued to sites in Sheldon accessible through the tool. Although all seven of the issued permits are up-to-date (they have not expired), the age, style, size, and upkeep of an existing permitted facility – particularly facilities constructed prior to 2002 – may make it a strong candidate for improvement to enhance stormwater management capabilities.

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[17] http://www.vtwaterquality.org/erp/projects/

[18] http://www.anr.state.vt.us/WMID/StormWater.aspx

4.4. Missisquoi River Basin Urban Areas Stormwater Mapping Project[19]

In 2009, Vermont DEC developed up-to-date municipal drainage maps for six communities in the Missisquoi River Basin. The drainage maps show stormwater infrastructure, such as pipes, manholes, catchbasins, and swales within a municipality. Data sources include data collected from field work, available state permit plans, record drawings, town plans, existing GIS data from contractors, and the input and guidance of knowledgeable members of the municipalities. As part of the project, Vermont DEC also identified potential locations for Best Management Practice (BMP) stormwater retrofit sites. Three high-priority sites were identified in Sheldon Springs (Table 1 and Figure 2). These are sites where stormwater treatment structures could be cost-effectively added or improved.

4.5. Sheldon Town Plan[20]

Three sections of the 2010 Sheldon town plan relate to stormwater management: Community Utilities (Chapter 8), Natural Features (Chapter 14), and Transportation (Chapter 15).

The Community Utilities section contains a brief description of the town's water systems and wastewater treatment. While this section describes the town's water source, water distribution system, and wastewater treatment facility, it does not identify specific stormwater management measures that the Town routinely deploys. It does, however, include recognition that stormwater enters the wastewater system during heavy rainfall events.

The Natural Features section includes a summary of surface water resources (Missisquoi, Tyler Branch, and Black Creek) and flood hazard areas, including a summary of minimum National Flood Hazard Insurance Program (NFIP) standards.

The Transportation section includes an incomplete inventory of the town's bridges that summarizes the maintenance of two of the town's four bridges. Often times, it is cost effective to combine the construction of additional stormwater management measures for road-related runoff with bridge construction, and so it is important to understand the timing of bridge replacement projects. The transportation section also contains a summary of a 1994 questionnaire sent to regional officials. Sheldon respondents listed maintenance of bridge and culverts as high priorities.

While not specific to Sheldon's Town Plan, Sheldon's 2008 Zoning Bylaws also contains language specific to stormwater management through its requirement of a minimum 50 foot buffer from the edge of streams.

5. OTHER RELATED INFORMATION

There are a significant number of farm operations in Sheldon. Farmsteads (barn areas) often contain a large amount of impervious surface and may be an important source of stormwater pollution.

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[19] http://www.vtwaterquality.org/erp/news/Missisquoi_FINAL_Report.pdf

[20] http://www.nrpcvt.com/TownPlans/SheldonTownPlan.pdf

5.1. NRCS Conservation Practice #558—Roof Runoff Structure[21]

NRCS Standard #558 addresses the management of stormwater from farm structures; specifically, where roof runoff from precipitation needs to be:

- diverted away from structures or contaminated areas;
- collected, controlled, and transported to a stable outlet; or
- collected and used for other purposes such as irrigation or animal watering facility.

The total barn roof area on a farm can be substantial, often in excess of one acre (the threshold for state stormwater regulation in the developed landscape) and therefore roof runoff from farm barns can be an important source of unmanaged stormwater.

6. CONCLUSIONS

This report is part of a larger project, funded by Vermont DEC, which will ultimately lead to a set of community-specific, prioritized projects to address stormwater runoff. Rather than starting from scratch in identifying stormwater management needs, the project (and this report) is drawing from the extensive library of water quality assessments and information that already exists, and augmenting them with interviews with local officials.

As this report demonstrates, there are numerous agencies and entities whose activities touch on various aspects of water quality in the Missisquoi watershed in general, and in the Town of Sheldon more specifically. This work is dynamic and ongoing, and so, while this summary is believed to be comprehensive, it will be important to periodically review and update the content to ensure the most current information can be incorporated. A comprehensive inventory of existing water quality assessments serves as a basis for connecting land use, stormwater management, floodplain management, river management activities; and public infrastructure needs to more effectively address all of the issues which contribute to degradation of a watershed.

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[21] http://efotg.sc.egov.usda.gov//references/public/VT/VT558-0311.pdf

APPENDIX B: FIGURES & TABLES

Figure 1. Sheldon watershed boundaries.

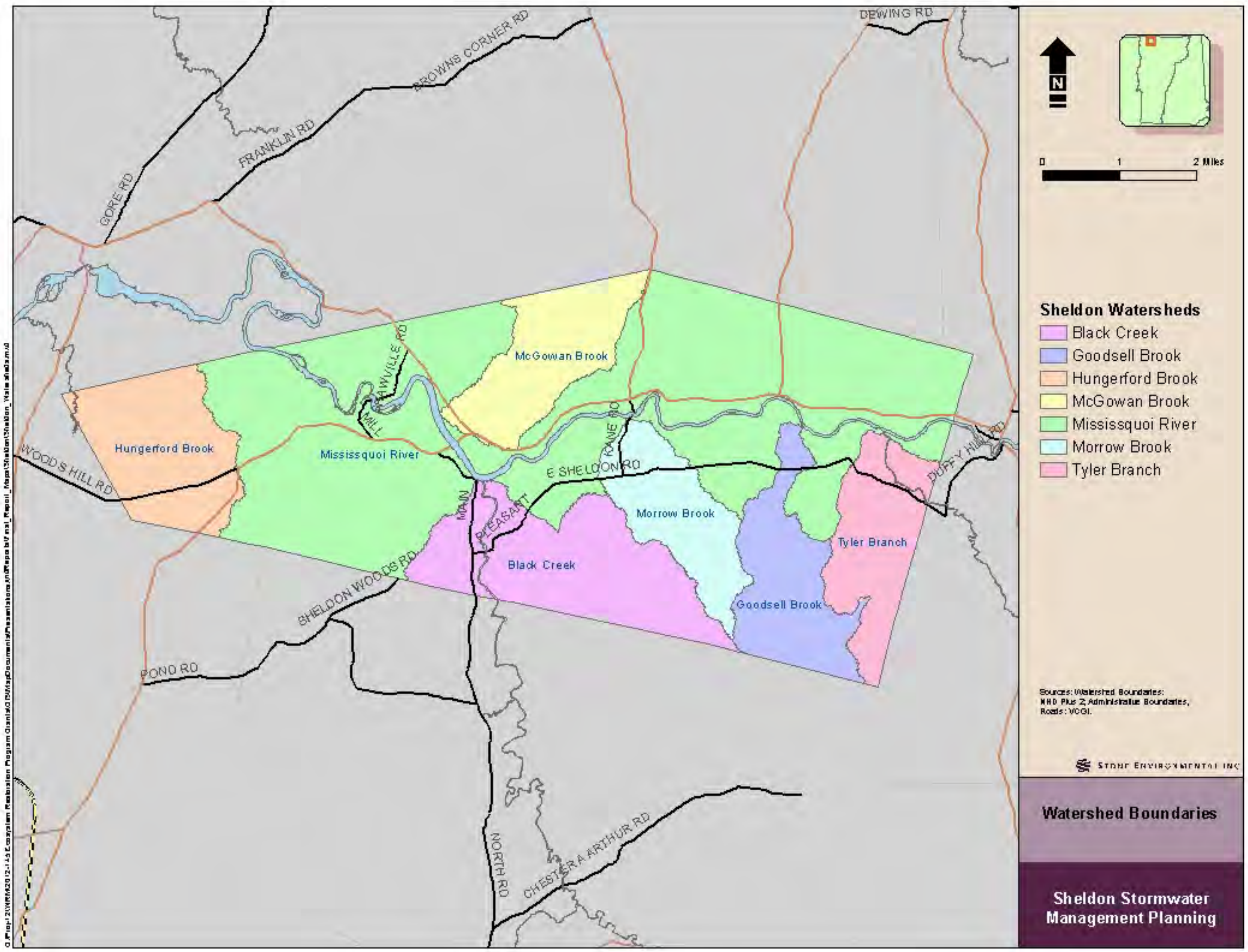


Table 1. Sheldon stormwater prioritization table.

Watershed Number	Action List	Proposed or Existing Stormwater Treatment Practice	Permit Number	Watershed Area (Acres)	Mapped Impervious Area (MIA)	EIA Equation (RANK)	Percent Effective Impervious Area
6	1	Buffer Strip Along River	4348-9003	3.45	46.8	4	28
9	1	Buffer Strip Along River		2.2	51.4	4	32
1	1	Wet Pond	4348-9003	8.34	48.8	4	30
8	2	Bioretention	4348-9003	7.57	34.9	4	17
2	2	SWPPP/CB Inserts	4348-9003	2.64	59.7	4	42
3	2	SWPPP/CB Inserts	4348-9003	1.13	99.2	4	99
4	2	SWPPP/CB Inserts	4348-9003	1.24	98.9	4	99
5	2	SWPPP/CB Inserts	4348-9003	3.73	52.5	4	34
7		N/A		6.31	5.7	4	1

Figure 2. Sheldon Springs stormwater infrastructure priority areas.

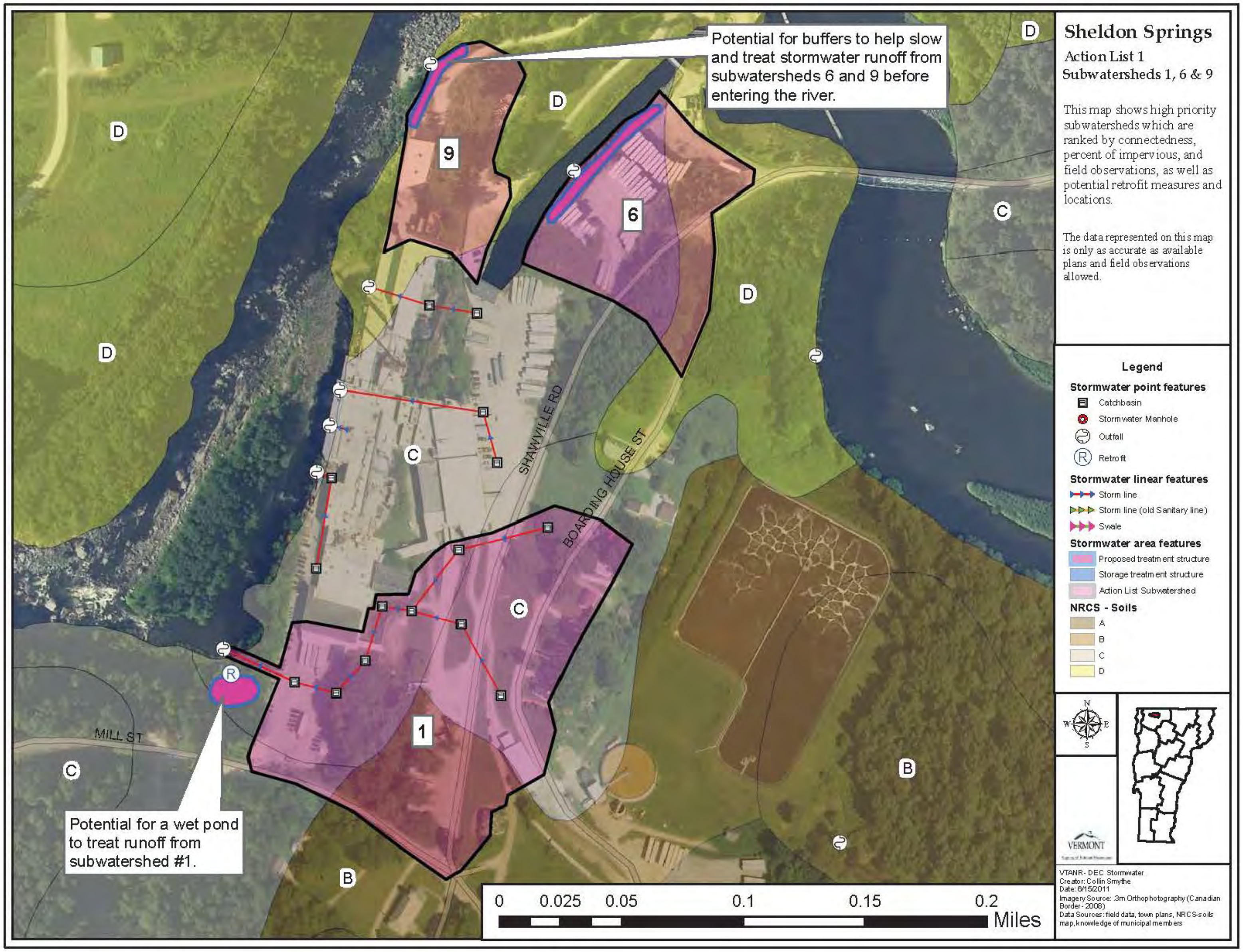


Figure 3. Hungerford Brook Reach and tributaries.

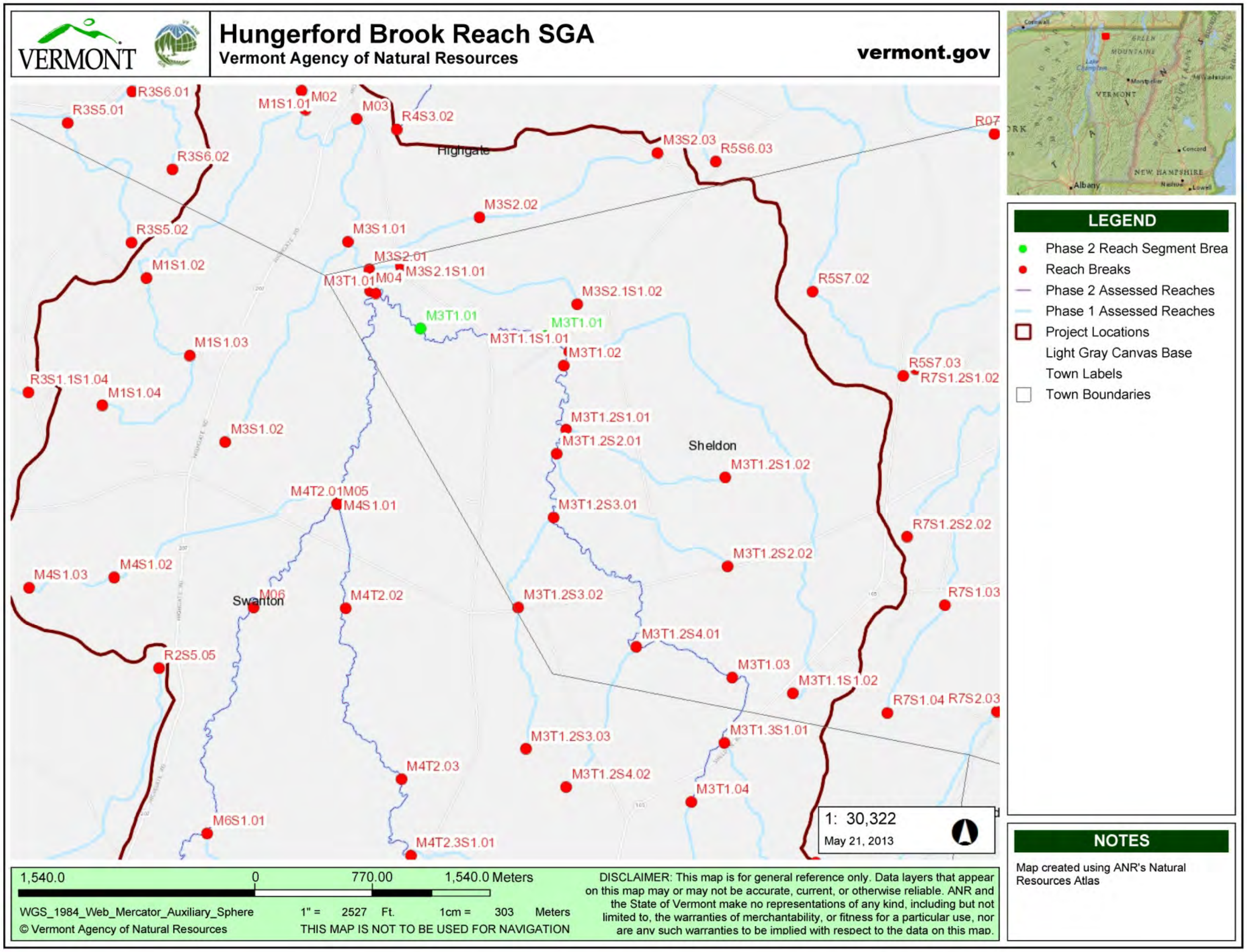


Figure 4. Missisquoi Reach Segment 1.

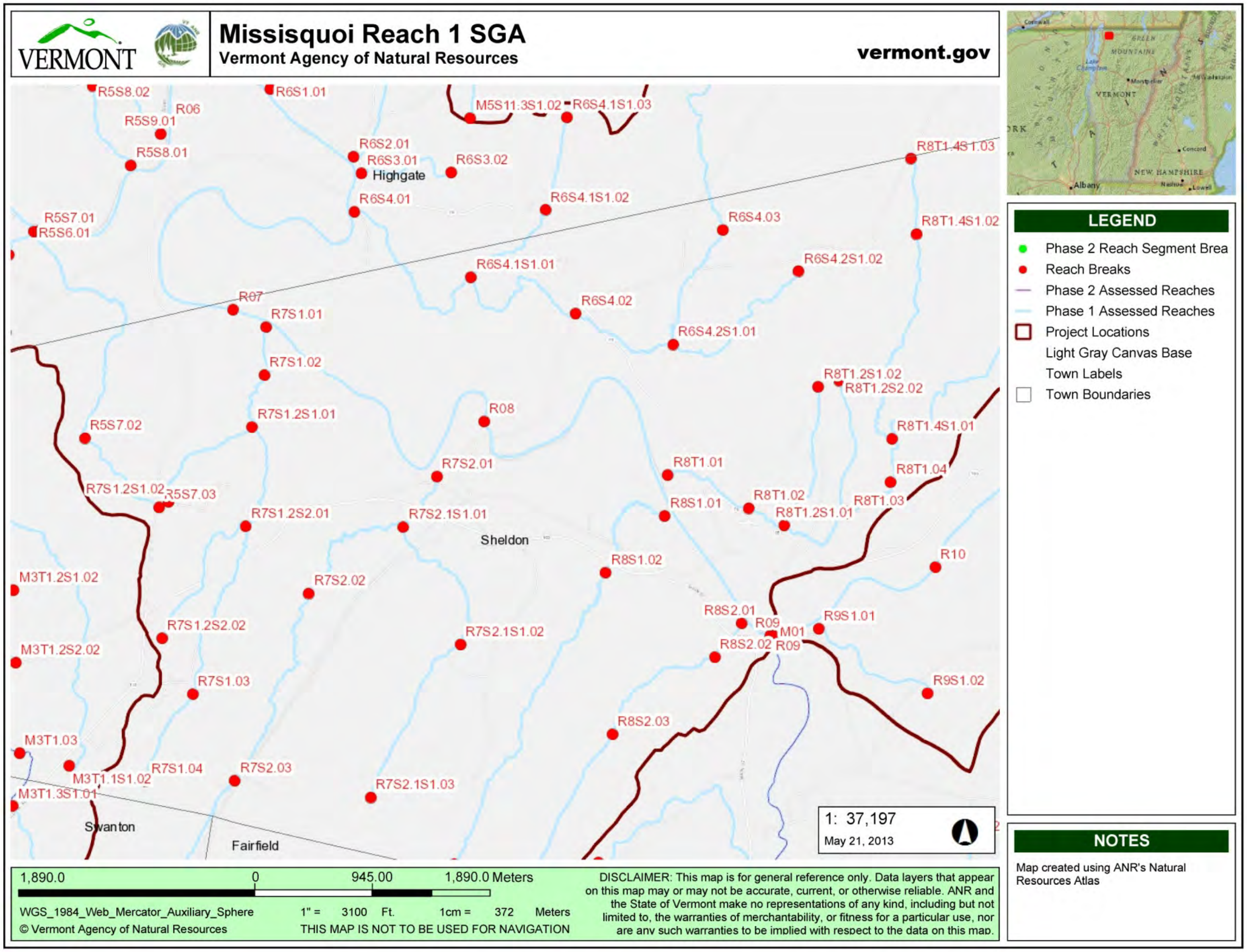


Figure 5. Missisquoi Reach Segment 2.

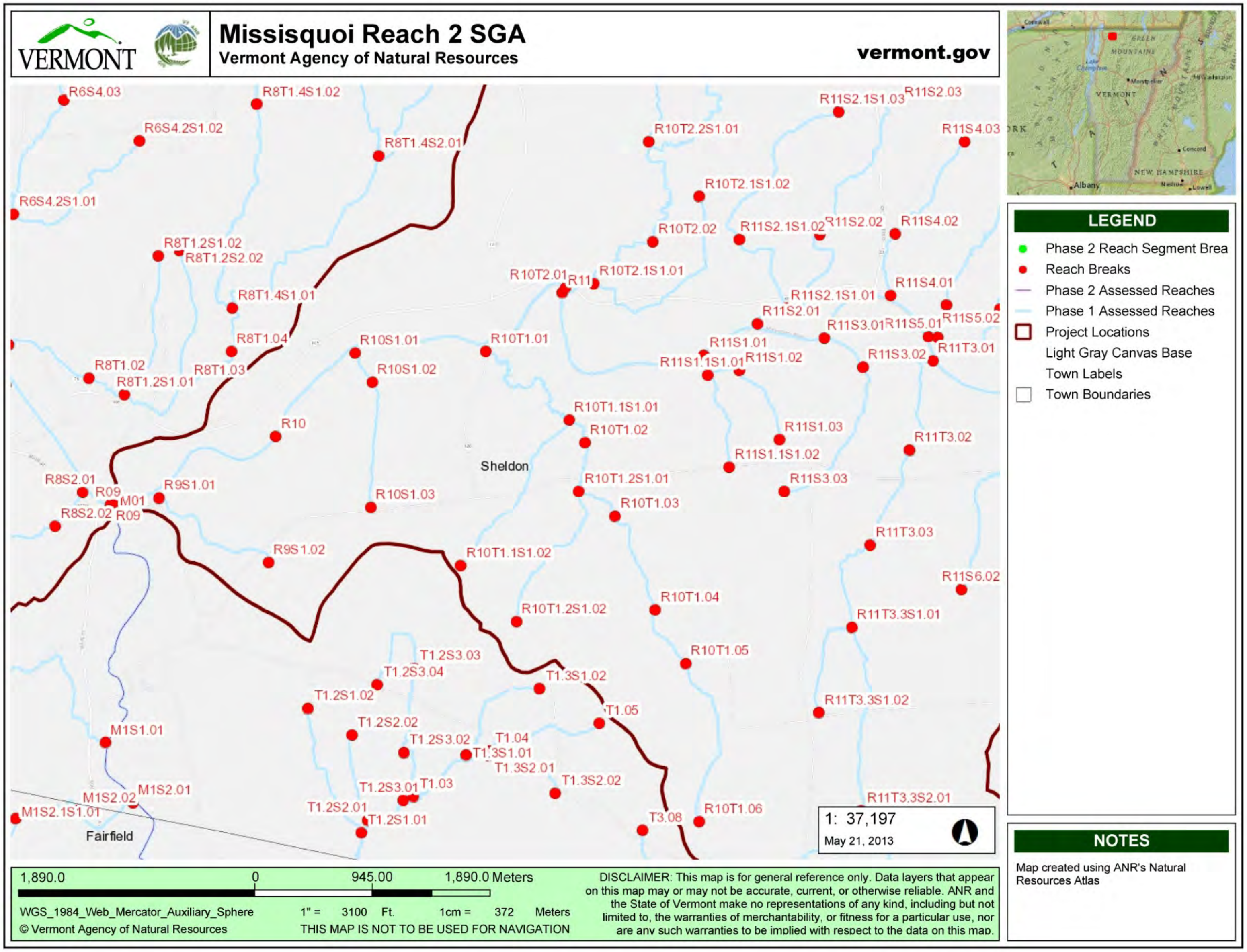


Figure 6. Missisquoi Reach Segment 3.

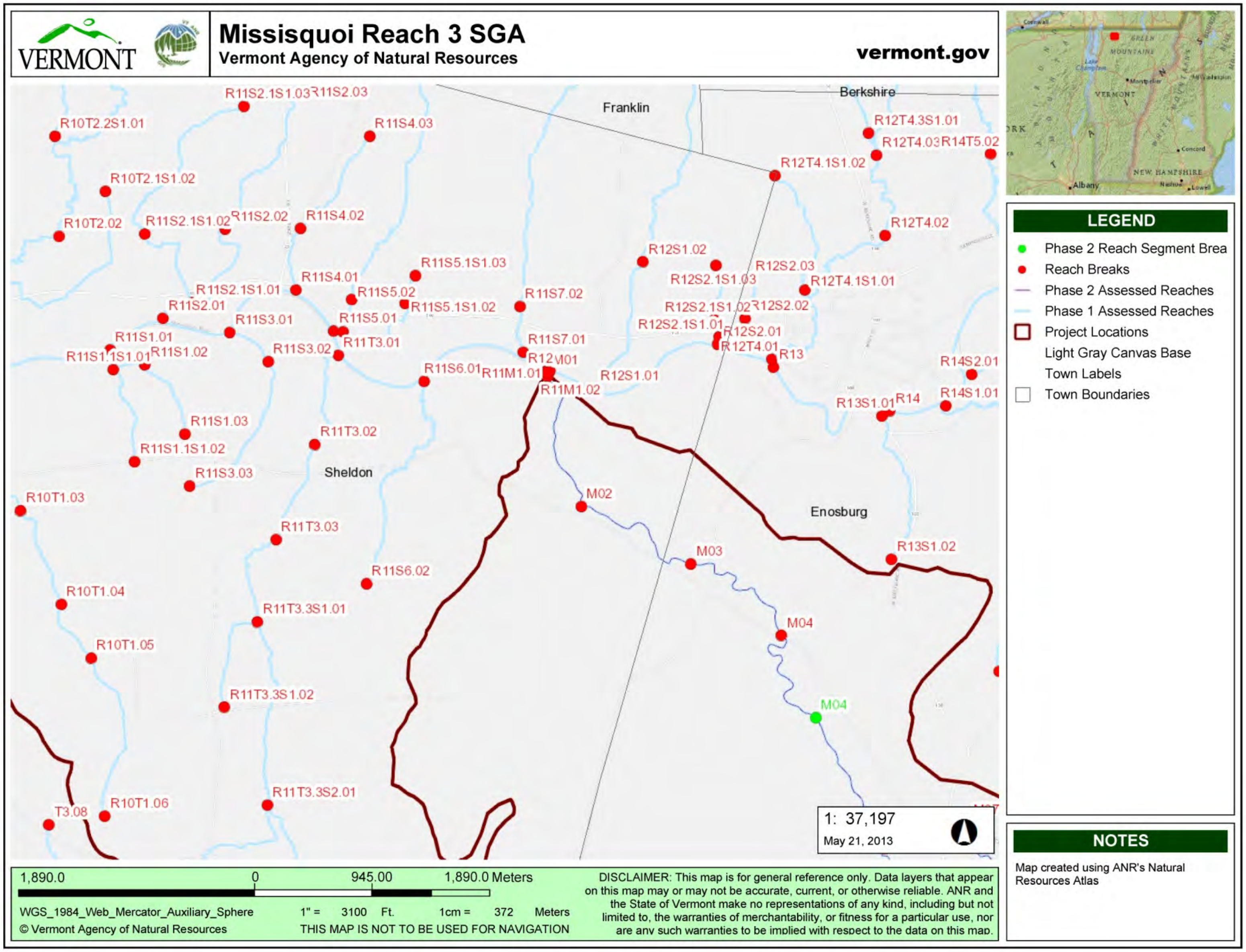


Figure 7. Tyler Branch.

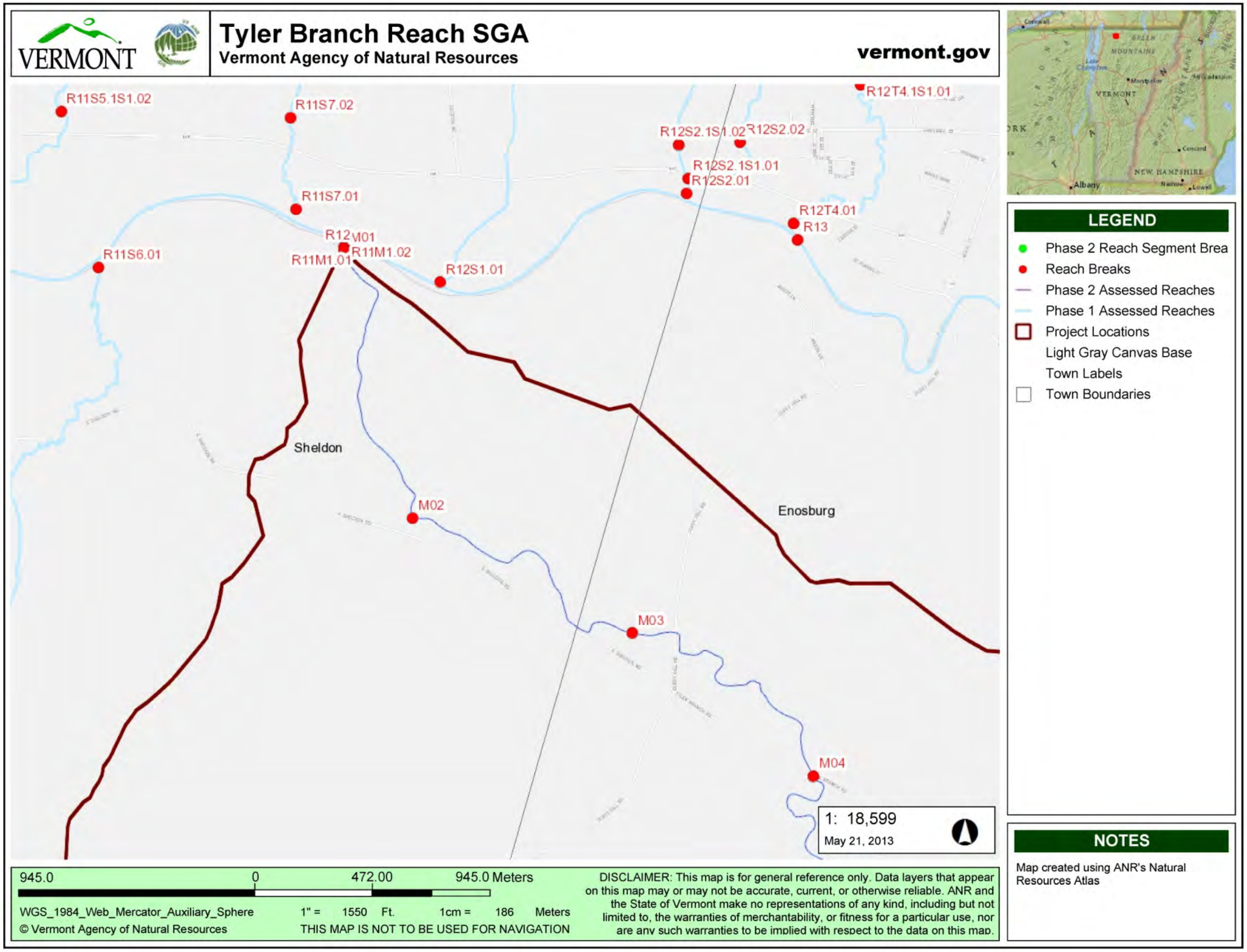


Figure 8. Black Creek Reach.

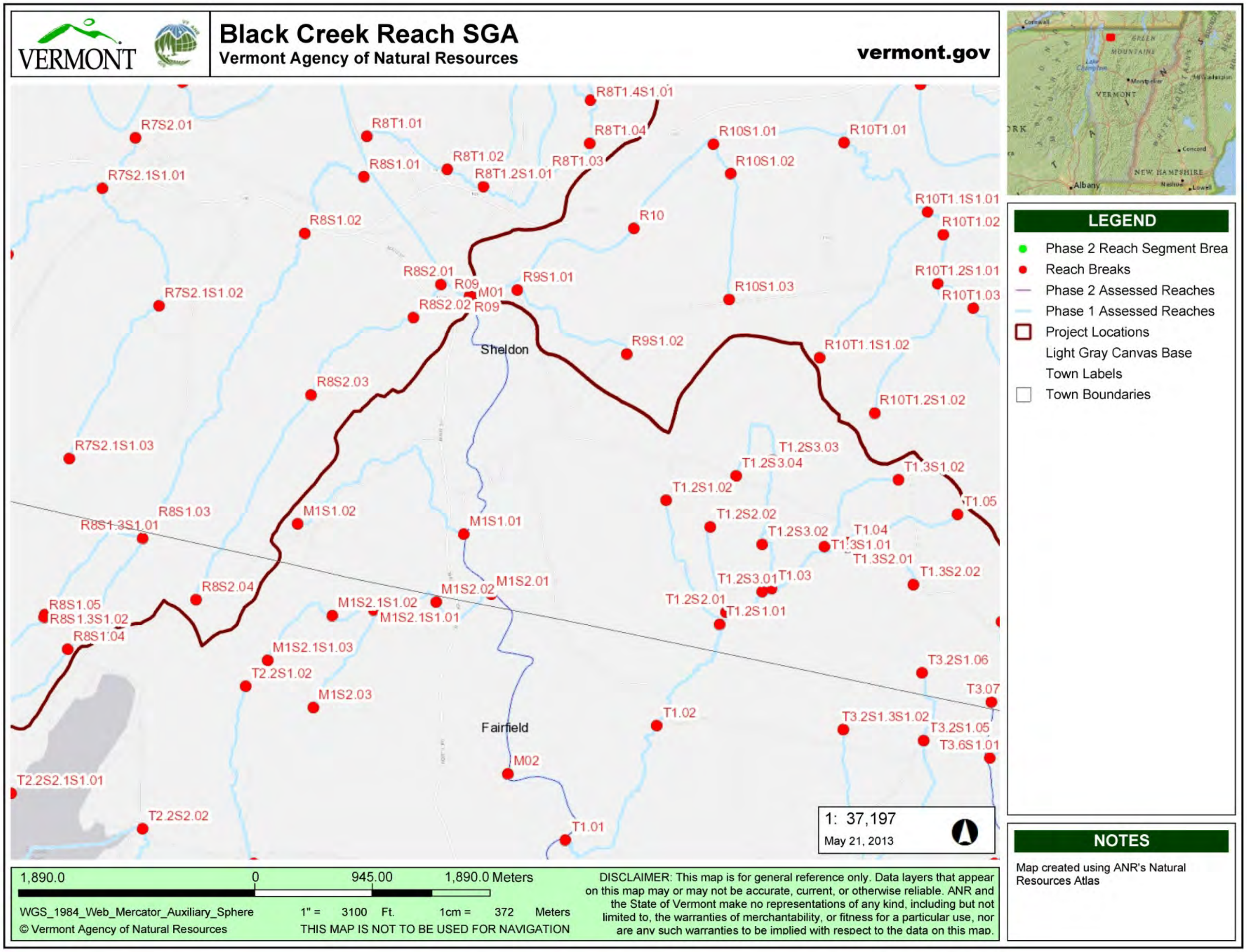


Table 2. Tabulated summary of pollutant concentrations for LaRosa Volunteer Data monitoring sites in Sheldon.

Sheldon: LaRosa Monitoring Sites	**Avg. Total Nitrogen (mg/l)**	**Avg. Total Phosphorus (ug/l)**	**Avg. Turbidity (NTU)**
2005			
Black Creek	0.63	64.77	8.11
Missisquoi River	1.13	79.15	13.30
2006			
Black Creek	0.81	120.8	9.26
Missisquoi River	0.62	37.94	6.33
2007			
Black Creek	0.79	78.75	6.79
Missisquoi River	0.60	41.17	5.42
2008			
Black Creek	0.68	68.25	15.30
Hungerford Brook Trib.	1.94	122.08	6.40
2009			
Black Creek	0.60	46.60	7.68
Hungerford Brook Trib.	1.84	113.22	5.43
2010			
Black Creek	0.54	43.79	4.85
Hungerford Brook Trib.	2.36	95.24	4.68

Figure 9. Areas of concern and priority projects identified by town officials and SGA reports.

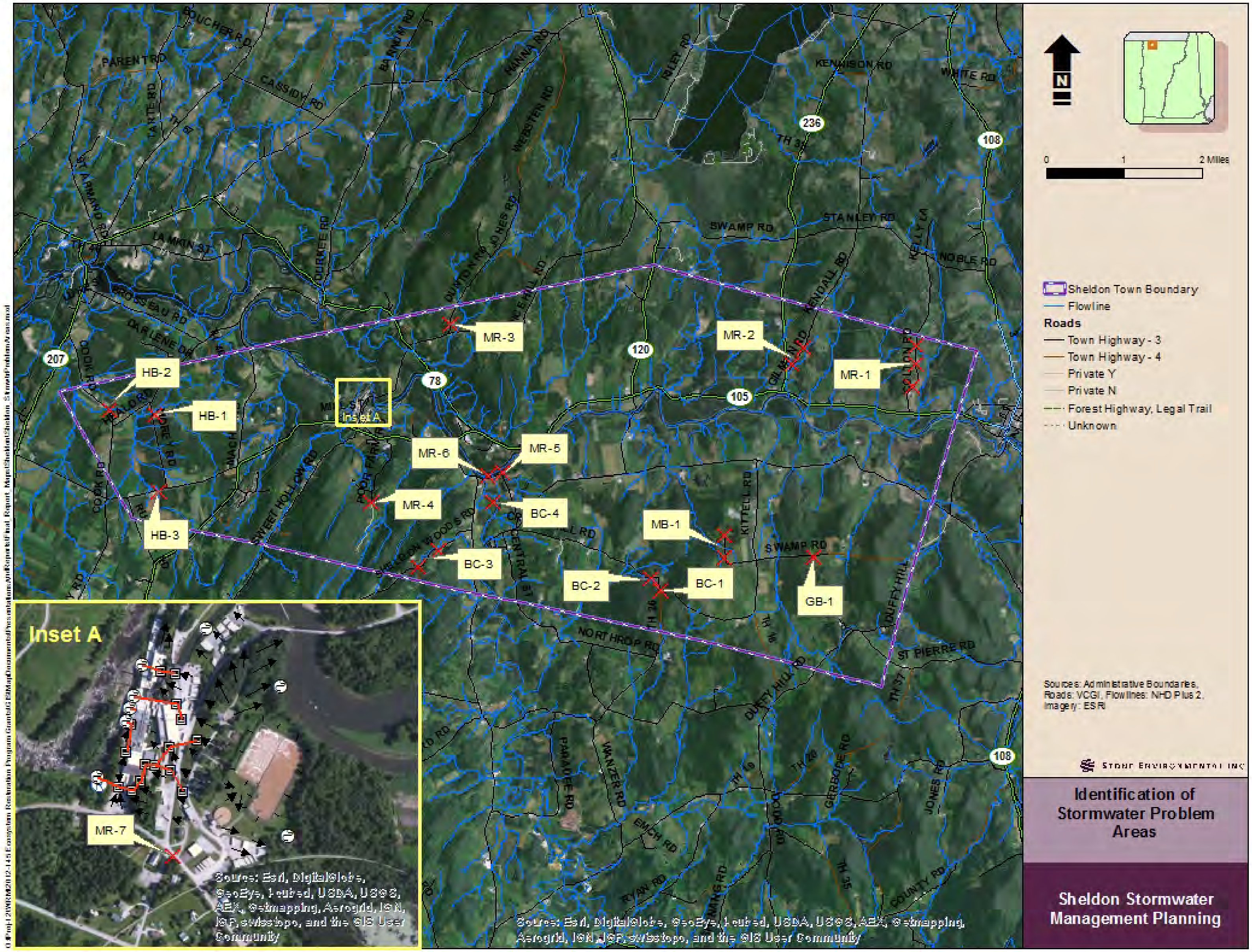


Table 3. Areas of concern and priority projects identified by town officials and SGA reports.

ID	Watershed	Problem Type	Description	ID Source
MR-1	Missisquoi River	Road Grade	Steep road grade (sheet runoff?).	Town Feedback
MR-2	Missisquoi River	Ledge	Ledge along road.	Town Feedback
MR-3	Missisquoi River	Erosion	Erosion, no place for water to go.	Town Feedback
MR-4	Missisquoi River	Ledge	Ledge keeps water on road.	Town Feedback
MR-5	Missisquoi River	Erosion	Erosion along curve in road.	Town Feedback
MR-6	Missisquoi River	Road Location	Road is right on river bank.	Town Feedback
MR-7	Missisquoi River	Drainage	Water has to drain across Mill St.	Town Feedback
GB-1	Goodsell Brook	Infrastructure	Water runs over road.	Town Feedback
MB-1	Morrow Brook	Erosion	Shoulder erosion.	Town Feedback
BC-1	Black Creek	Drainage	Water coming off class 4 road.	Town Feedback
BC-2	Black Creek	Road Grade	Steep road grade (sheet runoff?).	Town Feedback
BC-3	Black Creek	Erosion	Shoulder erosion.	Town Feedback
BC-4	Black Creek	Berm	500ft of berm on left bank, impeding floodplain connection.	Geomorphic Assessment
HB-1	Hungerford Brook	Infrastructure	Road is wide/culvert is too short.	Town Feedback
HB-2	Hungerford Brook	Infrastructure	Water goes over road at time, culvert is short, could use headers.	Town Feedback/Geomorphic Assessment
HB-3	Hungerford Brook	Infrastructure	Culvert may be channel restriction (two private bridge just north and just south of Cook Road on the same water body may need replacement).	Geomorphic Assessment

APPENDIX C: PROBLEM AREA DATA SHEETS

MEMO

STONE ENVIRONMENTAL INC

535 Stone Cutters Way
Montpelier, Vermont
05602 USA

Phone / 802.229.4541
Fax / 802.229.5417
Web Site / www.stone-env.com

To: Denise Smith
Executive Director
Friends of Northern Lake Champlain
P.O. Box 58
Swanton, VT 05488

From: Julie Moore
Direct Phone: 802-229-1881
E-Mail: jmoore@stone-env.com

SEI No. 12-145
Re: Stormwater Problem Area Data Sheets for the Town of Sheldon

---

Stone Environmental has combed through existing reports and also worked directly with the Town of Sheldon to identify current problem areas (e.g., actively eroding sites, roadway flooding and/or water ponding areas, culverts or other structures with insufficient hydraulic capacity) that are a direct, or indirect, result of stormwater runoff.

The approach to identifying problem areas included the following elements:

- Engagement with local officials, including:
  - May 3rd, kick-off meeting with the Road Foreman
  - May 23rd, meeting with the Road Foreman and another equipment operator
- Targeted site visits to verify problems areas (June and July 2013)
- Documentation (with photos) of existing problem areas

A "problem area data sheet" was developed and used as a guide to ensure consistent information was collected as site visits were completed. The data sheets for all of the problem areas identified in Sheldon are attached to this memo. Each problem area was given a preliminary classification according to the following system:

Level	Classification
1	Infeasible to remedy issue/outside of project scope.
2	Stable, but problem could escalate with future change in surrounding land use.
3	Small to moderate erosion and/or drainage problems are present; issues could be readily addressed.
4	Significant erosion and/or drainage problems are present; issues may be readily addressed.

Going forward, we will work with the Friends of Northern Lake Champlain to combine the information collected during this phase of the project in a scoring matrix that considers both the municipality's priorities and anticipated water quality benefits of addressing each problem area to develop a short of 6-10 high priority projects for implementation.

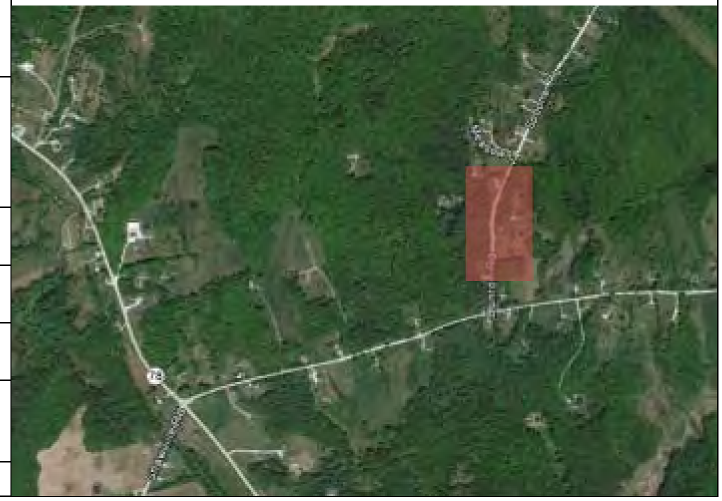
po

Problem Area Data Sheet

Problem Area ID: **MR-3**

Latitude: 44°55'22"N

Longitude: 72°57'11"W



Watershed: Missisquoi River

Location: Dunton Road near Rice Hill Rd junction

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Rill erosion was observed over much of the road. Ledge prevents water from leaving road in many locations. Sediment is deposited in culverts and ditches at the foot of Dunton Rd.

Field Photos

Photo 1. Road-edge erosion

Photo 2. Ditch and culvert full of sediment

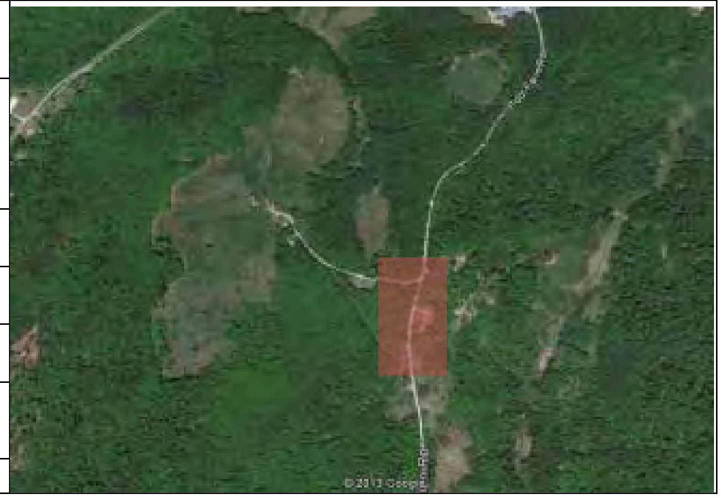
Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	3	2	Yes	Yes	Yes	No

pn

Problem Area Data Sheet

Problem Area ID:	**MR-4**
Latitude:	44°53'18"N
Longitude:	72°58'23"W
Watershed:	Missisquoi River
Location:	Southern end of Maple Glen Road/Poor Farm Road
Problem Type:	Local Drainage/Erosion
Identification Source:	Town Feedback
Ownership:	Local
Classification:	3



Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Ledge keeps water on road leading to road edge erosion. Sediment is deposited in adjacent ditches.

Field Photos

Photo 1. Road-edge erosion

Photo 2. Road surface erosion

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	2	Yes	Yes	Yes	Yes

Problem Area Data Sheet

Problem Area ID:	**MR-6**	Latitude: 44°53'42"N	Longitude: 72°56'32"W
Watershed:	Missisquoi River		
Location:	Bouchard Road near junction with Sheldon Creek Road		
Problem Type:	Bank Erosion		
Identification Source:	Town Feedback		
Ownership:	Local		
Classification:	2		

Date of Field Data Collection: 6/12/13

Description of Observed Conditions:

Road is very close to river bank. Heavy bank erosion observed immediately east of bridge (over Black Creek). Tree roots are holding bank, but there is little to no other vegetation. Stream has eroded nearly all soil beneath trees and may soon encroach on road.

Field Photos

Photo 1. Eroded bank

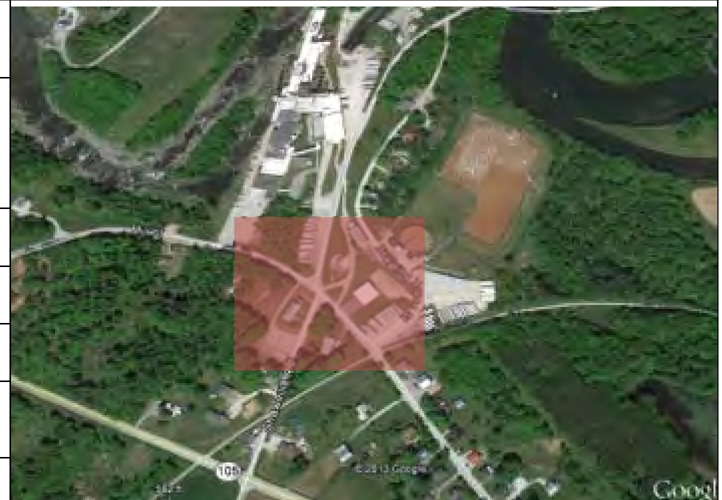
Photo 2. Eroded bank

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	2	Yes	No	Yes	No

Problem Area Data Sheet

Problem Area ID:	MR-7	Latitude: 44°54'19"N	Longitude: 72°58'34"W



Watershed:	Missisquoi River
Location:	Mill Street between Shawville Road and Missisquoi Valley Rail-Trail
Problem Type:	Drainage
Identification Source:	Town Feedback
Ownership:	Local
Classification:	4

Date of Field Data Collection: 6/12/13

Description of Observed Conditions:
All ditches, culverts and catch basins in the area are filled with sediment. Area has no properly functioning systems for conveying stormwater. Heavy erosion observed on ditch banks. Area will require larger engineering study to determine the most appropriate, comprehensive solution.

Field Photos

Photo 1. Trenching on road shoulder above culvert inlet

Photo 2. Trenching on road shoulder above culvert inlet

Problem Area Data Sheet

Problem Area ID: MR-7 (cont.)	
	
Photo 3 Shoulder above culvert inlet	**Photo 4.** Sediment deposited in ditch

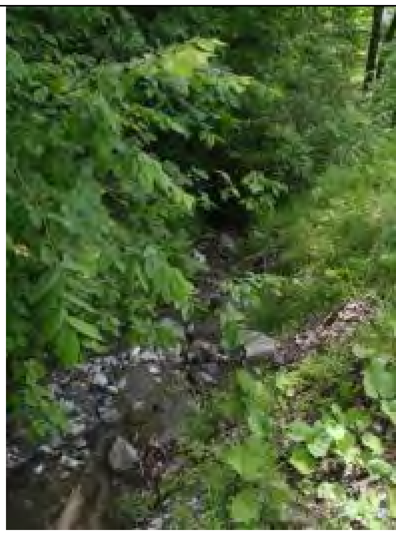



Photo 5 Eroded ditch	**Photo 6** Ditch bank collapse and sediment deposit
	
Photo 7. Ditch erosion	**Photo 8** Ditch erosion

py

Problem Area Data Sheet

Problem Area ID: MR-7 (cont.)	
	
Photo 9 Erosion along road shoulder	**Photo 10.** Rock-lined ditch, sediment choked
	
Photo 11. Shoulder erosion	**Photo 12.** Trenching on gravel driveways subject to heavy truck traffic

Problem Area Data Sheet

Problem Area ID: MR-7 (cont.)	
	
Photo 13. Roadway deterioration and shoulder trenching	**Photo 14.** Ditch and culvert full of sediment
	
Photo 15. Catch basin filled with sediment	**Photo 16.** Shoulder trench and overgrown culvert

Problem Area Data Sheet

Problem Area ID: MR-7 (cont.)	
	
Photo 17. Shoulder erosion	**Photo 18.** New drainage structure connected to parking lot behind fire station

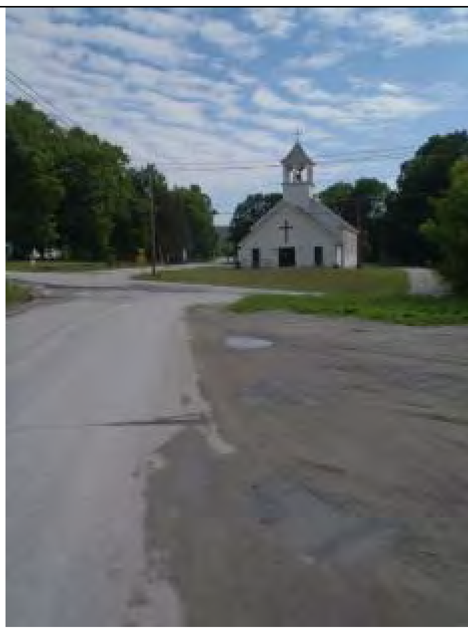



Photo 19 Sediment from lot deposited on road surface	**Photo 20.** Sediment deposited at a culvert outfall

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	3	3	3	Yes	Yes	Yes	Yes

CM

Problem Area Data Sheet

Problem Area ID:	**MR-8**	Latitude: 44°53'54"N	Longitude: 72°52'39"W

Watershed: Missisquoi River

Location: E. Sheldon Road, 0.4 miles west of Kittell Rd.

Problem Type: Erosion

Identification Source: SWMP Assessment

Ownership: Private

Classification: 2

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Stream banks are eroding downstream of the culvert. Cows have access to stream and to the bank above the culvert outlet. The stream banks on the downstream side are very steep. The installation of reinforced animal walkway and crossing would improve site conditions.

Field Photos

Photo 1. View downstream of culvert

Photo 2. Bank above culvert outfall

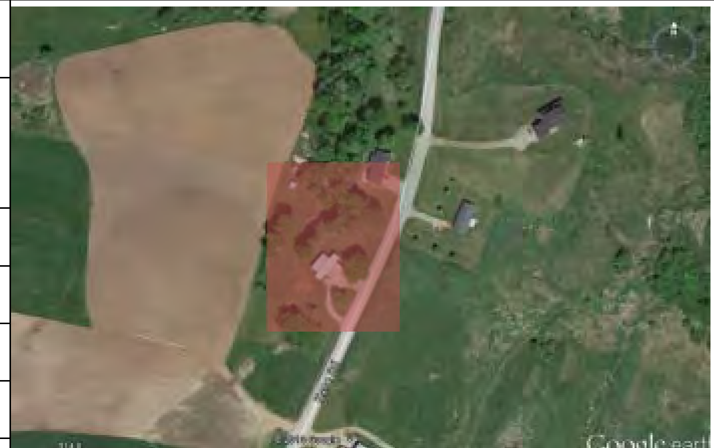
Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	3	2	Yes	Yes	Yes	No

CH

Problem Area Data Sheet

Problem Area ID:	**MR-9**	Latitude: 44°54'16"N	Longitude: 72°54'24”W



Watershed: Missisquoi River

Location: 460 Kane Rd.

Problem Type: Erosion

Identification Source: SWMP Assessment

Ownership: Private

Classification: 2

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Resident appears to have installed an undersized culvert into stream path to convey flows through property. Heavy bank erosion observed downstream from culvert.

Field Photos

Photo 1. Eroded stream bank downstream from culvert

Photo 2. Culvert inlet

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	2	No	Yes	No	No

co

Problem Area Data Sheet

Problem Area ID:	**GB-1**	Latitude: 44°52'49"N	Longitude: 72°52'31"W

Watershed: Goodsell Brook

Location: Swamp Road and Goodsell Brook crossing

Problem Type: Infrastructure

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 6/12/13

Description of Observed Conditions:
Bank around downstream culvert is slumping. No vegetation observed around culvert. Culvert is 1/4 of bankfull width. Sugaring operation upstream of culvert has done some ditching that also drains to this area

Field Photos

Photo 1. Scour pool

Photo 2. Bank erosion around culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	2	Yes	Yes	Yes	No

cn

Problem Area Data Sheet

Problem Area ID:	**GB-2**	Latitude: 44°52'11"N	Longitude: 72°52'23"W
Watershed:	Goodsell Brook		
Location:	Route 105, 0.5 miles west of Rt. 236 Junction		
Problem Type:	Erosion		
Identification Source:	SWMP Assessment		
Ownership:	Private		
Classification:	3		

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Ditch is actively eroding. A large sediment deposit was observed near culvert inlet. Large pile of gravel placed at intersection adjacent to stream.

Field Photos

Photo 1. Ditch bank slumping

Photo 2. Gravel pile directly above culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	3	3	2	No	Yes	No	No

cp

Problem Area Data Sheet

Problem Area ID:	**MB-1**	Latitude: 44°52'56"N	Longitude: 72°52'50"W

Watershed: Morrow Brook

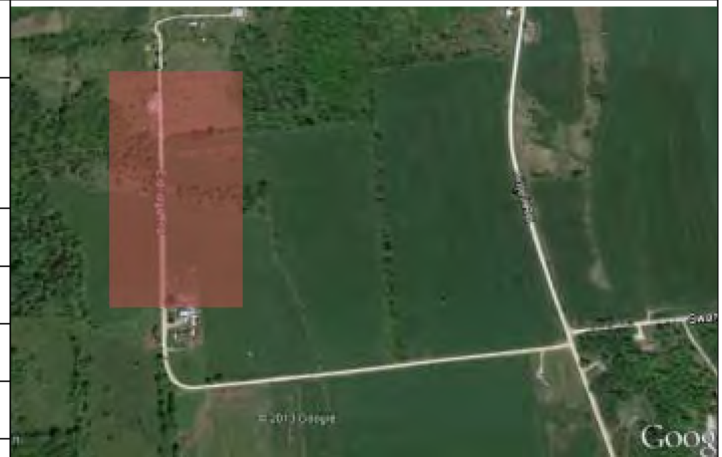
Location: North end of Eldridge Road

Problem Type: Shoulder erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 2



Date of Field Data Collection: 6/12/13

Description of Observed Conditions:

Water has eroded beneath upstream opening of culvert. Some roadside erosion directly above culvert both upstream and downstream.

Field Photos

Photo 1. Undersized culvert

Photo 2. Stream bed is eroded 2 inches below invert of culvert inlet.

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
1	2	2	1	Yes	Yes	Yes	No

cc

Problem Area Data Sheet

Problem Area ID:	**MR-11**	Latitude: 44°53'50"N	Longitude: 72°53'45"W

Watershed:	Missisquoi River
Location:	E. Sheldon Road, 1.0 miles West of Kittell Rd.
Problem Type:	Erosion
Identification Source:	SWMP Assessment
Ownership:	Private
Classification:	3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Active bank erosion observed. Beaver dams in area were removed several years ago and the area now serves as pasture to 13-14 animals. Bank above culvert is beginning to collapse. Spoke with farmer who owns the property with his father. He was very informative and interested in making improvements; opportunity has been shared with staff at Vermont Agency of Agriculture for follow-up.

Field Photos

Photo 1. View downstream of culvert

Photo 2. Bank slump above culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
3	3	3	2	Yes	Yes	Yes	No

CT

Problem Area Data Sheet

Problem Area ID:	**MR-12**	Latitude: 44°54'38"N	Longitude: 72°53'14"W

Watershed:	Missisquoi River
Location:	Rt. 105, 100 yards east of fruit stand at farm driveway
Problem Type:	Drainage
Identification Source:	SWMP Assessment
Ownership:	Local
Classification:	3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Asphalt road surface has started to collapse into ditch. Large sediment deposit in ditch.

Field Photos

Photo 1. Road shoulder erosion

Photo 2. Sediment in ditch

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	2	Yes	Yes	Yes	no

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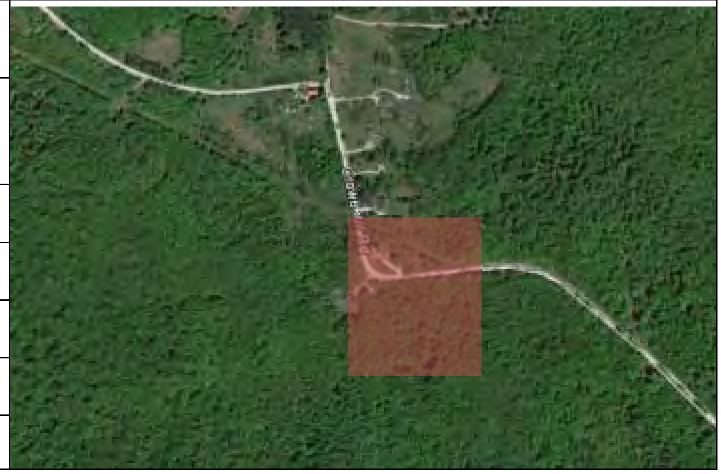
Problem Area Data Sheet

Problem Area ID:	**BC-1**	Latitude: 44°52'27"N	Longitude: 72°53'50"W



Watershed:	Black Creek
Location:	Crowe Hill Road junction with Town Highway 26
Problem Type:	Drainage
Identification Source:	Town Feedback
Ownership:	Local
Classification:	2

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Runoff from a class-4 road is causing rill erosion on the road surface. Large sediment deposit observed at wood-edge.

Field Photos

Photo 1. Road surface erosion

Photo 2. Road shoulder at intersection with Class VI road.

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	2	Yes	Yes	Yes	no

cɸ

Problem Area Data Sheet

Problem Area ID:	**BC-3**	Latitude: 44°52'52"N	Longitude: 72°57'27"W

Watershed: Black Creek

Location: Sheldon Woods Road near junction with Johnson Road

Problem Type: Erosion

Identification Source: Town Feedback

Ownership: Local

Classification: 2

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Shoulder erosion in some places. Observed sediment deposits in roadside grass swale.

Field Photos

Photo 1. Erosion at edge of road

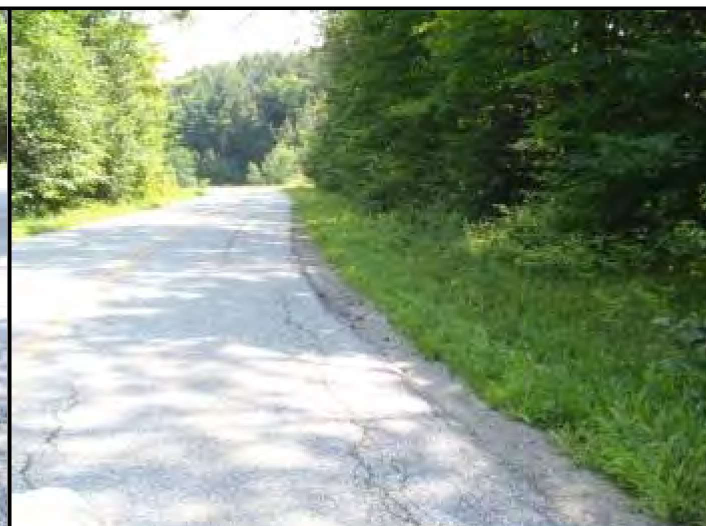


Photo 2. Erosion at edge of road

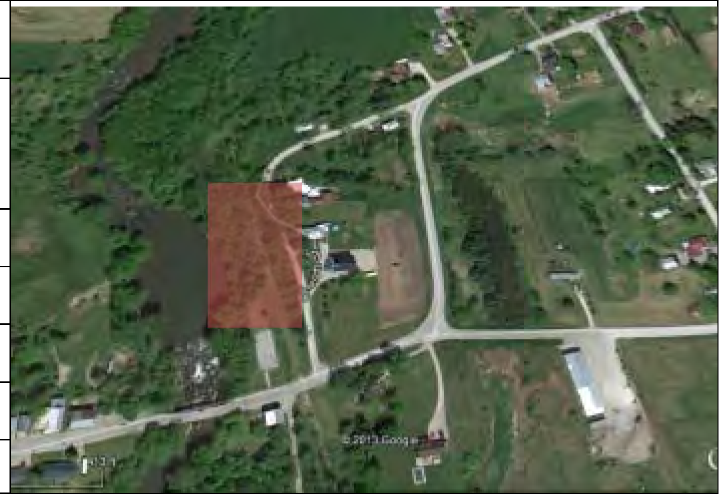
Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	2	1	Yes	Yes	Yes	No

TЛ

Problem Area Data Sheet

Problem Area ID:	**BC-5**
Latitude: 44°52'58"N	Longitude: 72°56'32"W
Watershed:	Black Creek
Location:	Church Street, off of Bridge Street
Problem Type:	Erosion
Identification Source:	SWMP Assessment
Ownership:	Public
Classification:	3



Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

The western edge of the road is at the top of a steep bank and is beginning to slump. Culvert under the road is crushed with water is ponding at the inlet.

Field Photos

Photo 1. Pool (2' dia.) at culvert inlet

Photo 2. Western edge of Church St.

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
2	2	3	2	Yes	Yes	Yes	Yes

Problem Area Data Sheet

Problem Area ID:	**HB-1**	Latitude: 44°54'00"N	Longitude: 73°01'44"W

Watershed: Hungerford Brook

Location: Morey Road south of Heald Road junction

Problem Type: Infrastructure

Identification Source: Town Feedback

Ownership: Local

Classification: 3

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Road edge is beginning to collapse into the stream above some culverts along Morey Rd. Culverts appear to be too short, at least as compared to current road width.

Field Photos

Photo 1. Road edge above culvert

Photo 2. Road edge erosion above culvert

Prioritization Ranking Factors

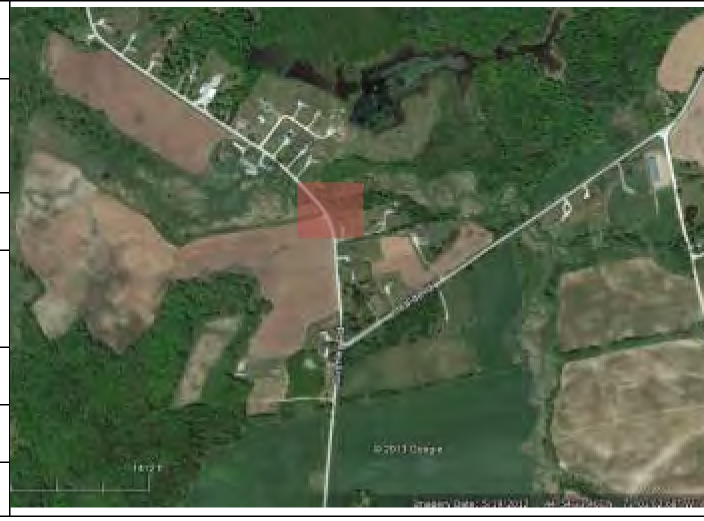
Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
1	1	2	1	Yes	Yes	Yes	No

TH

Problem Area Data Sheet

Problem Area ID:	HB-2	Latitude: 44°54'25"N	Longitude: 73°02'32"

Watershed:	Hungerford Brook
Location:	Cook/Bushey Road just north of Heald Road junction
Problem Type:	Infrastructure
Identification Source:	Town Feedback
Ownership:	Local
Classification:	3



Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Eight ft. culvert is undersized. Large (30' x 40') scour pool has formed at outlet.

Field Photos

Photo 1. Stream widening upstream of culvert

Photo 2. Scour pool downstream of culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
1	1	2	1	No	Yes	No	No

Problem Area Data Sheet

Problem Area ID:	**HB-3**	Latitude: 44°53'32"N	Longitude: 73° 1'44"W

Watershed: Hungerford Brook

Location: Woods Hill Road just west of Morey road junction

Problem Type: Infrastructure

Identification Source: Geomorphic Assessment

Ownership: Local

Classification: 2

Date of Field Data Collection: 7/9/13

Description of Observed Conditions:

Some bank erosion upstream of culvert. Downstream side appears to be okay.

Field Photos

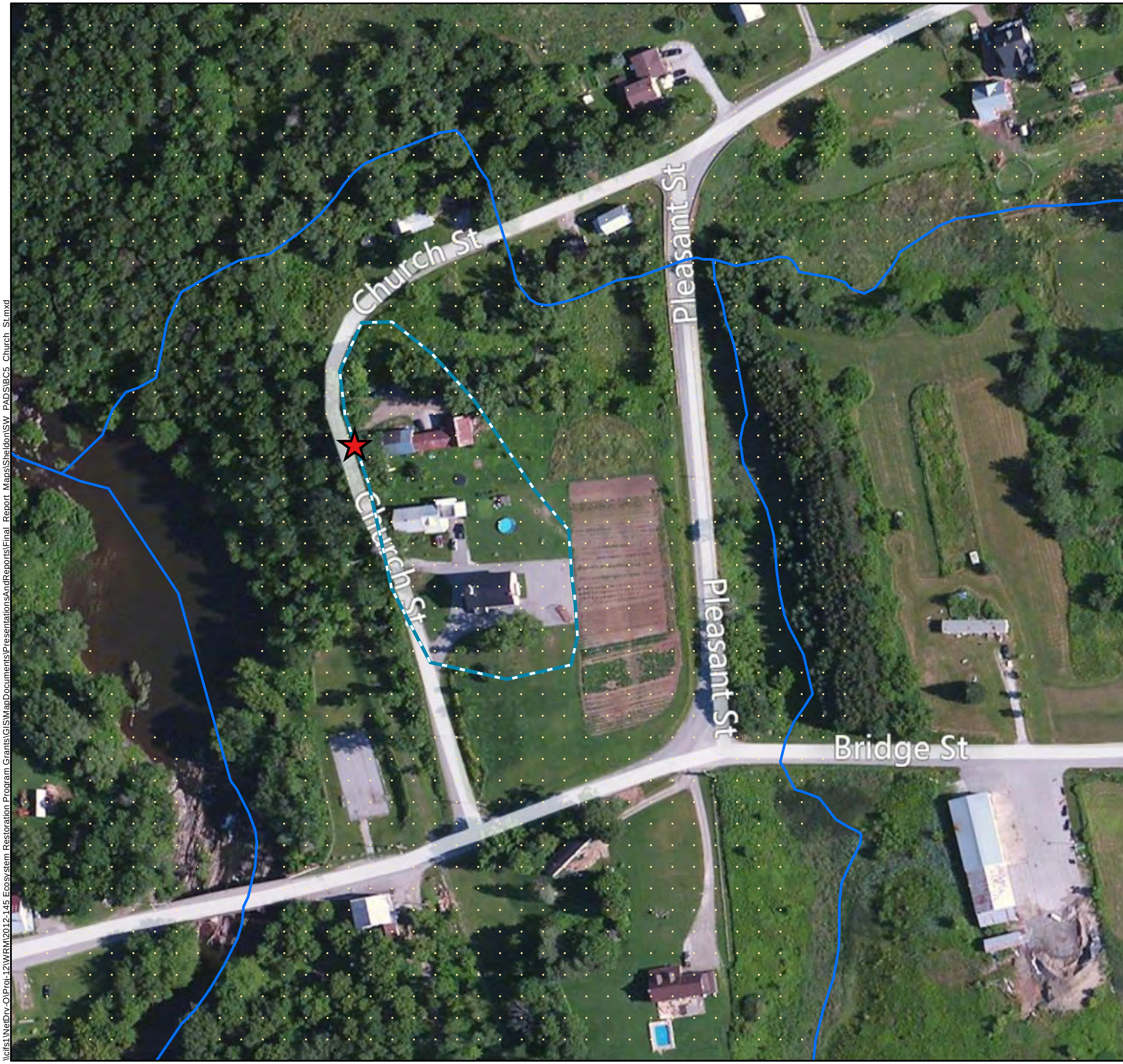
Photo 1. Upstream of culvert

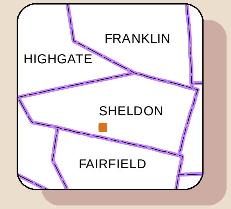
Photo 2. Downstream of culvert

Prioritization Ranking Factors

Relative Impact	Frequency	Current Condition	Urgency	Impact to public infrastructure?	Realistic to fix?	Impacts beyond water resources?	Part of a larger or systemic problem?
1	1	2	1	No	Yes	No	No

APPENDIX D: DRAINAGE AREA MAPS FOR PRIORITY STORMWATER PROBLEM AREAS





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0 50 100 200 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (1.6 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

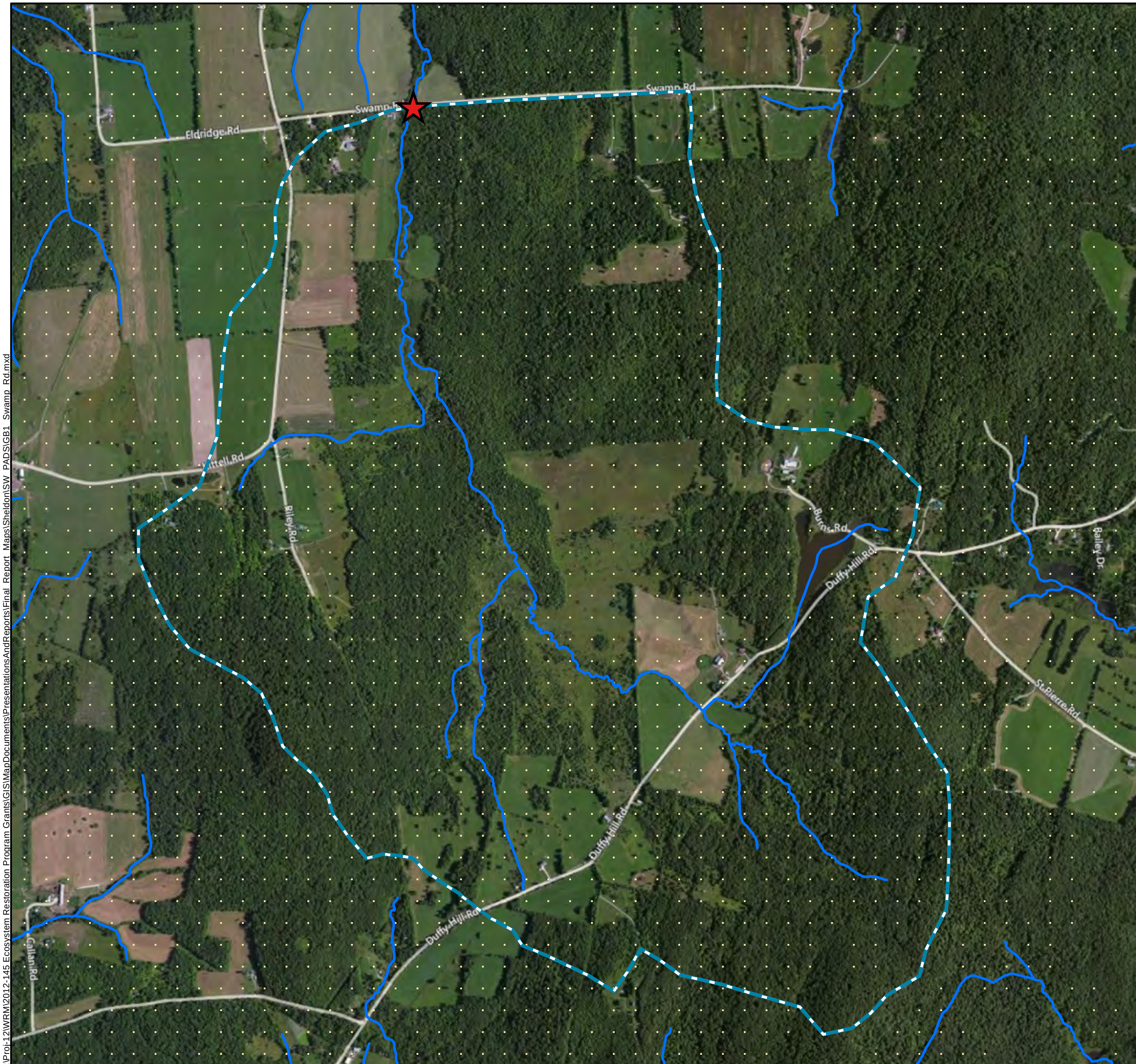
STONE ENVIRONMENTAL INC

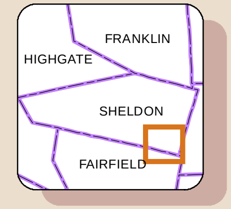
Church St

BC-5

Sheldon Stormwater Management Planning

\\cfs1\NetDrv-O\Proj-12\WRM\2012-145 Ecosystem Restoration Program Grants\GIS\MapDocuments\PresentationsAndReports\Final_Report_Maps\Sheldon\SW_PADS\BC5_Church_St.mxd





N

0 385 770 1,540
Feet

SW Treatment Opportunity

River or Stream

Drainage Area (1,428 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Swamp Road

GB-1

Sheldon Stormwater Management Planning

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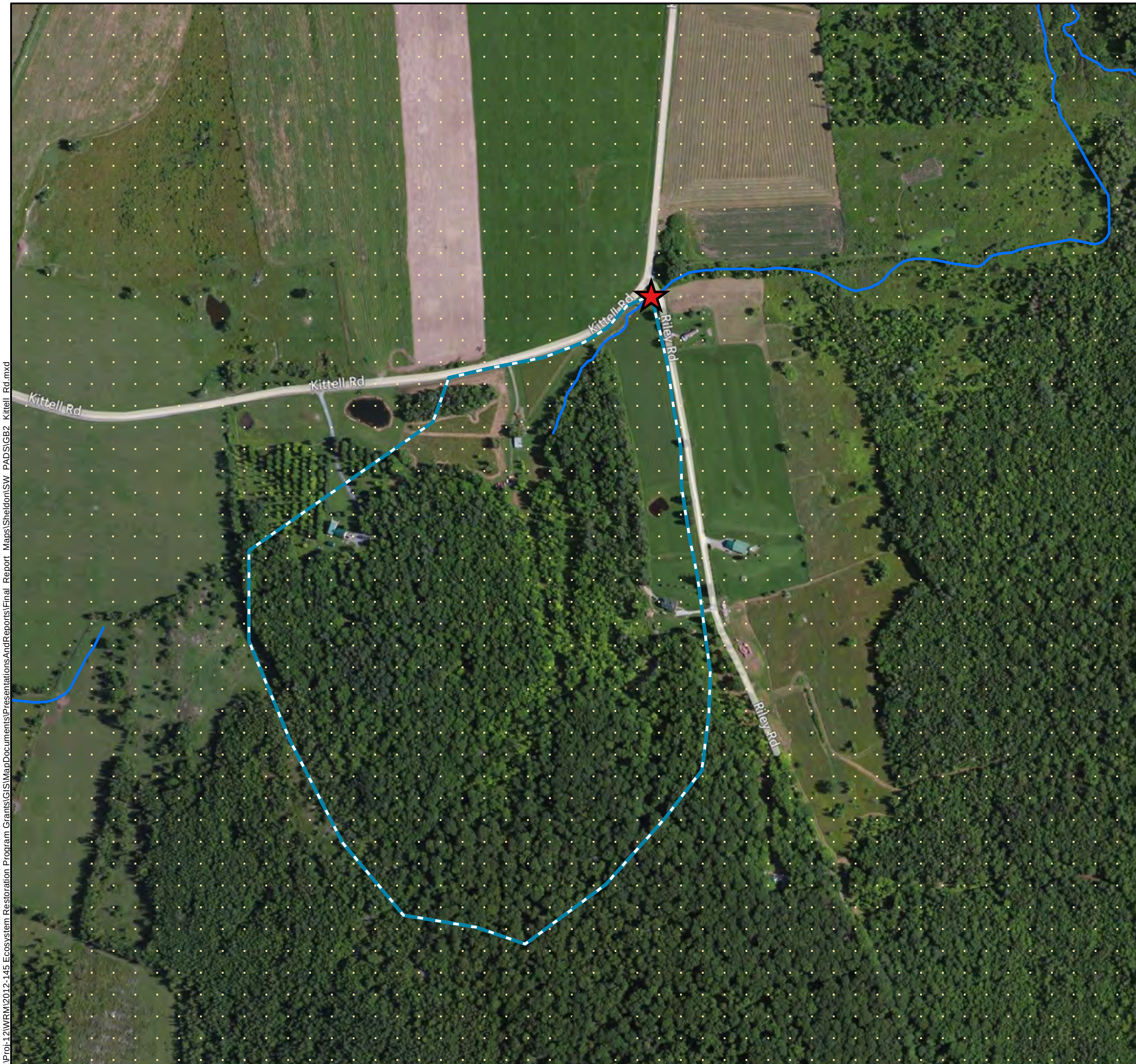

FRANKLIN
HIGHGATE
SHELDON
FAIRFIELD

0 125 250 500 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (64 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Kittell Road

GB-2

Sheldon Stormwater Management Planning

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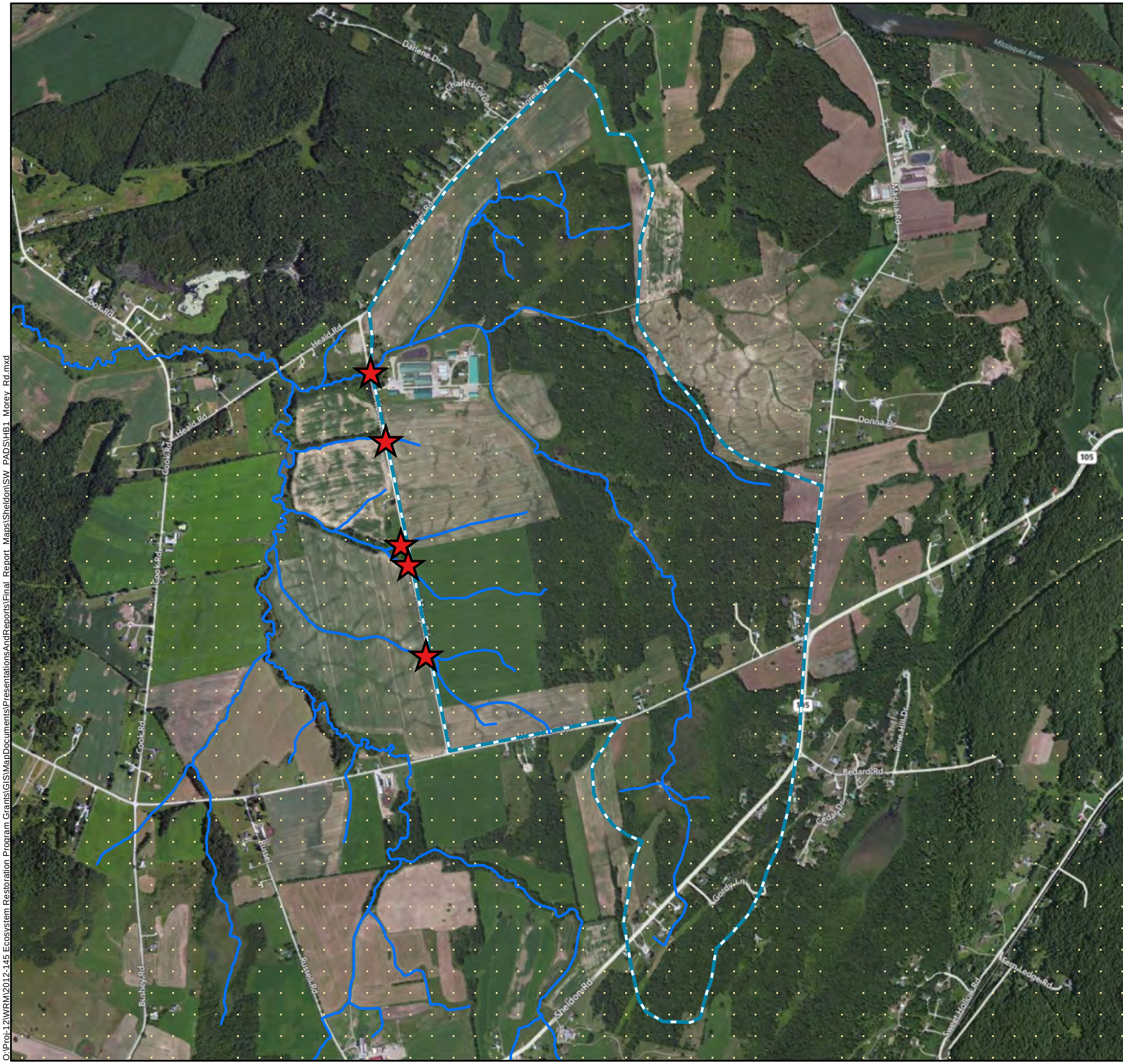

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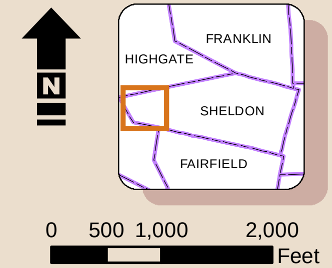


SW Treatment Opportunity

River or Stream

Drainage Area (964 Acres)

Erodible Soils (k > 0.17)

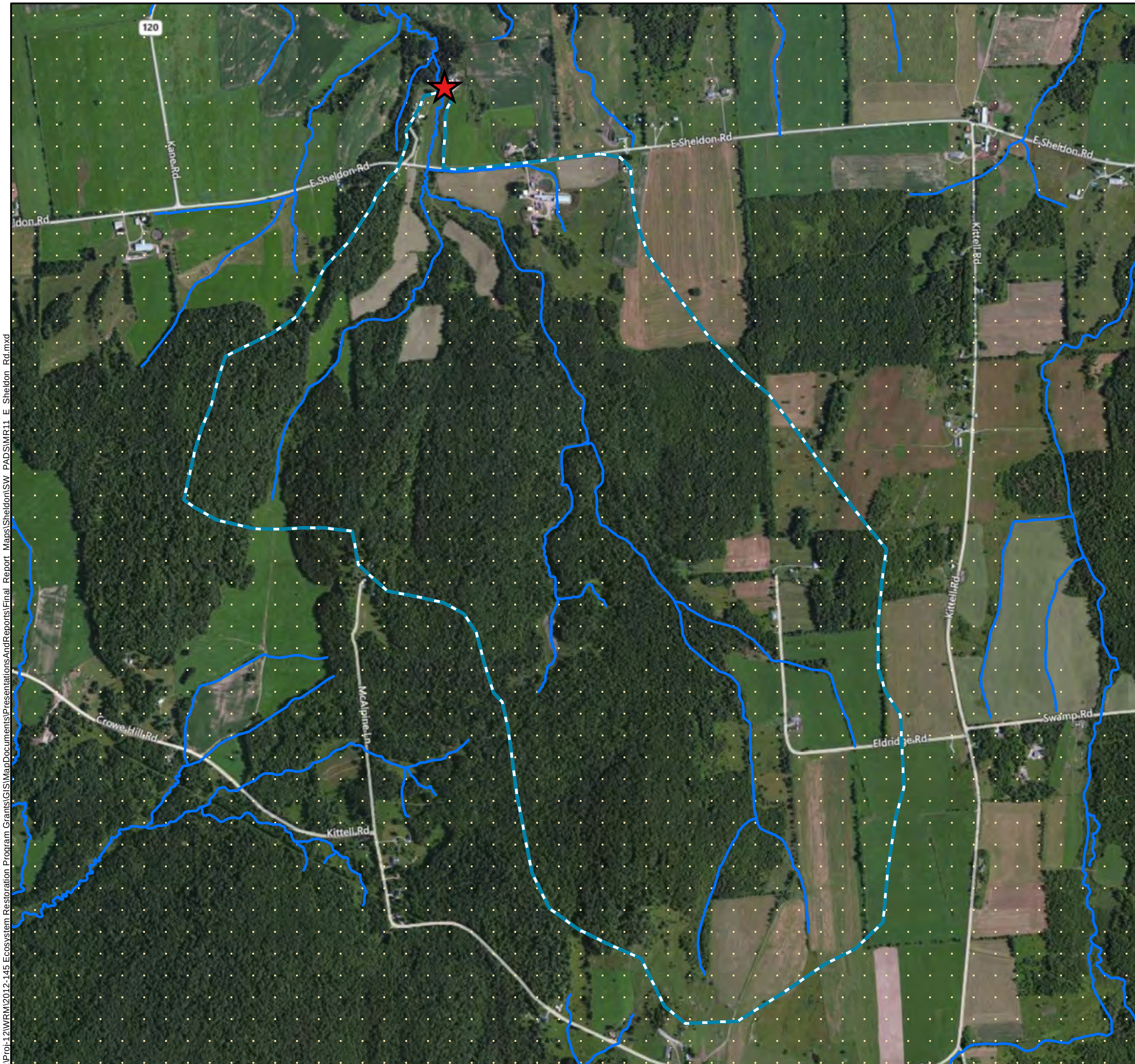
Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Morey Rd

HB-1

Sheldon Stormwater Management Planning



FRANKLIN
HIGHGATE
SHELDON
FAIRFIELD

N

0 385 770 1,540 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (1000 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

East Sheldon Rd

MR-11

Sheldon Stormwater Management Planning

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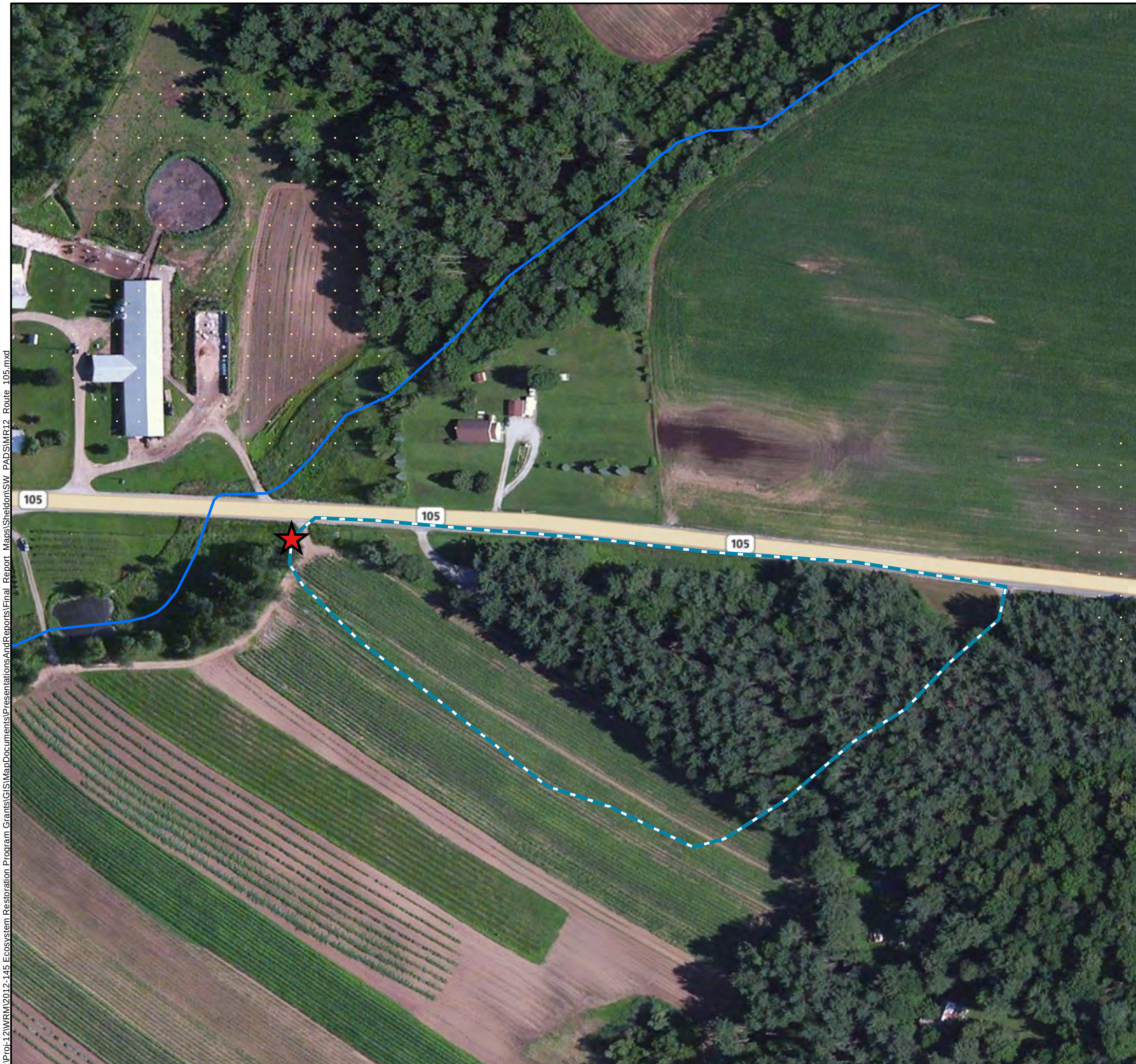

SW Treatment Opportunity

River or Stream

Drainage Area (7 Acres)

Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Route 105

MR-12

Sheldon Stormwater Management Planning

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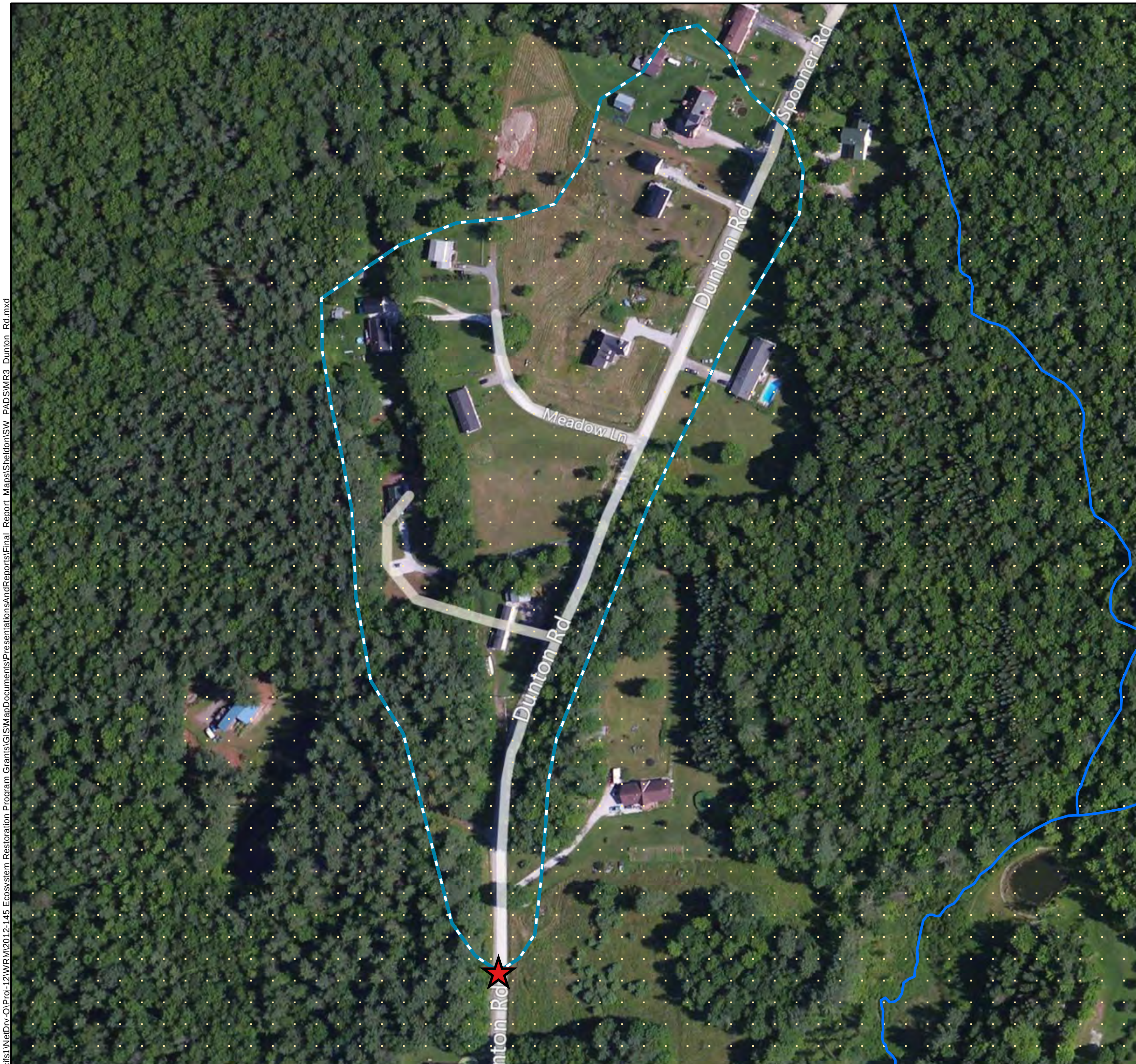
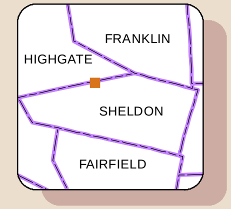




N

0 55 110 220 Feet

SW Treatment Opportunity

River or Stream

Drainage Area (13.7 Acres)

Erodible Soils (k > 0.17)

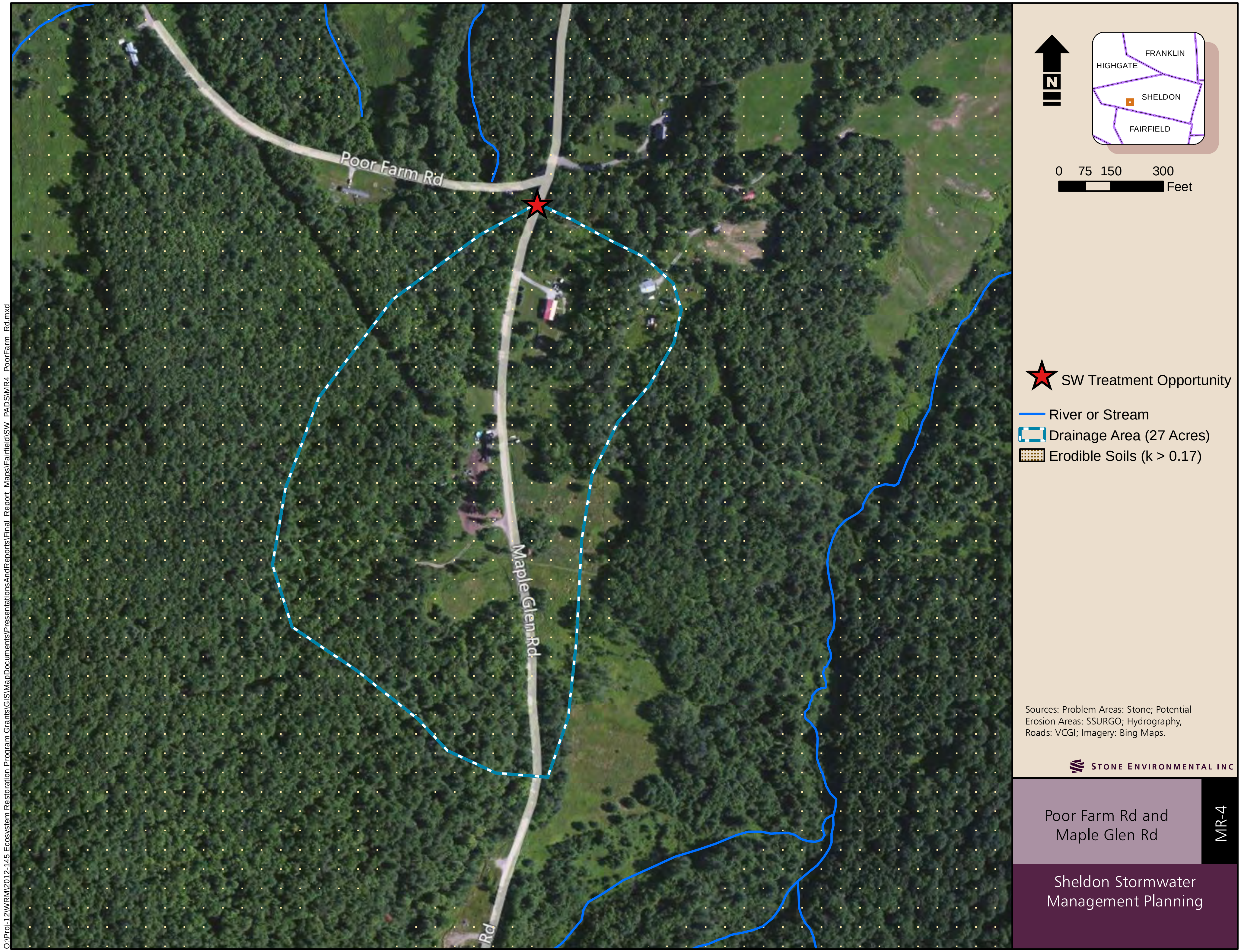
Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Dunton Rd

MR-3

Sheldon Stormwater Management Planning



Poor Farm Rd
Maple Glen Rd
Rd
FRANKLIN
HIGHGATE
SHELDON
FAIRFIELD
N
0 75 150 300
Feet
SW Treatment Opportunity
River or Stream
Drainage Area (27 Acres)
Erodible Soils (k > 0.17)
Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.
STONE ENVIRONMENTAL INC
Poor Farm Rd and Maple Glen Rd
MR-4
Sheldon Stormwater Management Planning
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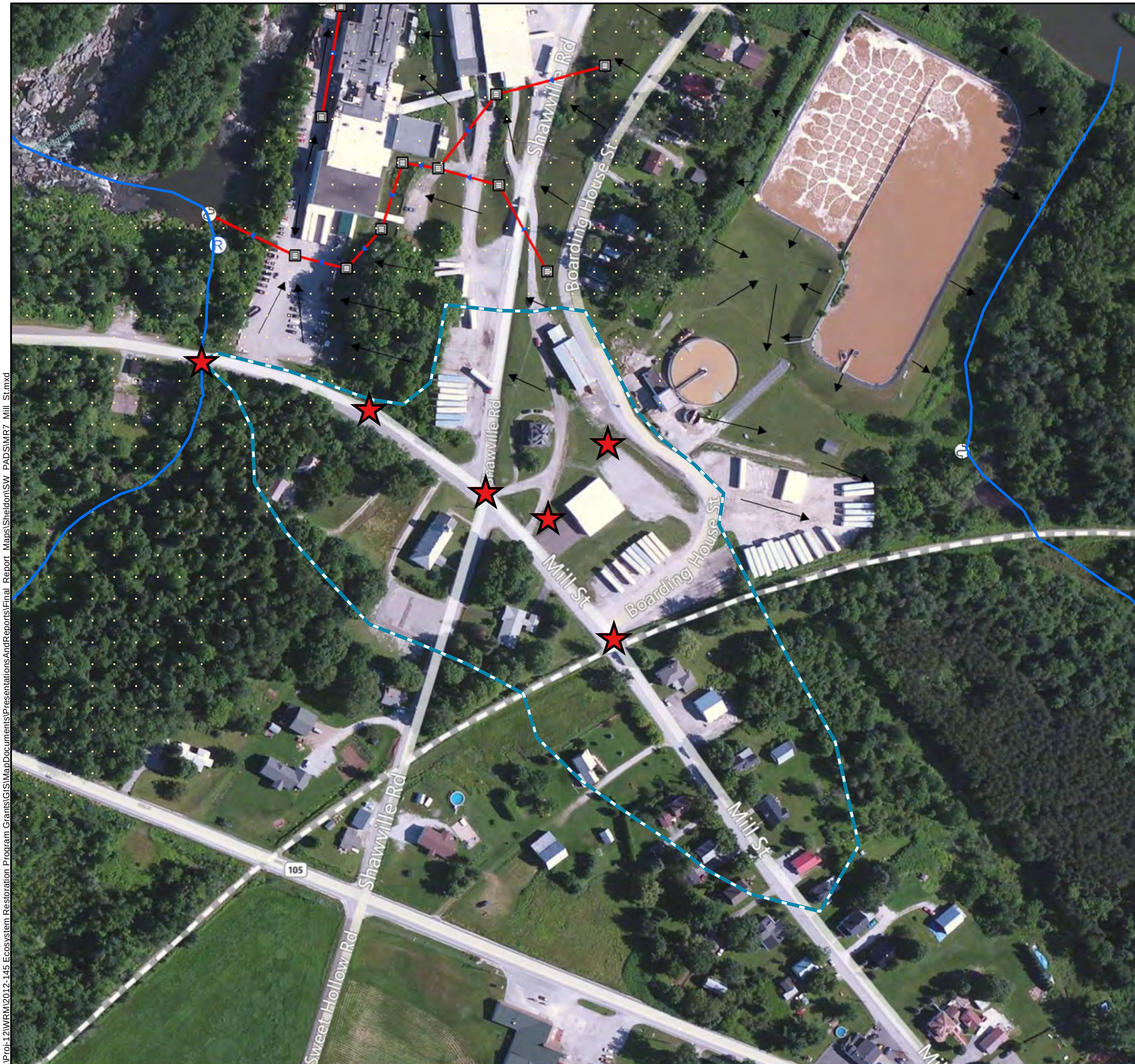

N

HIGHGATE
FRANKLIN
SHELDON
FAIRFIELD

0 62.5 125 250 Feet

SW Treatment Opportunity
River or Stream
Drainage Area (13 Acres)
Erodible Soils (k > 0.17)

Sources: Problem Areas: Stone; Potential Erosion Areas: SSURGO; Hydrography, Roads: VCGI; Imagery: Bing Maps.

STONE ENVIRONMENTAL INC

Mill St Between Shawville Rd and Rail-Trail

MR-7

Sheldon Stormwater Management Planning

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